DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT INCLUDING ENVIRONMENTAL ASSESSMENT

BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

PREPARED BY

U.S. ARMY, CORPS OF ENGINEERS
ST. LOUIS DISTRICT
MISSISSIPPI VALLEY DIVISION

October 2002

EXECUTIVE SUMMARY

This Combined Design Deficiency Report and Detailed Project Report describes a flood control project for the Bois Brule Levee and Drainage District, which is predominately in Perry County, Missouri and has a small part in Randolph County, Illinois. The flood control project has two components, (1) design deficiency repairs to restore the existing flood control system to its authorized 50-year level of protection, and (2) raising the level of protection to 100-year under Section 205 of the Flood Control Act of 1948. The Energy and Water Development Appropriations Act of 2002 (Public Law 107-66) directs the Secretary of the Army to construct both components of the project concurrently.

The Bois Brule levee district is located along the right bank of the Mississippi River between approximately river miles 94 and 111 above the Ohio River. The levee district protects about 26,060 acres, which is nearly all in agricultural production. The protected area also includes two industries, the Perryville airport, and a highway that connects to a bridge across the Mississippi River at Chester, Illinois. The existing Bois Brule flood control project consists of about 33.1 miles of levee, interior drainage ditching, four pump stations, and 339 seepage relief wells. The levee failed due to underseepage prior to the crest of the 1993 flood, and the entire levee district was flooded.

The main deficiency in the existing project is caused by problems in the underseepage design. In addition, levee overbuild was inadequate in some sections of the back levee where the levee settled so the top is below the authorized grade. The "independent" design deficiency project, one that would be constructed if no Section 205 project were constructed, includes 284 seepage relief wells, 13,100 linear feet of seepage berms, ditching, three pump stations with capacities of 10, 25 and 30 cubic feet per second (cfs) for the flow from the additional relief wells, 3.3 miles of restoration of the levee to its design grade, 68 piezometers, real estate lands and damages, and design, construction management and other related costs. The total October 2002 price level fully funded cost estimate for the "independent" design deficiency project is $19,240,000. Based on the cost sharing specified in PL 107-66, the Federal share is $18,788,000 and the sponsor share is $452,000. The sponsor's additional annual operation, maintenance, repair, replacement and rehabilitation costs for the design deficiency project are estimated to be $61,500. The average annual economic benefits for the design deficiency project are $1,669,100, the average annual costs are $1,545,600, and the benefit-to-cost ratio is 1.08.

The "independent" design deficiency project includes long seepage berms that eliminate the need for an additional pump station in the north drainage area served by the existing Bois Brule pump station. At the 100-year flood level, additional underseepage flow requires an additional pump station in this north drainage area, and additional relief wells are substituted for the long seepage berms.

The combined design deficiency project and Section 205 flood control project to raise the level of protection to 100-year includes 19.9 miles of levee raises with a maximum 5.2 feet raise in net levee grade (the levee raise provides 3 feet of freeboard at the upstream end of the levee tapering to 2 feet at the downstream end), 488 seepage relief wells, modification of 5 existing relief wells to be covered by new embankment, 1,300 linear feet of

seepage berms, 12.5 miles of stability berms, extensions of 11 existing gravity drains, four pump stations with capacities of 16, 41, 48 and 57 cfs for the flow from the additional wells and the additional underseepage flows from a 100-year flood, replacement of the railroad closure structure at the north end of the levee and demolition of the existing structure, demolition of the existing Highway 51 closure structure (no costs were included for a new highway closure structure because the Missouri Department of Transportation plans to construct a new highway over the levee in the future), 68 piezometers, real estate lands and damages associated with construction of the project, real estate costs for environmental mitigation areas, real estate damages outside the project area due to induced flooding from the levee raise (the preliminary fully funded cost estimate for induced flooding damages, $2,065,000, will be revised based on better survey and real estate information), utility relocations, railroad relocations associated with the new closure structure, and design, construction management and other related costs. The total October 2002 price level fully funded cost estimate for the combined design deficiency and Section 205 project is $51,000,000. Based on the cost sharing specified in PL 107-66 for both components of the project and on the $15,000,000 limit in the Water Resources Development Act of 1999, the Federal share is $33,369,000 and the sponsor share is $17,631,000. The sponsor's additional annual operation, maintenance, repair, replacement and rehabilitation costs for the combined project are estimated to be $157,300. The average annual economic benefits for the combined project are $2,675,600, the average annual costs are $4,010,300, and the benefit-to-cost ratio is 0.67.

The project as authorized has several deviations from current Corps of Engineers policy. Public Law 107-66 directs that the cost sharing for the design deficiency project be consistent with the original project authorization, which required no sponsor cash contributions. This differs from current Corps policy, which generally requires the cash contributions described in the Water Resources Development Act of 1986. The increased level of protection is likely to encourage new development in the floodplain. Executive Order 11988 requires Federal agencies to avoid undertaking actions which directly or indirectly induce growth in the flood plain, while corresponding Corps policy directs that Corps projects "to the extent possible, avoid or minimize adverse impacts associated with use of the base flood plain and avoid inducing development in the base flood plain unless there is no practicable alternative for the development." The combined project will not meet the Federal objective of water and related land resource project planning to contribute to National economic development, because the National economic development benefits for the combined project are less than its costs. The combined project will also induce flooding along the Mississippi River outside the Bois Brule levee. The extent of this induced flooding will be delineated during detailed project design and the sponsor will obtain easements from impacted property owners. In addition to these policy deviations, the cost sharing for the Section 205 component authorized by Public Law 107-66 (25 percent minimum sponsor share) deviates from the current cost sharing for flood control projects defined by the Water Resources Development Act of 1996 (35 percent minimum sponsor share).

If the Project Cooperation Agreement is signed on schedule, sponsor and Federal funding is provided as needed, and real estate acquisition is accomplished on schedule, construction of the combined project will begin in December 2003 and be completed in December 2006. However, completion of a small segment of Section 205 levee raise at Highway 51 may be delayed to coincide with Missouri Department of Transportation construction of a new

raised highway at this location. If the levee raise at Highway 51 is delayed and the Mississippi River is forecasted to exceed the 50-year flood level (the height of the existing highway closure structure), the opening in the levee at Highway 51 will be closed using emergency measures.

The District Commander recommends approval of this report as the decision document for the Project Cooperation Agreement for the flood control project for the Bois Brule Levee and Drainage District authorized by Public Law 107-66.

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI
MAIN REPORT

TABLE OF CONTENTS

SECTION PAGE

1. STUDY AND PROJECT AUTHORITIES....1
   1.1 AUTHORITIES FOR EXISTING PROJECT....1
1.2 AUTHORITY FOR DESIGN DEFICIENCY PROJECT....1
   1.3 AUTHORITIES FOR SECTION 205 STUDY AND PROJECT....2

2. FEDERAL POLICIES....3

3. PRIOR STUDIES AND REPORTS....3

4. PURPOSE AND SCOPE OF THIS STUDY AND REPORT....4

5. FLOOD CONTROL AND NAVIGATION PROJECTS IN THE AREA....5

   5.1 DEGOGNIA & FOUNTAIN BLUFF LEVEE & DRAINAGE DIST. IL....5
   5.2 KASKASKIA ISLAND DRAINAGE & LEVEE DISTRICT, IL 5
   5.3 STE. GENEVIEVE COUNTY LEVEE DISTRICT NUMBER 2, MO....6
   5.4 KASKASKIA RIVER LOCK & DAM & NAVIGATION PROJECT, IL....6
   5.5 PRAIRIE DU ROCHER, ILLINOIS AND VICINITY....6
   5.6 STE. GENEVIEVE, MISSOURI URBAN DESIGN LEVEE....6
   5.7 BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI....6

6. DESIGN DEFICIENCY PROJECT....9

   6.1 DESCRIPTION OF DEFICIENCIES IN THE DESIGN....9
   6.2 PLAN FORMULATION FOR DESIGN DEFICIENCY PROJECT....10
   6.3 COMPONENTS OF DESIGN DEFICIENCY PROJECT....11
   6.4 DESIGN AND CONSTRUCTION CONSIDERATIONS....12
   6.5 DESIGN, REAL ESTATE ACQUISITION, & CONSTRUCT SCHEDULE....13
   6.6 OPERATION, MAINTENANCE, REPAIRS, REPLACEMENT AND REHABILITATION....13
   6.7 COST ESTIMATES FOR DESIGN DEFICIENCY PROJECT....13
   6.8 DESIGN DEFICIENCY PROJECT ACCOMPLISHMENTS....14
   6.9 ECONOMIC, ENVIRONMENTAL AND SOCIAL EFFECTS OF DESIGN DEFICIENCY PROJECT....15
   6.10 CONDITIONS FOR ACCOMPLISHING DESIGN DEFICIENCY WORK UNDER ORIGINAL PROJECT AUTHORIZATION....16
   6.11 IMPLEMENTATION OF THE DESIGN DEFICIENCY PROJECT....16

7. COMBINED DESIGN DEFICIENCY/SECTION 205 PROJECT....17

   7.1 PLAN FORMULATION FOR SECTION 205 PROJECT....17
   7.2 COMPONENTS OF COMBINED PROJECT....22
   7.3 DESIGN AND CONSTRUCTION CONSIDERATIONS....24
   7.4 DESIGN, REAL ESTATE ACQUISITION, & CONSTRUCT SCHEDULE....24
   7.5 OPERATION, MAINTENANCE, REPAIRS, REPLACEMENT AND REHABILITATION....24
   7.6 COST ESTIMATES FOR COMBINED PROJECT....25
   7.7 COMBINED PROJECT ACCOMPLISHMENTS 27

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI
MAIN REPORT

TABLE OF CONTENTS

SECTION PAGE

7.8 ECONOMIC, ENVIRONMENTAL AND SOCIAL EFFECTS OF COMBINED PROJECT 27
7.9 IMPLEMENTATION OF THE COMBINED PROJECT.....30

8. COORDINATION, PUBLIC VIEWS AND COMMENTS.....34

9. CONCLUSIONS.....34

10. RECOMMENDATIONS.....35

TABLES

TABLE 1 Incremental and Fully Funded Cost Estimates, "Independent" Design Deficiency Project
TABLE 2 Incremental and Fully Funded Cost Estimates, Combined Design Deficiency and Section 205 100-Year Project
TABLE 3 Section 205 Project Fully Funded Costs in Combined Project
TABLE 4 Fully Funded Cost Sharing for Combined Project
TABLE 5 Deficiency Correction Features Federal and Non-Federal Cost Allocations
TABLE 6 Section 205 Features Federal and Non-Federal Cost Allocations
TABLE 7 Total Project Federal and Non-Federal Cost Allocations
TABLE 8 Allocations of Funds by Fiscal Year Fully Funded Design Deficiency Project
TABLE 9 Allocations of Funds by Fiscal Year Fully Funded Section 205 Project
TABLE 10 Allocations of Funds by Fiscal Year Fully Funded Combined Project

FIGURES

DRAWING 1 Vicinity Map and Nearby Levee Districts
DRAWING 2 Existing Project Features
DRAWING 3 Design Deficiency Levee Repairs
DRAWING 4 100 Year Levee Raise
DRAWING 5 New Stability Berms
DRAWING 6 North Railroad Closure Layout
DRAWING 7 Design Deficiency Relief Wells and Seepage Berms
DRAWIMG 8 100 Year Relief Wells and Seepage Berms
DRAWIMG 9 Borrow Areas
DRAWING 10 Ditching
DRAWING 11 Existing Utilities
DRAWING 12 100 Year Raise - Typical Sections
SCHEDULE 1 "INDEPENDENT" DESIGN DEFICIENCY PROJECT
SCHEDULE 2 COMBINED DESIGN DEFICIENCY AND SECTION 205 100-YEAR PROJECT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI
MAIN REPORT

TABLE OF CONTENTS

ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT
(Separate document attached)

APPENDICIES

APPENDIX A - Hydrology and Hydraulics
APPENDIX B - Geotechnical Engineering
APPENDIX C - Design
APPENDIX D - Real Estate
APPENDIX E - Relocations
APPENDIX F - Cost Estimates
APPENDIX G - Economics
APPENDIX H - Fish and Wildlife Coordination Act Report
APPENDIX I - Endangered Species Coordination
APPENDIX J - Clean Water Act Evaluation
APPENDIX K - Section 404 Public Notice and Section 404 Authorization
APPENDIX L - Farmland Conversion Impacts
APPENDIX M - Public Involvement and Correspondence

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI
MAIN REPORT

SECTION 1 - STUDY AND PROJECT AUTHORITIES

1.1 AUTHORITIES FOR EXISTING PROJECT

a. The existing levee in the Bois Brule Levee and Drainage District was authorized by the Flood Control Act of 22 June 1936, Public Law 74-738, "Perry County Drainage and Levee Districts Numbered 1, 2 and 3, Missouri: Raising and enlarging existing levee system to improve protection, special report on record in Office of the Chief of Engineers; estimated construction cost, $330,000; estimated cost of lands and damages, $14,600."

b. Perry County Drainage and Levee Districts Numbered 1, 2 and 3 were later reorganized into the Bois Brule Levee and Drainage District.

c. A Senate and House Public Works Committee resolution adopted on 12 October 1972 modified the levee project under the provisions of Section 201 of the Flood Control Act of 1965, Public Law 89-298, to reduce damages resulting from interior drainage. The modifications included the four pump stations in the levee district.

1.2 AUTHORITY FOR DESIGN DEFICIENCY PROJECT

a. According to Engineer Regulation 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. 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. 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.

- 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 shown later in this report, the Bois Brule design deficiency project meets all these conditions. Therefore, it is authorized by the original project authorization.

b. Current Corps policy for cost sharing requires that, except for compelling and unusual circumstances, cost sharing for correction of design or construction deficiencies be consistent with the project purpose as specified in the Water Resources Development Act of 1986 (PL 99-662). Analysis of the design or construction deficiency and preparation of a decision document is accomplished at full Federal expense.

c. The Energy and Water Development Appropriations Act of 2002 (PL 107-66) provides that "with $1,200,000 of the funds appropriated herein, the Secretary of the Army, acting through the Chief of Engineers, is directed to undertake design deficiency repairs to the Bois Brule Drainage and Levee District, Missouri, project, authorized and constructed under the authority of the Flood Control Act of 1936 with cost sharing consistent with the original project authorization."

d. HR 2311, which is associated with the Energy and Water Development Appropriations Act, 2002, states the following: "Bois Brule Drainage and Levee District, Missouri. --The Committee is aware of the devastating flooding and life-threatening situation that occurred to residents of Perry County, Missouri, during the flood of 1993 when levee deficiencies resulted in failure of the existing Bois Brule Drainage and Levee District, Missouri, project authorized by the Flood Control Acts of 1936 and 1965. Therefore, the Committee has provided $1,200,000 for the project and directs the Secretary of the Army to initiate design and construction of deficiency correction work to restore the Bois Brule Drainage and Levee District project to its authorized level of protection using continuing contracts as appropriate, and with study and construction cost sharing consistent with the original project. Additionally, the Committee is aware that a portion of the study effort being performed under the Section 205 program is attributable to the design deficiency project, and, therefore, directs the Secretary to transfer the associated study costs to the design deficiency project.

1.3 AUTHORITIES FOR SECTION 205 STUDY AND PROJECT

a. The study of the feasibility of raising the level of protection of the Bois Brule Levee and Drainage District was conducted as part of the Corps of Engineers' Continuing Authorities Program (CAP) authorized by Section 205 of the Flood Control Act of 1948 (PL 80-858), as amended. Flood Control projects are authorized by Section 205, upon approval of the study documents.

b. Section 332 of the Water Resources Development Act of 1999 states, "The maximum amount of Federal funds that may be allocated for the project for flood control, Bois Brule Drainage and Levee District, Missouri, authorized under section 205 of the Flood Control Act of 1948 (33 U.S.C. 701s) is $15,000,000."

c. The Energy and Water Development Appropriations Act, 2002 (PL 107-66) provides that "in accordance with section 332 of the Water Resources Development Act of 1999, the Secretary of the Army is directed to increase the authorized level of protection of the Bois Brule Drainage and Levee District, Missouri, project from 50 years to 100 years using $700,000 of the funds appropriated herein, and the project costs allocated to the incremental

increase in the level of protection shall be cost shared consistent with Section 103(a) of the Water Resources Development Act of 1986, notwithstanding section 202(a) of the Water Resources Development Act of 1996.

d. HR 2311, which is associated with the Energy and Water Development Appropriations Act, 2002, states the following: "The Committee, in accordance with the authority provided in Section 332 of the Water Resources Development Act of 1999, has also provided $700,000 for the Bois Brule Drainage and Levee District, Missouri project under the Continuing Authorities Program and directs the Secretary to increase the authorized level of protection from 50 years to 100 years. The project costs allocated to the incremental increase in level of protection shall be cost shared consistent with Section 103(a) of the Water Resource Development Act of 1986, notwithstanding Section 202(a) of the Water Resource Development Act of 1996, and this increment should be constructed concurrently with the deficiency correction work to ensure a technically sound and cost effective solution is provided to the flooding problems in the area."

SECTION 2 - FEDERAL POLICIES

a. The "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" dated March 10, 1983 state that the objective of Federal and federally assisted water and related resource planning is to "contribute to National economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements."

b. Executive Order 11988 dated May 24, 1977, outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency shall evaluate the potential effects of actions on flood plains, and should avoid undertaking actions that directly or indirectly induce growth in the flood plain or adversely affect natural flood plain values. Executive Order 11988 has as an objective the avoidance, to the extent possible, of long-and short-term adverse impacts associated with the occupancy and modification of the base flood plain and the avoidance of direct and indirect support of development in the base flood plain wherever there is a practicable alternative.

SECTION 3 - PRIOR STUDIES AND REPORTS

a. House Document No. 669, Seventy-sixth Congress, Third session. This document contains a report dated 27 February 1940 from the Chief of Engineers on the Mississippi River, between Coons Rapids Dam, Minnesota, and the mouth of the Ohio River. With respect to flood control, the report made the following recommendations: "That further project for local flood control be authorized only as a result of individual investigations authorized or requested by Congress pursuant to the general policy stated in the Flood Control Act of June 22, 1936."

b. A review report (House Document 669, 76th Congress, Third Session) was submitted in compliance with provisions of Section I of the River and Harbor Act of 21 January 1927, which directed surveys in accordance with

House Document 308, 69th Congress, First Session, and Section 10 of the Flood Control Act of 15 May 1928 which directed surveys of all tributaries of the Mississippi River "subject to destructive floods".

c. Preliminary Examination on Mississippi River, Drainage Improvements, Perry County Drainage and Levee Districts Nos. 1, 2 & 3, Missouri. A preliminary examination on drainage improvements for the districts was accomplished in May 1949. This report was submitted in accordance with authorization contained in Section 11, Flood Control Act approved 24 July 1946. The report investigated the damage to crops caused by a lack of interior drainage when the Mississippi River reaches a stage of about 12 feet on the Chester, Illinois gage.

d. Initial Appraisal Report. At the request of the Bois Brule Levee and Drainage District on 5 September 1985, an Initial Appraisal Report (IAR) was performed to evaluate the potential of raising the levee to a 100-year recurrence interval flood. The IAR was completed in December 1986 and concluded that, based on the preliminary analysis and other comparable experience, raising the Bois Brule Levee and Drainage District levee to provide protection from a 100-year recurrence flood had the potential to be economically justified and engineeringly feasible. The IAR recommended initiation of a Section 205 Reconnaissance Report to conduct adequate surveys, economic and hydraulic investigations, to determine the feasibility of providing 100-year protection.

e. Reconnaissance Report, under authority of Section 205 of the 1948 Flood Control Act, Bois Brule Levee and Drainage District, November 1991. The Section 205 reconnaissance study was initiated on 1 July 1988. The study investigated various means of providing economically feasible protection for the Bois Brule Levee and Drainage District from a 100-year recurrence interval flood. The reconnaissance report described three alternative plans: Plan #1, traditional levee raise with borrow from original adjacent borrow pits, Plan #2, traditional levee raise with borrow from widening the existing interior drainage ditches, and Plan #3, a sheet pile levee raise. Plan #2, the selected plan, provided the greatest net benefits and had a benefit-to-cost ratio of 1.18 to 1.0. The estimated cost for the proposed levee raise, including real estate costs of $633,000, was $9,543,000 in October 1991 dollars. The District Engineer recommended further study of the selected plan for raising the Bois Brule levee to a level that provides 100-year recurrence interval flood protection. He also recommended that Federal funds be provided for a feasibility study. The local sponsor supported the proposed plan and indicated a willingness to cost share the feasibility study. The reconnaissance study was completed prior to the 1993 flood when major underseepage problems became apparent. The cost estimates for the plans presented in the reconnaissance report did not include any costs for additional relief wells or pump stations.

SECTION 4 - PURPOSE AND SCOPE OF THIS STUDY AND REPORT

a. This is a combined report that describes the two components of a project for the Bois Brule Levee and Drainage District, a design deficiency component that will restore the project to its originally authorized 50-year level of protection and a Section 205 component that will raise the level of protection to 100-year.

b. The Section 205 feasibility study documented by this report was initiated after a Feasibility Cost Sharing Agreement was signed by the Bois Brule Levee and Drainage District and the Corps of Engineers in May 1992. The 1993 Mississippi River flood interrupted the feasibility study. Severe underseepage problems became apparent during the flood. The levee failed due to underseepage prior to the crest of the 1993 flood and the entire levee district was flooded. Little progress was made on the feasibility study for several months during the levee repair effort. When the study resumed the underseepage problem was taken into consideration. The possibility of a deficiency in the underseepage design also began to be considered. Work on the feasibility study was halted again in September 2000 at the request of the sponsor, and was resumed in January 2002.

c. In November 2001 the Energy and Water Development Appropriations Act, 2002 was enacted. This Federal law directed the Corps of Engineers to increase the authorized level of protection for the Bois Brule Levee and Drainage District from 50-year to 100-year. It also directed the Corps to undertake design deficiency repairs.

d. The scope of this report reflects the direction from Congress to proceed with both the design deficiency and levee raise components of the project. Less than normal detail is presented on plan formulation and project justification.

e. The purpose of this report is to provide a description and evaluation of the combined project authorized by the Energy and Water Development Appropriations Act, 2002, and to serve as the basis for a Project Cooperation Agreement. Project Cooperation Agreements are detailed legal instruments that commit the sponsor and the Government to fulfill their respective responsibilities and construct the project. This report is the "decision document" that will support a Project Cooperation Agreement for both the design deficiency and Section 205 components of the Bois Brule project.

SECTION 5 - FLOOD CONTROL AND NAVIGATION PROJECTS IN THE AREA

The flood control and navigation projects in the area of the Bois Brule Levee and Drainage District are shown on DRAWING 1.

5.1 GRAND TOWER AND DEGOGNIA AND FOUNTAIN BLUFF LEVEES, ILLINOIS

The Grand Tower Drainage and Levee District and the Degognia and Fountain Bluff Levee and Drainage District are connected and are part of the Corps of Engineers Alton to Gale levee system. The levees for these two levee districts provide about a 50-year level of protection for approximately 51,000 acres and extend from the Big Muddy River at about Mississippi River Mile 75.5 above the Ohio River to about River Mile 99.5.

5.2 KASKASKIA ISLAND DRAINAGE AND LEVEE DISTRICT, ILLINOIS

The Kaskaskia Island Drainage and Levee District is part of the Corps of Engineers Alton to Gale levee system. The levee provides about a 50-year level of protection for approximately 9,460 acres and extends from about Mississippi River Mile 111.5 to River Mile 116.0.

5.3 STE. GENEVIEVE COUNTY LEVEE DISTRICT NUMBER 2, MISSOURI

The Ste. Genevieve County Levee District Number 2 levee was privately constructed but has been repaired with Federal assistance. The levee provides about a 15-year level of protection for approximately 7,000 acres and extends from about Mississippi River Mile 116.0 to River Mile 122.5.

5.4 KASKASKIA RIVER LOCK AND DAM AND NAVIGATION PROJECT, ILLINOIS

The Kaskaskia River enters the Mississippi River at about River Mile 117.5 above the Ohio River. The Kaskaskia River Lock and Dam is located at Kaskaskia River Mile 0.8.

5.5 PRAIRIE DU ROCHER, ILLINOIS AND VICINITY

The Prairie Du Rocher and Vicinity Levee District is part of the Corps of Engineers Alton to Gale levee system. The levee provides a 100-year level of protection for about 13,000 acres and extends from about Mississippi River Mile 117.5 to River Mile 130.0.

5.6 STE. GENEVIEVE, MISSOURI URBAN DESIGN LEVEE

The Ste. Genevieve Urban Design Levee was constructed by the Corps of Engineers and the Ste. Genevieve Joint Levee Commission. It extends from about Mississippi River Mile 121.7 to River Mile 125.0. The levee protects the city of Ste. Genevieve and its National Historic Landmark District from an Urban Design Flood, which has a slightly larger discharge than the 500-year flood. The levee design accounted for "proposed raises to the Bois Brule and Prairie Du Rocher levees to provide 100-year protection."

5.7 BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

a. The Bois Brule Levee and Drainage District is located in Perry County, Missouri, and Randolph County, Illinois along the right bank of the Mississippi River between River Miles 94 and 111 above the Ohio River. Most of the levee district is in Missouri. Years ago the channel of the Mississippi River shifted to the east, but the boundary between Missouri and Illinois did not shift. So although the entire levee district is situated west of the Mississippi River, a small part of the district is in Illinois. The Levee District is bounded on the north and east by the Mississippi River, on the south and west by the Bois Brule Creek and Cinque Hommes Creek, and on the northwest by the Old River Channel. In addition to the flood control and navigation projects described above, the town of St. Mary's, Missouri and the small city of Chester, Illinois are close to the Bois Brule levee district. St. Mary's is located about 2 miles north up the Old River Channel, and Chester is across the Mississippi River at about River Mile 110. The nearest large cities are St. Louis, Missouri, which lies approximately 77 miles to the north, and Cape Girardeau, Missouri, which is approximately 44 miles to the south. There are approximately 26,060 acres of highly productive agricultural land within the levee district.

b. Levee. The Bois Brule Levee and Drainage District is protected by a Federally constructed levee. Federal levees were first constructed in 1938 and 1939, and then were reconstructed between 1950 and 1958 to withstand a 50-year flood with 2 feet of freeboard. The levees were under the jurisdiction of Perry County Levee Districts 1, 2 and 3. These levee

districts were later reorganized into the Bois Brule Levee and Drainage District. The levee is about 33.1 miles long and includes about 18.9 miles of riverfront levee along the Old Channel of the Mississippi River and the actual Mississippi River and 14.2 miles of back levee along Bois Brule Creek and Cinque Hommes Creek. This levee is part of the Corps of Engineers Alton to Gale levee system. The design Mississippi River discharge was 1,175,000 cfs at the Chester, Illinois gage when the 50-year levee was built. This represented an unregulated (U) condition on the Mississippi River prior to completion of the many upstream reservoirs in the Missouri and Mississippi River basins. The current discharge frequency relationship at the Chester gage is 1,010,000 cfs corresponding to a 45.7 ft stage for the 50-year event and 1,120,000 cfs corresponding to a 48.2 ft stage for the 100-year event.

c. Closure Structures. The Bois Brule levee system includes three closure structures: two swing gate structures where the levee crosses the Burlington Northern Santa Fe (BNSF) railroad tracks and one panel closure structure where the levee crosses Highway 51. A mainline BNSF track runs along the western edge of the levee district. The levee system crosses the railroad track with closure structures at the northwest end of the riverfront levee and in the back levee at the hamlet of McBride. Highway 51 crosses the northeast part of the riverfront levee. The highway closure structure is adjacent to the Highway 51 Bridge over Horse Island chute and a short distance from the Chester Bridge over the Mississippi River. The elevation of Highway 51 at the Horse Island Bridge and the highway closure structure at the levee is at approximately the 20-year Mississippi River flood level.

d. Pumping Stations. Four Federally constructed pumping stations and approximately 13,900 feet of new diversion ditches were added to the project to reduce damages resulting from interior flooding. The Cinque Hommes and Jones Cutoff pumping stations were completed in January 1982. The Missouri Chute and Bois Brule Creek pumping stations were completed in December 1983. Each pumping station was designed and optimized to minimize the impacts of interior flood damages. However, on 8 June 1995, the Bois Brule Levee and Drainage District submitted a letter to the St. Louis District office suggesting that the Missouri Chute and Cinque Hommes pumping stations are inadequate for removal of interior rainwater and seepage from high Mississippi River stages. The following is a description of each pumping station:

Missouri Chute Pumping Station: The Missouri Chute Pumping Station is located at levee station 580+93.51 and has a nominal capacity of 50 cfs provided by one diesel engine driven vertical pump. The pump discharges through a 36-inch discharge pipe over the levee with a siphon breaker to an outlet structure with a saxophone discharge. A 48-inch gravity drain is located adjacent to the pump station at levee station 582+22.52.

Jones Cutoff Pumping Station: The Jones Cutoff Pumping Station is located at levee station 1001+52.20 and has a nominal capacity of 125 cfs provided by two diesel engine driven vertical pumps. The pumps discharge through two 36-inch discharge pipes over the levee with siphon breakers to an outlet structure with a saxophone discharge. Two 30-inch gravity drains are located adjacent to the pump station at levee stations 999+36.23 and 999+83.25.

Cinque Hommes Pumping Station: The Cinque Hommes Pumping Station is located at levee station 1131+60.22 and has a nominal capacity of 125 cfs

provided by two diesel engine driven vertical pumps. The pumps discharge through two 36-inch discharge pipes over the levee with siphon breakers to an outlet structure with a saxophone discharge. Two 60-inch gravity drains are located adjacent to the pump station at levee station 1133+27.73.

Bois Brule Pumping Station: The Bois Brule Pumping Station is located at levee station 1466+56.28 and has a nominal capacity of 215 cfs provided by three diesel engine driven vertical pumps. The pumps discharge through three 36-inch discharge pipes over the levee with siphon breakers to an outlet structure with a saxophone discharge. Two 66-inch gravity drains are located adjacent to the pump station at levee station 1464+73.24.

e. Ditches. There are four principal and several lateral drainage ditches within the Bois Brule Levee and Drainage District. The principal ditches are Ditch "A", the Cinque Hommes-Bois Brule, the Jones Cutoff, and the Missouri Chute. These main ditches in the drainage system generally traverse the lowest areas in the district. Each principal ditch is further described below.

Ditch "A" originates in the northwestern section of the levee district south of the Burlington Northern Santa Fe railroad and follows a northeasterly course for about five miles, roughly parallel to the levee, until it passes under Missouri State Highway 51. It then circles back in a southerly direction for a distance of four miles until it arrives at the Bois Brule Pump Station and a gravity drain through the levee consisting of two 66 inch corrugated metal pipes (C.M.P.). The ditch is approximately 8.8 miles long.

Missouri Chute is an old tributary of the Mississippi River encompassing Pucket and Crains Islands. Originating at Mississippi River mile 107.1 the ditch makes a crescent shaped path south through the levee district before terminating at Mississippi River mile 103.2. The ditch ends at the Missouri Chute Pump Station and a gravity drain through the levee consisting of a 48 inch C.M.P. The ditch is approximately 5.2 miles long.

Jones Cutoff ditch begins at approximate levee station 700+00 and meanders in a southeasterly direction until it terminates into the landside borrow pits at the lower end of the district. The total length of the ditch is 5.1 miles. The borrow pits are drained by five gravity outlets through the levee and ranging in size from 24 inches to 42 inches in diameter, and by the Jones Cutoff Pump Station.

Bois Brule - Cinque Hommes ditch originates at approximate levee station 1469+15 on the back levee and meanders in a southeasterly direction roughly paralleling the back levee for a total distance of 6.6 miles to its terminus at the Cinque Hommes Pump Station and a double 60-inch gravity drain structure.

f. Gravity Drains. Existing interior drainage is passed through the levee by 16 gravity outlet structures, three of which drain into the Mississippi River and the remainder to Bois Brule and Cinque Hommes Creeks. They are located as follows:

Gravity Drain Locations

No.	Size in Inches	Discharge Into	Levee Stationing	Invert Elevation
1	18	Mississippi River	305+45.59	365.0
1	48	Mississippi River	582+22.52	351.0
1	36	Mississippi River	816+05.26	357.0
1	30	Bois Brule and Cinque Hommes Creeks	999+36.23	348.0
1	30	Bois Brule and Cinque Hommes Creeks	999+83.25	344.5
1	42	Bois Brule and Cinque Hommes Creeks	1060+69.76	345.5
1	24	Bois Brule and Cinque Hommes Creeks	1078+21.03	348.0
1	24	Bois Brule and Cinque Hommes Creeks	1100+24.46	349.0
1	18	Bois Brule and Cinque Hommes Creeks	1117+62.29	352.0
2	60	Bois Brule and Cinque Hommes Creeks	1133+27.73	344.0
1	24	Bois Brule and Cinque Hommes Creeks	1227+24.34	352.0
1	18	Bois Brule and Cinque Hommes Creeks	1292+17.71	351.0
1	24	Bois Brule and Cinque Hommes Creeks	1364+25.49	356.0
1	24	Bois Brule and Cinque Hommes Creeks	1435+95.37	354.0
2	66	Bois Brule and Cinque Hommes Creeks	1464+73.24	357.0
1	24	Bois Brule and Cinque Hommes Creeks	1501+60.44	361.0

g. Relief Wells. A total of 339 relief wells are located within the Bois Brule Levee and Drainage District. The locations of the wells are shown on DRAWING 2. These wells begin to flow at an approximate river stage of 26 feet on the Chester, Illinois gage. Examination of stage duration data for the Chester, Illinois gage (River Miles 109.9) indicates this stage is met or exceeded about 10 percent of the time annually.

h. Berms. The levee is flanked by about 1.4 miles of seepage berms and 19.1 miles of stability berms.

i. Piezometers. The Corps of Engineers installed about 120 piezometers along the Bois Brule levee. These piezometers are an engineering measuring device, and their care and maintenance is the responsibility of the Corps of Engineers. The Corps reads them during periods of high water and inspects them periodically. Due to a lack of Federal funds to replace damaged and missing piezometers, some of the original piezometers are no longer present or functional.

SECTION 6 - DESIGN DEFICIENCY PROJECT

6.1 DESCRIPTION OF DEFICIENCIES IN THE DESIGN

a. The main deficiency in the design of the Bois Brule project relates to seepage under the levee when the Mississippi River is flooding. Standard practices at the time were followed in the underseepage design for the authorized project. It included 357 relief wells according to the September 30, 1980 St. Louis District Project Map for the Bois Brule project. Some wells were lost due to the scour from the 1993 levee failure, and the project currently has 339 relief wells. The original project did not include any seepage berms, but 1.4 miles of seepage berms were constructed in 1994 in the area where the levee failed during the 1993 flood. Since the project was constructed, underseepage design criteria and standard design practices have

become more conservative. Refer to APPENDIX B - GEOTECHNICAL ENGINEERING for more discussion on the design criteria. The flood of 1993 showed that the Bois Brule project has a design deficiency related to underseepage, and will not function as intended because of inadequate underseepage features. During the 1993 flood, as the Mississippi River approached the 50-year flood level (the design flood), sandboils appeared at many locations along the interior of the levee. The levee failed due to underseepage before the Mississippi River reached the 50-year net levee grade, that is, before the flood level was in the freeboard area of the levee. After the levee failed, the Mississippi River continued to rise to about the 100-year level. The 26,060 acres inside the levee were flooded to an average depth of about 20 feet. Additional relief wells, seepage berms, and piezometers are needed to correct this design deficiency.

b. The four pump stations in the levee district were designed to handle rainfall in the interior of the levee plus flow from the original relief wells. The design of the pump stations is considered adequate for the original number of relief wells in the levee district. However, the four pump stations do not eliminate standing water, or water overflowing drainage ditches, inside the levee. Standard practice is to consider risk and probability of intense rainfall events when pump stations are designed. Economics studies associated with pump stations balance the cost of increased capacity at pump stations with the probability that there will be some ponding in the drainage system. Although the design of the original pump stations is considered adequate for the original relief wells, the new relief wells associated with the underseepage design deficiency will add flow to the interior drainage system and result in the need for increased pump capacity at three of the four pump stations.

c. Another deficiency in the design of the Bois Brule project is related to the levee overbuild. Standard practice is to construct levees higher than the intended design height because in the long term they are expected to consolidate and settle to the design height. Construction of the Bois Brule levee was completed in 1958. The levee is currently at or above the intended design height (the net levee grade) along most of its length, including along the Mississippi River and the Old River Channel (old channel of the Mississippi River) at the north end of the levee district. However, at a few locations along the back levee adjacent to Bois Brule Creek, the levee has settled so the actual height of the levee is less than the 50-year net levee grade. This implies that either insufficient overbuild was designed into the levee at these locations, or proper compaction was not achieved during construction. Since the rules for dealing with construction deficiencies are the same as those for design deficiencies, for simplicity this is assumed to be a design deficiency.

6.2 PLAN FORMULATION FOR DESIGN DEFICIENCY PROJECT

a. Generally, underseepage problems along levees can be rectified by seepage berms or relief wells along the inside of the levee. Relief wells introduce additional underseepage flow into the interior drainage system, but seepage berms do not. The first step in plan formulation for the underseepage component of the design deficiency project was an underseepage analysis of the existing levee with the 50-year design flood. The segments of the levee that require additional underseepage measures were defined using current design criteria. Experience from the 1993 Mississippi River flood also helped define the underseepage problem, for example, "hot spots" were

delineated where many sandboils and excessive underseepage occurred. The levee failed due to underseepage when the river was below the 50-year flood level.

b. One finding from the underseepage analysis is there are underseepage problems in reaches of the levee that already have a series of existing relief wells. In these existing well reaches, additional relief wells can be interspersed among the existing wells but seepage berms are not a practical solution because the berms would not be wide enough to be effective. Seepage berms are also not a practical solution in areas where there is no room for the berms because of existing borrow sites on the interior of the levee.

c. Since relief wells introduce additional underseepage flow into the interior of the levee, they can also result in the need for additional interior drainage ditching and pumping capacity. The plan formulation effort included an examination of the opportunity to solve the underseepage problem with seepage berms in each of the four drainage areas that feed the existing four pump stations. It was determined that in three of the four drainage areas, the need for significant increased pumping capacity could not be avoided. In these three drainage areas extensive new seepage berms were not practical because of the large number of interspersed design deficiency wells, or because existing and planned borrow areas near the levee do not leave room for seepage berms. One of the drainage areas that need additional pumping capacity does include two segments of new seepage berms. These two berms cost less than comparable relief wells. In the north area that drains to the Bois Brule pumping station, the need for increased pumping capacity was avoided by using long seepage berms and only two new relief wells to solve the underseepage problem. Long seepage berms were practical because there are only five existing relief wells and no borrow sites near the levee in this area. In the north drainage area the cost of seepage berms was found to be lower than the cost of relief wells, ditching and increased pumping capacity. The design deficiency improvements in the north drainage area do include two new relief wells because they need to be interspersed among the five existing relief wells. The increased underseepage flow from these two relief wells will not create a need for increased pumping capacity at the Bois Brule pumping station.

d. Plan formulation for restoring the levee height where it is lower than the authorized 50-year level of protection included consideration of two alternative levee side slopes: (1) constructing the new levee embankment with 1 on 3 side slopes, and (2) constructing the new levee embankment with the same side slopes as the existing levee which in some areas are flatter than 1 on 3. The side slopes for the design deficiency levee work will be 1 on 3 because this will reduce the quantity of material needed and eliminate the need for additional land due to the restoration of the levee height.

6.3 COMPONENTS OF DESIGN DEFICIENCY PROJECT

The levee restorations, relief wells, seepage berms, borrow area, pumping station locations, and drainage ditch extensions for the design deficiency project are described on DRAWINGS 3, 7, 9, and 10. The project includes:

- 284 new relief wells. As can be seen by comparing the four drainage areas on DRAWING 10 with the new relief wells shown on DRAWING 7, only

two new relief wells are planned for the area that drains to the Bois Brule pump station.

- 13,100 linear feet of landside seepage berms with a total volume of 305,600 CY. The locations of the seepage berms are shown on DRAWING 7. Most of the seepage berms are in the area that drains to the Bois Brule pump station. For the most part, the underseepage problems in this drainage area are resolved by seepage berms instead of relief wells.

- Separate new pump stations adjacent to the existing pump stations at Missouri Chute (new 25 cfs station), Jones Cutoff (new 30 cfs station), and Cinque Holmes (new 10 cfs station). Refer to DRAWING 10.

- New interior drainage ditching to take the flow from new relief wells to existing drainage ditches, new ditches into and out of three new pump stations, and new culverts. Refer to DRAWING 10. The new ditching and culverts in the drainage systems leading to the Missouri Chute, Jones Cutoff and Cinque Holmes pump stations are part of the design deficiency project. The new ditching and culverts in the drainage system leading to the Bois Brule pump station are not part of the design deficiency project. They are part of the 100-year project.

- 3.3 miles of levee restoration to its original grade as shown on DRAWING 3, with a total volume of 62,000 CY of fill.

- 1 borrow area shown on DRAWING 9 located near the levee repair areas in upland quarry overburden.

- 68 piezometers along the levee based on the underseepage analysis.

- Real estate. Additional permanent easements for new seepage berms, for the three new pump stations, and for new drainage ditches. Temporary construction easements for the borrow area and to give contractors working room and access to the job sites. No new permanent easements are needed where the levee is being restored to its original height because the existing levee footprint is adequate at these locations.

- Design, construction management, and other related costs.

6.4 DESIGN AND CONSTRUCTION CONSIDERATIONS FOR DESIGN DEFICIENCY PROJECT

The design deficiency project could be constructed "independently" from a 100-year project. Public Law 107-66 directs that design deficiency project and the Section 205 project be constructed concurrently. Some of the features of the "independent" design deficiency project will change when it is combined with the Section 205 project. The main change is in the north drainage area where the seepage berms are eliminated, and relief wells and a pump station are added. The design and construction plan for the combined project is described in Section 7.3 of this report.

6.5 DESIGN, REAL ESTATE ACQUISITION, AND CONSTRUCTION SCHEDULE

The design, real estate acquisition, and construction schedule for the "independent" design deficiency project is shown in SCHEDULE 1. The schedule for the combined design deficiency and Section 205 project is shown in SCHEDULE 2.

6.6 OPERATION, MAINTENANCE, REPAIRS, REPLACEMENT AND REHABILITATION

The "independent" design deficiency project will require more Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) than the existing project. Additional OMRRR is required for the additional 286 relief wells, the three new pump stations, the larger grass surface area of the new seepage berms, and the additional interior drainage ditches.

6.7 COST ESTIMATES FOR DESIGN DEFICIENCY PROJECT

6.7.1 INCREMENTAL COST ESTIMATE FOR DESIGN DEFICIENCY PROJECT

A summary of the incremental cost estimate for the "independent" design deficiency project at 1 Oct 2002 price levels is presented in TABLE 1 under "Current Estimate." TABLE 1 indicates that $135,000 was expended on the design deficiency project prior to 30 Sep 2001. The $135,000 was originally expended on the Section 205 project but was transferred to the design deficiency project in accordance with HR2311. See Section 1.2.d. of this report. The $134,900 transfer (rounded to the $135,000 in cost tables) was based on an examination of work performed and actual charges in the years FY1992 through FY2001. Two types of costs were transferred from the Section 205 project to the design deficiency project; costs for the design deficiency study that began in FY1999 and costs between FY1992 and FY1998 to develop information used for the design deficiency project (including soil borings, surveys and hydraulics). The total incremental cost estimate for the design deficiency project is $17,854,000. The detailed MCACES cost estimate is presented in APPENDIX F - COST ESTIMATES.

6.7.2 FULLY FUNDED COST ESTIMATE FOR DESIGN DEFICIENCY PROJECT

The fully funded cost estimate for the "independent" design deficiency project at 1 Oct 2002 price levels accounts for expected price level increases over the construction period shown in SCHEDULE 1. The per-month price level increases used in this estimate are provided in Engineer Circular 11-2-181. The total fully funded cost estimate for the design deficiency project is $19,240,000. The fully funded cost estimate is presented in TABLE 1 under "Fully Funded."

6.7.3 FEDERAL AND NON-FEDERAL COST SHARING, DESIGN DEFICIENCY PROJECT

The Federal and non-Federal cost sharing for the design deficiency project is specified in the Energy and Water Development Appropriations Act, 2002 (Public Law 107-66). All design and construction costs are a Federal responsibility, while the Lands, Easements, Rights-of-way, Relocations, and borrow and Disposal areas (LERRDs) are a non-Federal responsibility. Cost sharing for the "independent" design deficiency project is shown in TABLE 1 for both the incremental and fully funded cost estimates at 1 Oct 2002 price levels. The estimated fully funded Federal share is $18,788,000 and the estimated fully funded non-Federal share is $452,000.

6.7.4 OMRRR COST ESTIMATE FOR DESIGN DEFICIENCY PROJECT

The local sponsor will be responsible for the additional Operation, Maintenance, Repairs, Replacements, and Rehabilitations (OMRRR) associated with the design deficiency project. The additional operations costs associated with the "independent" design deficiency project include the cost of operating the additional three pump stations: Missouri Chute (25 cfs), Jones Cutoff (30 cfs), and Cinque Holmes (10 cfs). Additional maintenance, repair, replacement, and rehabilitation costs will be incurred for the additional pump stations and relief wells. The additional OMRRR costs are described in APPENDIX F. Some costs are incurred annually and some are incurred periodically. The total annualized additional OMRRR cost for the "independent" design deficiency project at October 2002 price levels is $61,500.

6.8 DESIGN DEFICIENCY PROJECT ACCOMPLISHMENTS

6.8.1 GENERAL ACCOMPLISHMENTS

The design deficiency project will restore the level of protection for the project to 50-year. Without the design deficiency project, the existing underseepage problems reduce the level of protection of the levee. Geotechnical studies find that the existing levee has a 15 percent chance of failure with about a 10-year flood (Probable Non-Failure Point) and an 85% chance of failure with about a 41-year flood (Probable Failure Point).

6.8.2 SAFETY

a. The actual level of protection afforded by the existing levee is uncertain because of the unknowns associated with the underseepage situation. Levee failures due to underseepage can occur very rapidly with little warning.

b. In 1993, the Bois Brule levee did not fail in an area where many sand boils had formed. Instead, it failed at approximately 2 AM in an area that only had minor evidence of underseepage problems during inspections the day before. Excessive underseepage and piping occurred very rapidly during the night, and the levee collapsed suddenly with very little warning. A Corps of Engineers levee inspector was driving along the levee that night. He heard a rushing sound landward of the levee, left his truck, and walked down the levee and out into the field with a flashlight to investigate. Then he heard a tremendous roar and the levee collapsed. He swam for his life and fortunately reached safety on the levee berm. The fact that the breach occurred near the downstream end of the levee was fortunate because the floodwater filled the 26,060-acre levee district rather gradually. Even so the damages from the 20-foot deep water were severe. If the failure had occurred at the upstream end of the levee, the force of the water flowing across the levee district would have been much greater, and there would have been little or no warning for the people in the district before the district was inundated with fast moving water.

c. The design deficiency project will solve the major safety problem inherent in the existing project. With the existing underseepage problems, sudden failure of the levee can occur at several locations along the levee at a river stage below the 50-year flood. Human life, vehicles on roads and

highways, buildings, livestock, and agricultural production are at risk. The improvement to safety accomplished by restoring the project to its authorized 50-year level of protection is compelling justification for the design deficiency project.

6.9 ECONOMIC, ENVIRONMENTAL AND SOCIAL EFFECTS OF DESIGN DEFICIENCY PROJECT

6.9.1 ECONOMIC EFFECTS OF DESIGN DEFICIENCY PROJECT

a. Engineer Regulation ER 1165-2-119 states that design deficiency projects can be justified based on either economics or safety. The Bois Brule design deficiency project is justified based on safety and economics.

b. The economic analysis for the design deficiency project is described in detail in APPENDIX G - ECONOMICS. Benefits that accrue to the design deficiency project include reduction in crop damage, reduction in structure damage, and reduction in travel losses. Reductions in crop and structure damages were quantified based on the design deficiency project bringing the level of protection for the levee district from its current level of protection (10-year Probable Non-Failure Point and 41-year Probable Failure Point) to the 50-year level of protection. The reduction in travel losses were predicated on the assumption that the state of Missouri will raise the elevation of Highway 51 riverward of the levee to the 50-year flood level and take the raised highway over the top of the existing levee in ten years. Average annual benefits and costs at 1 Oct 2002 price levels are $1,669,100 and $1,545,600, respectively. The net benefits are $123,500 and the benefit-to-cost ratio is 1.08 to 1.

6.9.2 ENVIRONMENTAL AND SOCIAL EFFECTS OF DESIGN DEFICIENCY PROJECT

a. The design deficiency project will have essentially no adverse environmental effects. The limited locations where the existing levee will be restored to its authorized height involve filling within the existing footprint of the levee. Borrow for the additional levee embankment is expected to come from nearby quarry overburden, and if the borrow is taken from other locations it can be taken in a way that either has no impact or enhances the environment. The seepage berms, short sections of additional interior drainage ditches and the three new pump stations will be located in areas of crop production. The seepage berms will be constructed mainly of sand dredged from the Mississippi River. This sand will be dredged either from areas already impacted by navigation dredging or areas that have been examined to satisfy any environmental concerns.

b. The social effects of the design deficiency project would be positive. Land and business owners would be relieved of the concern that the levee may fail due to underseepage during floods that are lower than the 50-year flood. Business owners and workers who rely on the Highway 51 connection across the Mississippi River would have assurance that they can ship their goods, not experience reductions in workforce because the transportation link is interrupted by flooding, and get to their jobs during flood events up to the 50-year flood.

c. The environmental and social impacts of the design deficiency project are described in detail in the attached Environmental Assessment.

6.10 CONDITIONS FOR ACCOMPLISHING DESIGN DEFICIENCY WORK UNDER THE ORIGINAL PROJECT AUTHORIZATION

As described below, the Bois Brule design deficiency project meets the conditions described in Section 1.2. Therefore, the work can be done under the original project authorization.

- The corrective actions are required to make the project function as originally intended by the designer in a safe, viable and reliable manner. History has shown that the project will fail if the actions to resolve the underseepage problems are not taken.

- The underseepage control measures and the other design deficiency measures are not required because of changed conditions.

- The design deficiency project does not change the authorized scope, function, or purpose of the project. The project will still provide a 50-year level of protection and include such features as levee, berms, relief wells, and pump stations.

- As discussed in Section 6.8.2, the design deficiency project is needed and justified for safety reasons.

- The additional relief wells and seepage berms, pump station capacity, and sections of levee raise are not required because of inadequate local maintenance. The existing relief wells and pump stations have been properly maintained and are functioning as planned. Piezometers are installed, used, and maintained by the Corps of Engineers.

6.11 IMPLEMENTATION OF THE DESIGN DEFICIENCY PROJECT

a. The design deficiency project could be constructed independently. An independent design deficiency project would include the features described in Section 6.3 and could be implemented on the approximate schedule in SCHEDULE 1. However, Public Law 107-66 directs that design deficiency project and the Section 205 project be constructed concurrently. Based on this direction some features of the design deficiency project will change, and the project be constructed as part of the combined project following the approximate implementation schedule shown in SCHEDULE 2.

b. Public Law 107-66 directs that the cost sharing for the design deficiency project be consistent with the original project authorization. No cash contribution will be required for the design deficiency project. Cost sharing for the combined project will be determined based on subtracting the design deficiency costs from the costs of the combined project. Each year the project cost estimate will be updated for actual costs and newly projected future costs. The updated estimate will be used to determine the sponsor's Section 205 project cash contribution requirement for the coming fiscal year.

SECTION 7 - COMBINED DESIGN DEFICIENCY/SECTION 205 PROJECT

7.1 PLAN FORMULATION FOR THE COMBINED DESIGN DEFICIENCY/SECTION 205 PROJECT

Plan formulation for the Section 205 levee raise component of the combined design deficiency and Section 205 project was initiated with the signing of the Feasibility Cost Sharing Agreement in 1992. Because Public Law 107-66 directs the Corps of Engineers to undertake design deficiency repairs and increase the level of protection for the levee district from 50-year to 100-year, this report focuses on the efforts to develop the least costly plan to meet the requirements of the law. It also provides background information so the authorized project can be understood in a regional context.

7.1.1 EXISTING CONDITIONS IN AND NEAR THE LEVEE DISTRICT

a. Flood Control Projects. The existing Bois Brule flood control project and other flood control projects in the vicinity of the Bois Brule project are described in Section 4 of this report. All the levees along this section of the Mississippi River must withstand Mississippi River flooding.

b. Flooding. Mississippi River floods have exceeded the 10-year flood stage at the Chester, Illinois gage seven times in the past 30 years (1973, 1979, 1982, 1983, 1986, 1993, and 1995). During the 1993 flood, the Bois Brule levee and the Kaskaskia Island levee failed prior to overtopping, and Ste. Genevieve County Levee District Number 2 levee was overtopped. At approximately 0230 hrs on 25 July 1993, the Bois Brule levee failed near the downstream end of the levee district and 26,060 acres were inundated. The total length of levee breach was approximately 1,200 feet. The Mississippi River rose even higher after the levee failed and on 7 August 1993 peaked at the Chester gage with a new record stage of 49.59 feet and a discharge of 1,000,000 cfs. The Mississippi River at Chester was above flood stage from 8 June through 12 October 1993. The Great Flood of 1993 at the Chester gage was estimated to be about a 100-year flood.

c. Unprotected Flood Prone Areas. Several areas near the Bois Brule levee are not protected from Mississippi River flooding. These include the town of St. Marys, low-lying parts of Chester, Illinois, and other areas.

d. Climate. The climate of the levee district is humid with warm summers and cold winters. The average rainfall is 39.5 inches and is well distributed throughout the year. The average January temperature is 32 degrees Fahrenheit, while in July the average is 79 degrees Fahrenheit.

e. Topography. The Mississippi River bottomland areas, including the Bois Brule Levee and Drainage District, are generally flat but do have some rolling attributes resulting from previous river channel movements and overflow deposits. As the river overflowed its channel and spread out over the flood plain, the coarser sediments were dropped first, thus resulting in ridge and swale topography. The ground within the levee district varies in elevation between 355 and 375 feet NGVD and is totally enclosed by levees.

f. Hydrology and Hydraulics. The Bois Brule Levee and Drainage District has no official rainfall station within its limits. However, a precipitation gage operated by the National Weather Service is located at the gauging station at Chester, Illinois, at river mile 109.9 on the Mississippi

River. Based on the National Oceanic and Atmospheric Administration Climatological Data for 1931 -1988 the mean annual precipitation has varied from a maximum of 62.5 inches in 1950 to a minimum of 29.5 inches in 1963, while the average annual precipitation is about 39.5 inches. For more information see APPENDIX A - HYDROLOGY AND HYDRAULICS.

g. Environmental Resources. The Bois Brule levee district area is primarily a rural agricultural area protected by the levee. Agricultural land accounts for over 90 percent of the project area. Primary crops include corn, wheat, and soybeans. Little remains of the former floodplain forests in the study area. Wooded acreage, landward of the levee, is characterized mainly by small tracts and scattered trees along water ditches and within the lower swales. Bands of wooded land occur in various sections of low wet areas on the Mississippi River side of the levee. Color aerial photographs taken in 1986 indicate aquatic habitats landward of the levee are small and of generally low habitat quality, and consist mainly of standing water in drainage ditches, low areas and a few ponds, with little or no rooted aquatic vegetation. Most of these aquatic areas can be considered permanent wetlands, although some crop acreage in lower swales can be classified as nonpermanent "cyclic wetlands". Permanent and semi-permanent wetlands are common adjacent to the river side of the levee within and adjacent to the bands of forest. Other levee districts along the Mississippi River in this region display similar environmental attributes.

h. Economic Development. The area protected by the existing Bois Brule levee is nearly entirely highly productive agricultural land. The area did include the hamlets of Claryville and Belgique, but these communities are now essentially abandoned. The hamlet of McBride includes a few buildings inside the levee. There are a few homes distributed throughout the area on farms. Two industries are located inside the levee, Saberliner and Gilster-Mary Lee. The Bois Brule levee district has rail service, river access, highways and an airport. Highway 51 crosses the levee district, passes through the levee, and connects to a nearby bridge over the Mississippi River at Chester, Illinois. Industries outside the levee district and within the levee district depend on Highway 51 for employee access (many employees live and work on opposite sides of the river) and to ship their goods. The land within the Bois Brule levee district is shown on Federal Emergency Management Agency (FEMA) maps as a "Special Flood Hazard Area Inundated by 100-Year Flood" and is subject to development restrictions. Other levee districts along the Mississippi River in this region also have thousands of acres of highly productive agricultural lands and access to the river. Some of these levee districts also include mainline railroads and major highways. Land in many of the levee districts is also shown as flood hazard areas on FEMA maps. The region surrounding the Bois Brule levee district includes thousands of acres of high ground situated above the Mississippi River floodplain and available for development with no restrictions due to flood hazards.

i. Transportation.

a. The Bois Brule Levee and Drainage District includes the following transportation facilities.

- The Perryville Municipal Airport, which has a 7,000-foot runway and very few facilities that would be damaged by flooding.

- A mainline Burlington Northern Santa Fe railroad track.

- Five Missouri State roads, Highway 51 and Routes C, E, H, and M, as well as other local roads. Highway 51 provides the only connection between Missouri and Illinois over the Mississippi River between St. Louis, Missouri and Cape Girardeau, Missouri. The elevation of Highway 51 where it crosses the Bois Brule levee and between the levee and the Chester Bridge is at about a 20-year Mississippi River flood level.

b. Transportation facilities near the Bois Brule Levee and Drainage District include Interstate 55 and U.S. Highway 61 in Missouri, and State Highway 3 in Illinois. Besides the mainline Burlington Northern Santa Fe railroad on the Missouri side of the Mississippi River, a mainline railroad runs along the Illinois side.

7.1.2 FUTURE CONDITIONS WITHOUT DESIGN DEFICIENCY/SECTION 205 PROJECT

This section describes expected future conditions in and near the levee district if no Bois Brule design deficiency or Section 205 levee-raise project is constructed.

a. Flood Control Projects. The existing Bois Brule flood control project and other flood control projects in the vicinity of the Bois Brule project are described in Section 5 of this report. A Corps of Engineers reconnaissance study of the feasibility of raising the levees in the Grand Tower and the Degognia and Fountain Bluff levee districts was initiated but because of the induced Mississippi River flood heights that would result from a levee raise the study is no longer active. The Corps of Engineers knows of no viable plans for the construction or modification of levees immediately upstream, adjacent to or downstream of the Bois Brule levee that would affect the current 50 or 100-year flood profiles in this vicinity.

b. Flooding. The potential for flooding of the Bois Brule levee district and the other levee districts in the area is expected to be the same in the future as it is in the existing situation.

c. Hydrology and Hydraulics. A major hydrologic and hydraulics study is underway for the upper Mississippi River, lower Missouri River and Illinois Rivers. This investigation is known as the "Upper Mississippi River System Flood Flow Frequency Study" and its purpose is to update the discharge frequency relationships and water surface profiles for the Mississippi River above Cairo, Illinois, the Illinois River, and the Missouri River downstream from Gavins Point Dam. Five Corps of Engineers Districts are participating in this study: Omaha, Kansas City, St. Paul, Rock Island, and St. Louis. The study is scheduled for completion in the latter part of fiscal year 2003.

In the St. Louis District, existing discharge-frequency relationships for the Mississippi River and the lower 80 miles of the Illinois River were developed after the 1973 flood. Existing water surface profiles were published in 1979 and these have been the official flood profiles used by state and Federal agencies to manage floodplains. The impact of the Great Flood of 1993 and the addition of 20 years of additional discharge and stage data was the basis for this new study. New discharge-frequency relationships that include the effect of regulation by upstream reservoirs will be established for the Upper Mississippi Basin. New water surface profiles

based on the most recent survey data will be developed using a calibrated UNET unsteady flow routing model.

The projected impact in the Bois Brule levee area is a reduction in discharge for the rarer floods such as the 100-year flood. The final water surface profiles are projected to be unchanged or slightly lower than the existing profiles. Therefore, the design net levee grade for the Bois Brule Section 205 project is unlikely to be adversely impacted by the results of this study.

d. Economic Development. No appreciable change in land use is anticipated in the Bois Brule levee district. New construction within the Bois Brule levee district will be restricted and costly due to floodplain zoning and flood insurance requirements. The first floor of a new facility must be higher than a 100-year flood, and a 100-year flood is about 20 feet deep in the levee district. No appreciable change in land use is anticipated in the other levee districts along the Mississippi River, or in the unprotected flood-prone areas. Development in the flood-free areas on high ground in the vicinity of the Bois Brule levee district and in other areas adjacent to the Mississippi River floodplain will depend on economic pressures.

e. Transportation. When the Highway 51 Bridge over Horse Island chute becomes structurally unsound, the state of Missouri plans to replace the bridge with a higher bridge and elevate the highway between the Chester Bridge and the Bois Brule levee so the highway has the same level of flood protection as the levee.

7.1.3 MEASURES CONSIDERED FOR COMBINED DESIGN DEFICIENCY/SECTION 205 PROJECT

a. In order to provide 100-year protection for the Bois Brule levee district the existing levee must be raised. The most cost effective way to raise the levee is with additional fill. A levee raise using a sheet pile wall was considered during the 1991 reconnaissance study but was found to be much more costly than fill. The final levee design incorporates additional fill taken from various clay borrow sites along the levee and from planned extensions to existing drainage channels. Landside stability berms to be constructed with clay borrow are included where required because of the additional height of the levee.

b. Alternative levee freeboard designs were considered, including a uniform 2 ft of freeboard for the entire length of the levee and 3 ft of freeboard at the upstream end of the riverfront levee tapering to 2 ft at the downstream end. The alternative that would construct 3 ft of freeboard at the upstream end tapering to 2 ft at the downstream end was selected. A levee raise with 2 feet of uniform freeboard is inappropriate for this specific 100-year level-of-protection project because the levee could overtop at any location when Mississippi River floods exceed the 100-year level, including at the north end of the project along the Old Channel of the Mississippi River. In a 100-year plus flood situation, the Ste. Genevieve County Levee District Number 2 levee and the Kaskaskia Island levee will have overtopped, and significant Mississippi River flows will occur on the west side of Kaskaskia Island in the Old River channel. If the north end of the Bois Brule levee overtops and fails, large volumes of floodwater will rush through the 16-mile long Bois Brule levee interior. Dangerous flood

velocities and high flood levels will occur very rapidly. The existing development in the levee interior and any new development that may be established after 100-year protection is provided will be subjected to rapid and dangerous flooding. The 1993 flood demonstrated that when a long levee fails at its upstream end, the flow through the interior will cause another levee failure at the downstream end as the water exits the protected area. When floods greater than the 100-year flood occur in the Bois Brule area, it will be better if the levee is overtopped at its downstream end because (1) the floodwater will back up into the levee district allowing time for evacuation of the protected area, and (2) only one levee breach will have to be repaired instead of two. Fortunately, the 1993 failure of the Bois Brule levee occurred near its downstream end, and allowed an orderly evacuation of the floodplain before the levee district was inundated.

c. Several measures were considered to provide a 100-year level of protection at the north railroad closure structure. These included modifying the existing closure structure, replacing the structure at its existing location, and replacing it at a new location. Structural engineering studies found that it would be impractical to modify the existing structure and meet Corps design standards with a 3.8 feet higher gate and structure. Three locations were considered for a new north railroad closure structure: the same location as the existing structure, riverside of the existing structure, and landward of the existing structure. Burlington Northern Santa Fe Railroad officials have indicated that a rail bypass (shoo-fly) should be used to accommodate existing train traffic during construction rather than a temporary bridge that must be installed every time a train comes through the construction site. Replacement of the closure structure at the existing site would involve degrading a section of the existing levee to accommodate a railroad shoo-fly around the north closure site. This option would also involve demolishing the existing closure structure before constructing a new closure structure at the same location. There would be two large openings in the line of protection at its upstream end for several months. This alternative was eliminated from consideration because the risk of flooding is too great. Historically, the Mississippi River has flooded in all seasons of the year at this location. Replacement of the north railroad closure structures with a new structure either riverward or landward of the existing structure can be accomplished with no risk of flooding. The new closure structures would be located far enough from the existing structure to allow trains to pass through the existing closure structure and then go around the construction sites for the new structures on a shoo-fly. The levee must be realigned to tie into the new closure structure. Costs were compared for new closures structures on the landward and riverward sides of the existing closure structure. The closure structure on the landward side was selected because it had the lowest cost.

d. Measures considered to control underseepage for the 100-year project included seepage berms and relief wells. During a 100-year flood relief wells will introduce more underseepage flow into the interior than would be experienced with only a levee in place. Seepage berms would help control underseepage but would not introduce additional underseepage flow into the interior. To compare the costs of underseepage control measures, the cost of seepage berms was compared to the cost of relief wells and their attendant drainage ditches and increased pumping requirement. New pumping facilities adjacent to existing pumping stations were considered more practical than modifying the existing pumping facilities. Modifying the existing pumping facilities would require larger sumps, larger pumps, larger discharge pipes,

and other changes. The plan for underseepage control for the 100-year project is similar to the plan for the design deficiency project in three of the four drainage areas in the levee district, except that additional relief wells and greater pumping capacity will be required. For the area that drains to the Bois Brule pumping station, the 100-year underseepage control plan is significantly different than that for the design deficiency project. The design deficiency plan has new seepage berms and only two additional relief wells, but requires no increased pumping capacity or drainage ditches. The 100-year underseepage control plan recognizes that underseepage flows with seepage berms are greater during a 100-year flood than they would be during a 50-year flood. The increase in underseepage flow was not defined in this feasibility study, but it was estimated to require additional pumping capacity and drainage ditches. Since additional pumping capacity and drainage ditches would be needed with seepage berms, the 100-year underseepage control plan for the area draining to the Bois Brule pump station will not include seepage berms. Instead, it includes relief wells, a new pumping station and additional ditching. The underseepage control plan for the entire levee district mainly consists of new relief wells, increased pumping capacity and drainage ditches. A few small sections of seepage berm have been included where the cost of the berm is less than the cost of the corresponding relief wells. The underseepage control plans for all four drainage areas will be reexamined as part of a detailed interior drainage study that will be accomplished during final project design.

7.2 COMPONENTS OF COMBINED PROJECT

The main physical features of the combined design deficiency and Section 205 project are described on DRAWINGS 4, 5, 6, 8, 9, 10, 11 and 12. The project includes:

- 19.9 miles of levee raise as shown on DRAWING 4, with a total volume of 1,457,200 CY of fill.

- 12.5 miles of stability berms as shown on DRAWING 5, with a total volume of 768,000 CY.

- 11 gravity drain extensions to extend the existing gravity drains through wider levee sections or berms.

- 1,300 linear feet of landside seepage berms with a total volume of 145,000 CY. The locations of the seepage berms are shown on DRAWING 8.

- 488 new relief wells as shown on DRAWING 8.

- 5 modified existing wells. The 5 wells will be covered by new embankment. Modifications include converting to T-type wells and adding concrete pipes to take the discharge through the embankment to daylight.

- Separate new pump stations adjacent to the existing pump stations at Missouri Chute (new 48 cfs station), Jones Cutoff (new 57 cfs station), Cinque Holmes (new 16 cfs station), and Bois Brule (new 41 cfs station). Refer to DRAWING 2.

- **New interior drainage ditching to take flow from new relief wells to existing drainage ditches where necessary, new ditches into and out of the four new pump stations, and new culverts. Refer to DRAWING 10.**

- **A new railroad closure structure for the Burlington Northern Santa Fe railroad track to replace the existing closure structure at the north end of the project. See DRAWING 6. This work includes a single gate closure structure at a new location landward of the existing structure, new levee embankment tying into the new closure structure, removal of a section of the existing levee, and demolition of a portion of the existing closure structure.**

- **Demolition of the existing Highway 51 closure structure. The levee will be raised at this location. It is assumed that a new highway closure structure is not needed. During recent preliminary coordination, the Missouri Department of Transportation indicated they might construct a new section of Highway 51 over the top of the raised levee in ten years (2012). The new section of Highway 51 would include a raised highway across Horse Island between the Chester Mississippi River Bridge and Horse Island Chute, a new higher bridge over Horse Island Chute, a connection between the new Horse Island Bridge and the top of the new levee, and a new approach to the top of the levee from the landward side. Additional coordination with the Missouri Department of Transportation will be accomplished to determine their firm plans for the Highway 51 work.**

- **13 borrow areas as shown on DRAWING 9.**

- **68 piezometers along the levee based on the underseepage analysis.**

- **Real estate for construction of the project. Additional permanent easements in some locations where the levee is being raised, where the levee is being relocated at the north railroad closure structure, for new stability and seepage berms, for the four new pump stations, for new drainage ditches, and for the new borrow areas. Temporary construction easements to give contractors working room and access to the job sites.**

- **Real estate for environmental mitigation.**

- **Real estate outside the project area. This includes flowage easements on properties significantly impacted by induced flooding caused by raising the levee from the 50-year level to the 100-year level. The preliminary assessment of induced flooding to date indicates that induced flooding impacts properties adjacent to the existing Bois Brule levee and upstream from the levee to the Little Rock Landing gage upstream from Ste. Genevieve. This area includes lands along the Mississippi River, at the downstream end of the Kaskaskia River, and along the Old Channel of the Mississippi River (including parts of the town of St. Marys).**

- **Utility relocations including relocation of electric power lines and alteration of 20-inch petroleum lines at three locations. See DRAWING 11.**

- Railroad relocations including a temporary railroad bypass at the north railroad closure structure and the cost for Burlington Northern Santa Fe work associated with the closure structure, such as removing and reinstalling track, maintaining signaling while the railroad bypass is being used, installing temporary and permanent track crossings, and providing flagmen. See DRAWING 6.

- No relocations of existing public roads are needed due to the levee raises and berms. It is assumed that no road relocation costs will be incurred by the project in association with the planned Missouri Department of Transportation construction of a new section of Highway 51 over the raised levee.

- Design, construction management, and other related costs.

7.3 DESIGN AND CONSTRUCTION CONSIDERATIONS FOR COMBINED PROJECT

Public Law 107-66 directs that design deficiency project and the Section 205 project be constructed concurrently to ensure a technically sound and cost-effective solution. The design and construction plan for the combined project involves the following activities, many of which will be accomplished concurrently: (1) complete an interior drainage analysis to redefine the needed pump station capacities and interior drainage system, (2) complete the evaluation of induced flooding and its associated real estate costs, (3) develop plans and specifications for five construction contracts, (4) develop a scope of work for an agreement with Burlington Northern Santa Fe railroad for the railroad's work at the north railroad closure structure, (5) develop right-of-way requirements drawings and utility drawings for all construction contracts, (6) the sponsor acquires the right-of-way for all construction contracts, executes the agreement with Burlington Northern Santa Fe, and acquires all flowage easements needed because of induced flooding, (7) execute the five construction contracts and the railroad work. The five construction contracts include the following work: (1) the Relief Wells #1 contract that includes 74 design deficiency relief wells that can be constructed with no additional permanent or temporary construction easements; (2) the levee raise, stability berms, seepage berms, gravity drain extensions, and ditching; (3) the four pump stations; (4) the north railroad closure structure including the railroad bypass; and (5) the remaining 414 relief wells, the modification of 5 relief wells into T-type wells, and the 68 piezometers. Work covered by the railroad agreement will include removing and replacing track at the north railroad closure structure, installing a signaling system to the railroad bypass, and track crossings.

7.4 DESIGN, REAL ESTATE ACQUISITION, AND CONSTRUCTION SCHEDULE

The schedule for the combined project is shown in SCHEDULE 2.

7.5 OPERATION, MAINTENANCE, REPAIRS, REPLACEMENT AND REHABILITATION

The combined design deficiency project and Section 205 project will require more Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRRR) than the existing project. Additional OMRRR is required for the additional 488 new relief wells, the 5 modified wells, the four new pump stations, the larger grass surface area of the new berms and the higher levee, the additional interior drainage ditches, and the environmental

mitigation measures. OMRRR would not change significantly for the other new features, such as the new north railroad closure structure.

7.6 COST ESTIMATES FOR COMBINED PROJECT (INCREMENTAL, FULLY FUNDED, OMRRR)

7.6.1 INCREMENTAL COST ESTIMATE FOR COMBINED PROJECT

A summary of the incremental cost estimate for the combined design deficiency and Section 205 project at 1 Oct 2002 price levels is presented in TABLE 2 under "Current Estimate." The total incremental cost estimate for the combined project is $46,576,000. This estimate does not include the $836,000 estimated incremental cost of the Section 205 feasibility study. The detailed MCACES cost estimate is presented in APPENDIX F - COST ESTIMATES. The main areas of uncertainty in this cost estimate are (1) the costs of interior drainage and pumping facilities which may be either higher or lower due to planned additional underseepage and interior drainage analyses, (2) the cost of a highway closure structure if Highway 51 is not reconstructed over the levee at no cost to the project, and (3) the cost of easements on properties impacted by induced flooding which could be higher than the preliminary estimate presented in this report.

7.6.2 FULLY FUNDED COST ESTIMATE FOR COMBINED PROJECT

The fully funded cost estimate for the combined design deficiency and Section 205 project starts with the incremental cost estimate at 1 Oct 2002 price levels and then accounts for expected price level increases over the construction period shown in SCHEDULE 2. The per-month price level increases used in this estimate are provided in Engineer Circular 11-2-181. The total fully funded cost estimate for the combined project is $51,000,000. This estimate does not include the $838,000 estimated fully funded cost of the Section 205 feasibility study. The fully funded cost estimate is presented in TABLE 2 under "Fully Funded." Although the schedule presented in SCHEDULE 2 is considered realistic, it could be extended due to such factors as environmental reviews, real estate acquisitions and funding constraints. A longer schedule would result in an increase in the project cost.

7.6.3 FEDERAL AND NON-FEDERAL COST SHARING FOR COMBINED PROJECT

a. The cost sharing for both components of the combined project, the design deficiency part and the Section 205 100-year part, are specified in Public Law 107-66. The cost sharing for the design deficiency part does not require a sponsor cash contribution, while a cash contribution is required for the Section 205 part. The sponsor must provide lands, easements, rights-of-way, relocations, and borrow and disposal areas (LERRDS) for both parts of the project. The cash contribution for the Section 205 component is to be consistent with the Water Resources Development Act of 1986, which requires the sponsor to pay for LERRDS, pay cash contributions of 5 percent of the total cost, and pay any additional cash contribution so the total sponsor contribution including LERRDS is at least 25 percent of the total project cost. For the Section 205 component the sponsor must also contribute sufficient funds so the Federal expenditures do not exceed the $15,000,000 maximum set in the Water Resources Development Act of 1999, see Section 1.3.b. of this report. The Federally funded part of the fully funded Section 205 feasibility study cost ($419,000) applies to the $15,000,000 maximum, so the Federal funding limit for the remaining Section 205 project is $14,581,000.

b. The design deficiency part of the combined project is not the same as the "independent" design deficiency project that would be constructed if there were no Section 205 100-year project. The "independent" design deficiency project has some differences in components and a different schedule than the combined project. The "independent" design deficiency project includes long seepage berms but no additional pumping station in the north drainage area, and the combined project includes additional relief wells, ditching and a pumping station in this area but no seepage berms. To account for the differences in components and schedule, the non-Federal cash contribution requirement for the fully funded combined project was computed as follows. The costs of the "independent" fully funded design deficiency project were subtracted from the costs of the fully funded combined project. The remaining costs of the fully funded combined project were considered to be the Section 205 costs. These cost estimates are shown in TABLE 3. As shown in TABLE 4, non-Federal cash contributions were computed for the Section 205 costs. The cost sharing for the combined project was computed using the non-Federal cash contributions for the Section 205 component. The cost sharing for the combined project based on fully funded cost estimates at 1 Oct 2002 price levels is shown in TABLE 4. The estimated fully funded Federal share is $33,369,000, including $14,581,000 for the Section 205 project and $18,788,000 for the design deficiency project. The estimated fully funded non-Federal share is $17,631,000, including $9,239,000 due to the WRDA99 maximum on Federal expenditures, $3,192,000 in project cash contributions, and $5,200,000 in LERRDS costs. TABLES 5, 6 and 7 show summaries of the Federal and non-Federal costs by project feature. TABLES 8, 9 and 10 show the Federal and non-Federal costs by fiscal year through construction of the project per SCHEDULES 1 and 2.

c. When the combined project is constructed, actual Federal and sponsor cost sharing requirements will be determined annually based on an update of the fully funded cost estimates for both the combined project and the "independent" design deficiency project. The fully funded cost estimate for the combined project will be updated based on actual costs as they occur. The fully funded cost estimate for the "independent" design deficiency project will be updated based on actual or similar costs experienced by the combined project. A realistic schedule will be maintained for the "independent" design deficiency project, and this schedule will continue to be different than the schedule for the combined project. The fully funded cost estimate for the "independent" design deficiency project will be subtracted from the fully funded cost estimate for the combined project, and the sponsor's required cash contribution for the coming fiscal year will be determined.

7.6.4 OMRRR COST ESTIMATE FOR COMBINED PROJECT

The sponsor is responsible for the additional Operation, Maintenance, Repairs, Replacements, and Rehabilitations, (OMRRR) associated with the combined design deficiency and Section 205 project. The additional operation costs include the cost of operating the additional four pump stations: Missouri Chute (48 cfs), Jones Cutoff (57 cfs), Cinque Holmes (16 cfs), and Bois Brule (41 cfs). Additional maintenance, repair, replacement, and rehabilitation costs will be incurred for the additional pump stations and relief wells. The additional OMRRR costs are described in APPENDIX F - COST ESTIMATES. Some costs are incurred annually and some are incurred

periodically. The total annualized additional OMRRR cost for the combined project at October 2002 price levels is $157,300.

7.7 COMBINED PROJECT ACCOMPLISHMENTS

The combined design deficiency and Section 205 project will raise the level of protection for the Bois Brule Levee and Drainage District to 100-year. With the higher level of protection there is a lower risk that the two existing industries and the other structures in the levee district will be flooded, that the existing highways will be inundated and the local transportation link across the Mississippi River will be cut off, and that agricultural ground will be flooded. Since the 26,060 acres in the floodplain within the levee district will be protected from the 100-year Mississippi River flood, and most of the area will be rezoned to allow development, new development is likely to occur in the levee district. This new development will have a low probability of being flooded but it may be flooded in the future, and it would not be constructed in the levee district unless the levee is raised to the 100-year level. Corps economics studies indicate that the value of a 400-acre area in the levee district will increase because of the development potential with 100-year flood protection. The higher levee will also raise the level of Mississippi River flooding outside the levee and will have adverse effects on some properties adjacent to and upstream of the levee. See Section 7.8.3 of this report for a discussion the induced flooding that results from the levee raise.

7.8 ECONOMIC, ENVIRONMENTAL AND SOCIAL EFFECTS OF COMBINED PROJECT

7.8.1 ECONOMIC EFFECTS OF THE COMBINED PROJECT

a. The economic analysis for the combined design deficiency and Section 205 levee raise project is described in detail in APPENDIX G - ECONOMICS. Benefits that accrue to the combined project include reduction in crop damage, reduction damage to existing structures, reduction in travel losses, and location benefits because development can more readily occur in the levee district. Reductions in crop and structure damages were quantified based on the combined project bringing the level of protection for the levee district from its current level of protection (10-year Probable Non-Failure Point and 41-year Probable Failure Point) to the 100-year level of protection. The reduction in travel losses were predicated on the assumption that the state of Missouri will raise the elevation of Highway 51 riverward of the levee to the 100-year flood level and take the highway over the top of the levee in ten years. Average annual benefits and costs at 1 Oct 2002 price levels are $2,657,500 and $4,010,300, respectively. The project has negative net benefits of -$1,334,700 and a benefit to cost ratio of 0.67 to 1. The combined design deficiency and Section 205 levee raise project is not economically justified, and as can be seen in APPENDIX G - ECONOMIC CONSIDERATIONS, an analysis of the incremental increase in benefits and costs from the design deficiency project to the combined project also shows a lack of economic justification. The combined project does not meet the Federal objective to contribute to National economic development.

b. The economic effect of the induced flooding outside the protected area caused by the Section 205 levee raise component of the project is accounted for by including an estimate of the cost of flowage easements on the significantly affected properties in the total cost of the project.

7.8.2 ENVIRONMENTAL AND SOCIAL EFFECTS OF THE COMBINED PROJECT

a. DIRECT EFFECTS. As discussed in the attached draft Environmental Assessment and Findings of No Significant Impact, the combined design deficiency and Section 205 levee raise project has no direct significant impact on topography, geology and soils; cultural resources; prime farmland; wetlands and aquatic resources; water quality; threatened and endangered species; terrestrial resources; aesthetics; or socio-economic resources. Mitigation was included in the combined project because borrow and other plans may change during detailed design, conservation easements may be required at some new borrow areas, and it is wise to include some mitigation cost in the project cost estimate. The mitigation is the purchase of 260 acres riverward of the levee and 159 acres landward of the levee. The mitigation does not include any tree planting or construction work. The approximate cost of mitigation is $538,000, based $1,000 per acre for easements riverward of the levee and $1,750 per acre for easements landward of the levee.

b. INDIRECT EFFECTS. The indirect environmental and social effects of the combined project include two issues and concerns that are described in detail in the attached draft Environmental Assessment; induced development in the floodplain within the Bois Brule levee district, and induced flooding outside the protected area.

7.8.3 INDUCED FLOODING OUTSIDE THE PROTECTED AREA WITH COMBINED PROJECT

a. While the design deficiency project will have no impact on flood levels outside the levee, the Section 205 project to raise the level of protection to 100 year does impact the flood levels on the Mississippi River and on the lower part of the Kaskaskia River. The Unsteady Flow Network (UNET) model was used to determine the impact of raising the Bois Brule Levee and Drainage District to a 100-year recurrence interval level of protection. Using the UNET model, a revised water surface profile was computed based on the effects of lost storage behind a levee system assuming no levee failure. For the 100-year flood event, induced flooding was calculated to be 0.9 foot increase in water levels immediately upstream of the Bois Brule levee at River Mile 109.0 and 0.1 foot or greater as far downstream as River Mile 23.6 (south of Cape Girardeau near Dogtooth Island) and upstream as River Mile 156.0 (north of Herculaneum). This analysis is described in more detail in APPENDIX A - HYDROLOGY AND HYDRAULICS.

b. A meeting was held on 11 February 1998 with the Missouri State Emergency Management Agency (MO SEMA) and the Federal Emergency Management Agency (FEMA), Region VII, to discuss the issue of floodway delineation. Both agencies agreed that, although the lost flood storage is real, there are no regulations by either agency regarding the lost storage within the floodplain. The floodway limit is at the riverside toe of the levee and a landside enlargement is allowable with induced flood heights identified as a negative benefit. Induced flooding was discussed with MO SEMA and the Illinois Department of Natural Resources, Office of Water Resources on 4 October 2002. Generally, the state of Illinois requires that flooding easements be purchased on properties in Illinois that are impacted by increases in depth or duration of flooding.

c. The real estate costs associated with induced flooding presented in this report are based on the limited analysis described below. A more

extensive effort is underway to better define the level of induced flooding, the extent of the affected area, and the costs associated with any significant impact on properties. The timing of these efforts is shown in SCHEDULE 2.

d. Levees in the affected section of the Mississippi River (River mile 23.6 to 156.0) were considered but no effort was made to define the cost of induced flooding in these areas. The Bois Brule levee is one of the higher "50-year" levees in the area because of subsequent reduction in the 50-year design discharge. Higher levees include the urban design levee and floodwall in Cape Girardeau, Missouri, the Ste. Genevieve, Missouri urban design levee, the 100-year Prairie du Rocher and Modoc levee in Illinois, and the planned urban design levee in Festus-Crystal City, Missouri. Lower levees include the East Cape Girardeau and Clear Creek levee in Illinois, the North Alexander levee in Illinois, the Clear Creek levee in Illinois, the Miller Pond levee in Illinois, the Preston levee in Illinois, the Grand Tower levee in Illinois, the Degognia and Fountain Bluff levee in Illinois, the Kaskaskia Island levee in Illinois, the Ste. Genevieve County Levee District Number 2 in Missouri, the Fort Chartres and Ivy Landing levee in Illinois, the Stringtown levee in Illinois, and the Harrisonville and Ivy Landing levee in Illinois. Of the higher levees, only the Prairie du Rocher and Modoc levee would be affected by the Bois Brule levee raise. The freeboard for the 100-year Prairie du Rocher and Modoc levee would be reduced because of the increase in the 100-year flood profile at that location. The urban design levees protect against the 500-year flood or higher and would not be impacted by a 100-year Bois Brule levee because the Bois Brule levee would no longer be functioning when flooding reaches the 500-year level. Because the lower levees will be overtopped before the existing Bois Brule levee is overtopped, the additional height on the Bois Brule levee would not cause these levees to be overtopped but would cause slightly deeper flooding in an already flooded levee district. The flooded areas along the landward edge of the 100-year floodplain would be larger.

e. The limited effort to define the costs associated with induced flooding focused on two locations with significant induced flood heights: the town of St. Marys, MO at the upstream end of the Bois Brule levee (0.9 feet rise for the 100 year flood), and the backwater effect up the Kaskaskia River (0.6 feet), which extends about 36 miles upstream in Illinois. No effort has been made to define the impacts in other unprotected areas along the Mississippi River.

f. Induced flood heights up the Kaskaskia River are defined by the Mississippi River flood heights at approximately River Mile 117.4:

Existing 100-Year Flood Elevation = 393.94 feet
Induced 100-Year Flood Elevation = 394.55 feet

Increase = 000.61 feet

The land area between the existing 100-year flood line and the induced 100-year flood line was assumed to be approximately 50 feet wide on both sides of the Kaskaskia River as an average. The Mississippi River 100-yr elevation controls the lower 36 miles. Upstream of Fayetteville the 100-yr Kaskaskia headwater flood profile controls.

Area = 100 ft x 36 miles (5280ft mile/43560 sq ft/acre) = 436 acres

g. An approximate estimate of the area impacted by induced flooding at the town of St. Marys, Missouri was based on planimetering the difference between the 100-year and 500-year flood lines on the FEMA Flood Insurance Rate Maps. The approximate impacted urban area was 4.0 acres.

h. The fully funded October 2002 price level cost estimate for the induced flooding is $2,065,000. The bulk of these costs come from the estimated acquisition cost for the easements, that is the cost to develop legal survey descriptions, complete appraisals, negotiate with the property owners, and record the needed easements. The $2,065,000 is a preliminary estimate that will be refined as part of an effort to better define the levels of induced flooding, the area and parcels impacted by induced flooding, and the real estate costs associated with the induced flooding. The methodology and computations for the incremental estimate (prior to full funding) are described in APPENDIX D - REAL ESTATE.

i. The State of Illinois requires a different methodology to define the increase in flood levels caused by levee projects. Using this methodology the induced flood height is 1.1 feet at the upstream end of the Bois Brule levee, and the limits of the 0.1-foot rise are at Mississippi River Miles 101.6 and 145.3. The analysis done for the State of Illinois is described in APPENDIX A - HYDROLOGY AND HYDRAULICS.

j. Because it may induce flooding in unprotected developed areas such as St. Marys, Missouri and the low lying parts of Chester, Illinois, the Section 205 levee raise component of the combined project may deviate from the objectives of Executive Order 11988. Among other things, Executive Order 11988 requires that Federal agencies reduce the hazards and risks associated with floods, and minimize the impact of floods on human safety, health and welfare. The impacts of induced flooding in these developed areas will be defined as part of the detailed studies described in Section 7.8.3.c.

7.9 IMPLEMENTATION OF THE COMBINED DESIGN DEFICIENCY AND SECTION 205 PROJECT

7.9.1 SPONSOR RESPONSIBILITIES FOR COMBINED PROJECT

a. In accordance with Federal law and Corps of Engineers regulations, the local sponsor of the project, the Bois Brule Levee and Drainage District, has the following responsibilities.

(1) Provide a minimum of 25 percent, but not to exceed 50 percent, of total Section 205 project costs allocated to structural flood control, as further specified below:

(a) Provide, during construction, a cash contribution equal to 5 percent of total Section 205 project costs assigned to structural flood control;

(b) Provide all lands, easements, and rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the non-Federal sponsor must provide for the construction, operation, and maintenance of the project, and perform or ensure the performance of all relocations that the Government determines to be necessary for the construction, operation, and maintenance of the Section 205 project;

(c) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the Section 205 project;

(d) Provide, during construction, any additional costs as necessary to make the total non-Federal contributions equal to 25 percent of total Section 205 project costs allocated to structural flood control.

(2) For both the design deficiency and Section 205 components of the project:

(a) Provide all lands, easements, and rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the non-Federal sponsor must provide for the construction, operation, and maintenance of the project, and perform or ensure the performance of all relocations that the Government determines to be necessary for the construction, operation, and maintenance of the project;

(b) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the project;

(c) Provide the non-Federal share of that portion of total cultural resource preservation mitigation and data recovery costs attributable to flood control that are in excess of 1 percent of the total amount authorized to be appropriated to the project, in accordance with the cost sharing provisions of the project cooperation agreement;

(d) For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

(e) Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

(f) Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence construction of any water resources project or separable element thereof until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

(g) Hold and save the Government free from all damages arising from the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for

damages due to the fault or negligence of the Government or the Government's contractors;

(h) Assume responsibility for any legal liabilities resulting from transfer of water from one watershed to another;

(i) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extend and in such detail as will properly reflect total project costs;

(j) Perform, or cause to be performed, any investigations for hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government;

(k) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

(l) Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

(m) Participate in and comply with applicable Federal floodplain management and flood insurance programs;

(n) Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to have prepared within one year after the date of signing the project cooperation agreement, a floodplain management plan. The plan shall be designed to reduce the impacts of future flood events in the project area, including but not limited to, addressing those measures to be undertaken by non-Federal interests to preserve the level of flood protection provided by the project. As required by Section 402, as amended, the non-Federal interest shall implement such plan not later than one year after completion of construction of the project. The non-Federal sponsor shall provide an information copy of the plan to the Federal Government upon its preparation.

(o) Prevent future encroachments on project lands, easements, and rights-of-way, which might interfere with the proper functioning of the project;

(p) Not less than once each year, inform affected interests of the limitations of the protection afforded by the project;

(q) Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in

adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

(r) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), as amended by Public Law 102-240, Section 1055 (re: rural electrification), as amended by Public Law 105-117, Section 104 (re: Alien not lawfully present in United States), and the Uniform Regulation contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

(s) Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable federal labor standards requirements, including, but not limited to, the Davis-Bacon Act (40 U.S.C. 276a et. seq.), the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et. seq.) and the Copeland Anti-Kickback Act (40 U.S.C. 276c).

(t) Do not use Federal funds to meet the non-Federal sponsor’s share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

b. As part of the sponsor's responsibility to provide lands and easements for the Section 205 levee raise component of the project, the sponsor must provide flowage easements on properties significantly affected by the induced flooding caused by the levee raise. The sponsor does not have the legal authority to condemn properties outside the levee district to obtain these easements, and may hire the Federal government to conduct these condemnations if necessary.

7.9.2 PROJECT COOPERATION AGREEMENT FOR COMBINED PROJECT

a. The schedule for completing a Project Cooperation Agreement (PCA) for the combined design deficiency and Section 205 project is shown in SCHEDULE 2. A Project Cooperation Agreement is a legal document that will be signed by the Bois Brule Levee and Drainage District and the Department of the Army. It describes in great detail the responsibilities of both parties for the implementation of the project, and commits both parties to fulfill these responsibilities.

b. The Project Cooperation Agreement must be signed before construction can begin, and SCHEDULE 2 shows the PCA executed prior to advertisement of the first construction contract.

c. Separate Project Cooperation Agreements could be executed for some design deficiency correction work and for the remainder of the combined project, but the plan is to have one PCA for the entire combined project.

7.9.3 OTHER AGENCY RESPONSIBILITIES FOR COMBINED PROJECT

a. The Corps of Engineers has coordinated with the Missouri Department of Transportation (MODOT) District Office in Sikeston about their plans to raise Highway 51 between the Chester Bridge over the Mississippi River and the north end of the Bois Brule levee, replace the Highway 51 bridge over Horse Island Chute, and build an approach to the top of levee from the landward side. This work is not currently in the MODOT five-year construction plan. It may be constructed in ten years (2012). Further coordination with MODOT will be accomplished to determine their firm plans for the Highway 51 work. The Perry County Industrial Development Authority is looking into potential Federal assistance for this highway work. MODOT indicates that the highway work may be completed on an earlier schedule if some entity is willing to pay the interest on the loan if funds for the highway and bridge project are borrowed from the Highway Trust Fund.

b. If the Highway 51 work is not completed until [Assume 2012] and the Section 205 levee raise described herein is completed everywhere except at Highway 51 in October 2006, there will be a period of about [Assume 6] years when emergency actions must be taken to close off the levee gap at Highway 51 if floods are forecasted to go higher than 50-year. The existing closure structure at Highway 51 protects against the 50-year flood. The Bois Brule Levee and Drainage District will be responsible for taking the emergency actions to provide 100-year protection at Highway 51.

c. It should be noted that the costs in the Section 205 project to demolish the existing Highway 51 closure structure and raise the levee in this area are included in the Embankments and Ditching contract that is scheduled to be completed in October 2006. This work would actually be completed at a later date depending on the actual timing of the state of Missouri Highway 51 construction work.

d. The cost of raising Highway 51 in the vicinity of the Bois Brule levee is not included in the total project cost estimate used to determine cost sharing for the combined Bois Brule design deficiency and Section 205 levee raise project. These highway costs are incorporated into the economic analysis.

SECTION 8 - COORDINATION, PUBLIC VIEWS AND COMMENTS

This section will be completed after the public has reviewed this draft report.

SECTION 9 - CONCLUSIONS

a. The project as authorized has several deviations from current Corps of Engineers policy. Public Law 107-66 directs that the cost sharing for the design deficiency project be consistent with the original project authorization, which required no sponsor cash contributions. This differs from current Corps policy, which generally requires the cash contributions described in the Water Resources Development Act of 1986. The increased level of protection is likely to encourage new development in the floodplain. Executive Order 11988 requires Federal agencies to avoid undertaking actions

which directly or indirectly induce growth in the flood plain, while corresponding Corps policy directs that Corps projects "to the extent possible, avoid or minimize adverse impacts associated with use of the base flood plain and avoid inducing development in the base flood plain unless there is no practicable alternative for the development." The combined project will not meet the Federal objective of water and related land resource project planning to contribute to National economic development, because the National economic development benefits for the combined project are less than its costs. The combined project will also induce flooding along the Mississippi River outside the Bois Brule levee. The extent of this induced flooding will be delineated during detailed project design and the sponsor will obtain easements from impacted property owners. In addition to these policy issues, the cost sharing for the Section 205 component authorized by Public Law 107-66 (25 percent minimum sponsor share) deviates from the current cost sharing for flood control projects defined by the Water Resources Development Act of 1996 (35 percent minimum sponsor share).

b. Public Law 107-66 directs the Secretary of the Army to construct a flood control project for the Bois Brule Levee and Drainage District with two components, a design deficiency part that restores the authorized 50-year level of protection, and a Section 205 part that raises the level of protection to 100-year.

c. A Project Cooperation Agreement is needed for construction of the authorized flood control project, and the Project Cooperation Agreement must be supported by an approved decision document.

SECTION 10 - RECOMMENDATIONS

I recommend approval of this report as the decision document for the Project Cooperation Agreement for the flood control project for the Bois Brule Levee and Drainage District authorized by Public Law 107-66.

Signed

(Will Be Signed In Final Report)

C. Kevin Williams
Colonel, U.S. Army
District Engineer

TABLE 1
(Page 1 of 2)

COST ESTIMATE WORKSHEET				Project: Bois Brule (Design Deficiency Project)											STATUS CODE: C-COMPLETE; U-UNDER CONTRACT;							PRINTED:	5-Nov-02
FORM 17 EFFECTIVE 1 OCT 02				CWIS: 091549											N-NOT STARTED							PREPARED:	5-Nov-02
LN	ACCT	FEATURE/ITEM		Months	PREVIOUS ESTIMATE				CHANGES		CURRENT ESTIMATE					FULLY-FUNDED							ACTUAL $
NO	NO		Award	of	DIRECT	CTG%	CTG $	TOTAL	PL	OTHER	DIRECT	CTG%	CTG $	TOTAL	REASON FOR CHANGE/REMARKS	INFL	INFL					S	30-Sep-01
(1)	(2)	(3)	Date	Duration	(4)	(5)		(6)	(7)	(8)	(9)	(10)		(11)	(12)	FACTOR	AMOUNT	DIRECT	CTG%	CTG $	TOTAL	T	(14)
1	11	**LEVEES AND FLOODWALLS**								11,970	9,576	25%	2,394	11,970			864	10,274	25%	2,560	12,834		
2		Relief Wells #1	Dec-03	12						2,405	1,924	25%	481	2,405	Based on MCACES dated 26 April 2002 at 1 Oct 02 price level	1.048	116	2,021	25%	500	2,521	N	
3		Relief Wells #2 and Piezometers	Dec-04	13						6,992	5,594	25%	1,398	6,992		1.078	546	6,028	25%	1,510	7,538	N	
4		Embankment and Ditching	Dec-04	13						2,573	2,058	25%	515	2,573		1.078	202	2,225	25%	550	2,775	N	
5	13	**PUMPING PLANTS**								1,546	1,237	25%	309	1,546			97	1,318	25%	325	1,643		
6		Pump Station	Jun-04	12						1,546	1,237	25%	309	1,546		1.062	97	1,318	25%	325	1,643	N	
7	30	**PLANNING, ENGINEERING AND DESIGN**								2,548	2,548	0%	0	2,548	Actual cost includes $135 sunk costs.		208	2,756	0%	0	2,756		135
8	31	**SUPERVISION and ADMINISTRATION**								1,352	1,079	25%	273	1,352			203	1,245	25%	310	1,555		
9		Relief Wells #1	Dec-03	12						241	193	25%	48	241		1.118	29	216	25%	54	270		
10		Relief Wells # 2 & Piezometers	Dec-04	13						699	557	25%	142	699		1.141	100	639	25%	160	799		
11		Embankment and Ditching	Dec-04	13						257	205	25%	52	257		1.141	37	236	25%	58	294		
12		Pump Station	Jun-04	12						155	124	25%	31	155		1.232	37	154	25%	38	192		
13		Total Federal Cost								17,416	14,440	21%	2,976	17,416			1,372	15,593	20%	3,195	18,788		
14																							
15																							
16																							
17																							

TABLE 1
(Page 2 of 2)

COST ESTIMATE WORKSHEET			Project: Bois Brule (Design Deficiency Project)												STATUS CODE: C-COMPLETE; U-UNDER CONTRACT;							PRINTED:	5-Nov-02
FORM 17 EFFECTIVE 1 OCT 02			CWIS: 091549												N-NOT STARTED							PREPARED:	5-Nov-02
LN	ACCT	FEATURE/ITEM		Months	PREVIOUS ESTIMATE				CHANGES		CURRENT ESTIMATE					FULLY-FUNDED							ACTUAL $
NO	NO		Award	of	DIRECT	CTG%	CTG $	TOTAL	PL	OTHER	DIRECT	CTG%	CTG $	TOTAL	REASON FOR CHANGE/REMARKS	INFL	INFL	DIRECT	CTG%	CTG $	TOTAL	S	30-Sep-01
(1)	(2)	(3)	Date	Duration	(4)	(5)		(6)	(7)	(8)	(9)	(10)		(11)	(12)	FACTOR	AMOUNT					T	(14)
1	01	NON-FEDERAL LANDS AND DAMAGES								438	391	12%	47	438			14	404	12%	48	452		
2		Basic Construction Project Acquisition Costs	Jul-03	6						192	192	0%	0	192		1.029	6	198	0%	0	198		
3		Basic Construction Project Payments for Easements and ROW	Jul-03	6						234	187	25%	47	234		1.029	7	193	25%	48	241		
4		Basic Construction Project Relo Assist PL 91-646	Jul-03	6						12	12	0%	0	12		1.029	1	13	0%	0	13		
5																							
6		Non-Federal Cost								438	391	12%	47	438			14	404	12%	48	452		
7																							
8		Total Project Cost								17,854	14,831	20%	3,023	17,854			1,386	15,997	20%	3,243	19,240		135
9																							
10																							
11																							
12																							
13																							
14																							
15																							
16																							
17																							

OFFICIAL FORM 17 TO BE INCLUDED IN THE COMBINED DESIGN DEFICIENCY REPORT AND SECTION 205 DPR.

TABLE 2
(Page 1 of 3)

COST ESTIMATE WORKSHEET				Project: Bois Brule (100-year levee, includes design deficiency)											STATUS CODE: C-COMPLETE; U-UNDER CONTRACT;							PRINTED:		5-Nov-02
FORM 17 EFFECTIVE 1 OCT 02				CWIS: 091549											N-NOT STARTED							PREPARED:		5-Nov-02
LN	ACCT	FEATURE/ITEM		Months	PREVIOUS ESTIMATE				CHANGES		CURRENT ESTIMATE					FULLY-FUNDED								ACTUAL $
NO	NO		Award	of	DIRECT	CTG%	CTG $	TOTAL	PL	OTHER	DIRECT	CTG%	CTG $	TOTAL	REASON FOR CHANGE/REMARKS	INFL	INFL	DIRECT	CTG%	CTG $	TOTAL	S	30-Sep-01
(1)	(2)	(3)	Date	Duration	(4)	(5)		(6)	(7)	(8)	(9)	(10)		(11)	(12)	FACTOR	AMOUNT					T	(14)
1	11	**LEVEES AND FLOODWALLS**								28,715	22,971	25%	5,744	28,715			2,752	25,095	25%	6,372	31,467		
2		Relief Wells #1	Dec-03	12						2,405	1,924	25%	481	2,405	Based on MCACES dated 26 April 2002 at 1 Oct 02 price level	1.048	116	2,011	25%	510	2,521	N	
3		Relief Wells #2 and Piezometers	Jan-06	12						13,570	10,856	25%	2,714	13,570		1.108	1,467	11,987	25%	3,050	15,037	N	
4		Embankment and Ditching	Apr-05	17						11,677	9,341	25%	2,336	11,677		1.093	1,087	10,179	25%	2,585	12,764	N	
5		Replace North RR Closure	Dec-04	12						1,063	850	25%	213	1,063		1.076	82	918	25%	227	1,145	N	
6	13	**PUMPING PLANTS**								4,346	3,477	25%	869	4,346			270	3,701	25%	915	4,616		
7		Pump Station	Jun-04	12						4,346	3,477	25%	869	4,346		1.062	270	3,701	25%	915	4,616	N	
8	30	**PLANNING, ENGINEERING AND DESIGN**								5,261	5,261	0%	0	5,261	Actual cost includes $135 sunk costs.		485	5,746	0%	0	5,746		135
9	31	**SUPERVISION and ADMINISTRATION**								3,307	2,651	25%	656	3,307			664	3,181	25%	790	3,971		
10		Relief Wells #1	Dec-03	12						241	193	25%	48	241		1.118	29	216	25%	54	270		
11		Relief Wells # 2 & Piezometers	Jan-06	12						1,357	1,087	25%	270	1,357		1.204	278	1,309	25%	326	1,635		
12		Embankment and Ditching	Apr-05	17						1,168	938	25%	230	1,168		1.204	239	1,127	25%	280	1,407		
13		Railroad Closure	Dec-04	12						106	85	25%	21	106		1.141	16	98	24%	24	122		
14		Pump Station	Jun-04	12						435	348	25%	87	435		1.232	102	431	25%	106	537		
15		Federal Cost and non-Federal Contribution								41,629	34,360	21%	7,269	41,629			4,171	37,723	21%	8,077	45,800		
16																							
17		Less non-Federal cash contribution								#REF!	2,672	#REF!	#REF!	#REF!			#REF!	3,192	0%	0	#REF!		
18		Less Non-Federal Contrib								#REF!	6,960	#REF!	#REF!	#REF!			#REF!	9,239	0%	0	#REF!		
19		Total Federal Cost								#REF!	24,728	#REF!	#REF!	#REF!			#REF!	25,292	32%	8,077	#REF!		135

TABLE 2
(Page 2 of 3)

COST ESTIMATE WORKSHEET — Project: Bois Brule (100-year levee, includes design deficiency) — STATUS CODE: C-COMPLETE; U-UNDER CONTRACT; N-NOT STARTED — PRINTED: 5-Nov-02

FORM 17 EFFECTIVE 1 OCT 02 — CWIS: 091549 — PREPARED: 5-Nov-02

LN NO (1)	ACCT NO (2)	FEATURE/ITEM (3)	Award Date	Months of Duration	PREVIOUS ESTIMATE DIRECT (4)	PREVIOUS ESTIMATE CTG% (5)	PREVIOUS ESTIMATE CTG $ (5)	PREVIOUS ESTIMATE TOTAL (6)	CHANGES PL (7)	CHANGES OTHER (8)	CURRENT ESTIMATE DIRECT (9)	CURRENT ESTIMATE CTG% (10)	CURRENT ESTIMATE CTG $ (10)	CURRENT ESTIMATE TOTAL (11)	REASON FOR CHANGE/REMARKS (12)	FULLY-FUNDED INFL FACTOR	FULLY-FUNDED INFL AMOUNT	FULLY-FUNDED DIRECT	FULLY-FUNDED CTG%	FULLY-FUNDED CTG $	FULLY-FUNDED TOTAL	ST	ACTUAL $ 30-Sep-01 (14)
2	01	NON-FEDERAL LANDS AND DAMAGES								4,363	4,138	5%	225	4,363			161	4,295	5%	229	4,524		
3		Basic Construction Project Acquisition Costs	Jul-03	6						816	816	0%	0	816		1.029	24	840	0%	0	840		
4		Basic Construction Project Payments for Easements and ROW	Jul-03	6						969	775	25%	194	969		1.029	29	801	25%	197	998		
5		Basic Construction Project Relo Assist PL 91-646	Jul-03	6						51	51	0%	0	51		1.029	2	53	0%	0	53		
6		Induced Flooding Acquisition Costs	Dec-03	12						1,728	1,728	0%	0	1,728		1.045	78	1,806	0%	0	1,806	N	
7		Induced Flooding Payments for Easements	Dec-03	12						153	122	25%	31	153		1.045	7	128	25%	32	160		
8		Induced Flooding Relo Assist PL 91-646	Dec-03	12						108	108	0%	0	108		1.045	5	113	0%	0	113		
9		Environmental Mitigation Payments for Easements and ROW	Jul-03	6						538	538	0%	0	538		1.029	16	554	0%	0	554		
10	02	RELOCATIONS								472	397	19%	75	472			74	459	19%	87	546		
11		Embankment and Ditching Relocations	Apr-05	17						112	97	15%	15	112		1.204	23	117	15%	18	135		
12		Railroad Closure Relocations	Dec-04	12						360	300	20%	60	360		1.141	51	342	20%	69	411		
13	30	PLANNING, ENGINEERING, & DESIGN								65	65	0%	0	65			9	74	0%	0	74		
14		Relocations								65	65	0%	0	65			9	74	0%	0	74		
15	31	SUPERVISION and ADMINISTRATION								47	47	0%	0	47			9	56	0%	0	56		
16		Relocations for Embankment and Ditching	Apr-05	17						11	11	0%	0	11		1.204	3	14	0%	0	14		
17		Relocations for RR Closure	Dec-04	12						36	36	0%	0	36		1.141	6	42	0%	0	42		
18		Non-Federal Cost								4,947	4,647	6%	300	4,947			253	4,884	6%	316	5,200		
19		Plus non-Fed Contribution								#REF!	2,672	#REF!	#REF!	#REF!			#REF!	3,192	0%	0	#REF!		
20		Plus non-Federal cash contribution due to Cap on Fed Section 205								6,960	6,960	#REF!	#REF!	#REF!			#REF!	9,239	0%	0	#REF!		
21																							
22		Total non-Federal								#REF!	14,279	#REF!	#REF!	#REF!			#REF!	17,315	#REF!	#REF!	#REF!		
23		Total Federal								#REF!	24,728	#REF!	#REF!	#REF!			#REF!	25,292	32%	8,077	#REF!		135
24		Total Project								#REF!	39,007	#REF!	#REF!	#REF!			#REF!	42,607	#REF!	#REF!	#REF!		

TABLE 2
(Page 3 of 3)

COST ESTIMATE WORKSHEET	Project: Bois Brule (100-year levee, includes design deficiency)	STATUS CODE: C-COMPLETE; U-UNDER CONTRACT;	PRINTED:	5-Nov-02
FORM 17 EFFECTIVE 1 OCT 02	CWIS: 091549	N-NOT STARTED	PREPARED:	5-Nov-02

LN NO (1)	ACCT NO (2)	FEATURE/ITEM (3)	Award Date	Months of Duration	PREVIOUS ESTIMATE DIRECT (4)	CTG% (5)	CTG $ (5)	TOTAL (6)	CHANGES PL (7)	CHANGES OTHER (8)	CURRENT ESTIMATE DIRECT (9)	CTG% (10)	CTG $ (10)	TOTAL (11)	REASON FOR CHANGE/REMARKS (12)	FULLY-FUNDED INFL FACTOR	INFL AMOUNT	DIRECT	CTG%	CTG $	TOTAL	ST	ACTUAL $ 30-Sep-01 (14)
No Cash contribution is required for the Design Deficiency Component. Sponsor must pay for LERRDS for Design Deficiency Project. Fully funded Design Deficiency Total Project Cost estimate is $19,240; Fully funded LERRDS is $452																							
		Total Project Cost	51,000		Levees						22,971			28,715		Levees		25,095			31,467		
					Pumping Plant						3,477			4,346		Pumping Plant		3,701			4,616		
		Total	51,000		E&D						5,261			5,261		E&D		5,746			5,746		
		25% Non-Federal portion	12,750		S&A						2,651			3,307		S&A		3,181			3,971		
		75% Federal share	38,250		Subtotal						34,360			41,629		Subtotal		37,723			45,800		
		Total Cost of Project	51,000																				
					Lands						4,138			4,363		Lands		4,295			4,524		
					Relocations						397			472		Relocations		459			546		
					E&D						65			65		E&D		74			74		
					S&A						47			47		S&A		56			56		
					Subtotal Non-Federal						4,647			4,947		Subtotal Non-Federal		4,884			5,200		
					Total FC						39,007			46,576	Total Combined Cost Estimate for FC			42,607			51,000		
											14,831			17,854	Less Design Deficiency Cost Estimate			#REF!			#REF!		
											24,176			28,722	Section 205 Cost Estimate			#REF!			#REF!	1/	
											6,044			7,181	25 % of Section 205 Cost Estimate			#REF!			#REF!		
											#REF!			#REF!	Less Section 205 LERRDS			#REF!			#REF!	1/	
											#REF!			#REF!	Cash Contribution			#REF!			#REF!	1/	
											15,000			15,000	Cap limitation on Federal share of Section 205 Cost Estimate			15,000			15,000	2/	
											419			419	Less feasibility expenditures			419			419	2/	
											14,581			14,581	Federal Estimate for the Section 205 Project			14,581			14,581	2/	
											24,176			28,722	Section 205 Cost Estimate			#REF!			#REF!		
											#REF!			#REF!	Less Section 205 LERRDS			#REF!			#REF!		
											#REF!			#REF!	Less Section cash contribution			#REF!			#REF!		
											#REF!			#REF!	Section 205 federal estimate for combined project without the cap			#REF!			#REF!	2/	
											14,581			14,581	Less section 205 share for the combined project			14,581			14,581	2/	
											#REF!			#REF!	Sponsor contribution based on Cap limitation on Federal share			#REF!			#REF!	2/	
											9,752			11,644	25% of Total FC			10,652			12,750		
											1,950			2,329	5% of Total FC			2,130			2,550		
											9,752			11,644	25% minimum			10,652			12,750		
											4,647			4,947	Less Combined Project LERRDS			4,884			5,200		
											5,105			6,697	Cash Contribution			5,768			7,550		
											1,950			2,329	Less 5%			2,130			2,550		
											3,155			4,368	Additional cash			3,638			5,000		
											4,647			4,947	Combined Project LERRDS			4,884			5,200		
											#REF!			#REF!	Less Design Deficiency LERRDS			#REF!			#REF!		
											#REF!			#REF!	Section 205 LERRDS			#REF!			#REF!		
											838			838	Total Section 205 Feasibility Study Costs			838			838		
											419			419	Federal share is 50%			419			419		
											419			419	Cash Contribution (Non-Federal share is 50%)			419			419		

1/ Sponsor must pay cash contribution for the Section 205 Component -- 5% of total Section 205 cost and a 25% minimum including Section 205 LERRDS.

Section 205 LERRDS = Combined Project LERRDS ($5,200) less Design Deficiency LERRDS ($452) = $4,748

Section 205 Total Project Cost = Combined Project TPC ($51,000) less Design Deficiency TPC ($19,240) = $31,760

Section 205 cash contribution: = (25% X Section 205 TPC) less Section 205 LERRDS = (25% X $31,760) less $4,748 = $7,940 less $4,748 = $3,192

2/ Sponsor must pay all Federal costs that exceed the $15M Cap limitation on Section 205 funds. The cap applies to Federal Section 205 feasibility study costs (estimated to be $419). (Total estimated fully funded section 205 feasibility study costs = $838 with Federal share being 50%.)

The cap for Federal funds for the Section 205 project = $15,000 less 419 = $14,581. Without the cap, the Section 205 Federal share for the combined project would be $23,820 (Section 205 TPC $31,760 less Section 205 LERRDS $4,748 less Section 205 non-Fed cash contributions $3,192)

Sponsor contribution due to the cap = Federal cost without cap $23,820 less cap for the Section 205 project $14,581 = $9,239

TABLE 3

Section 205 Project Fully Funded Costs in
Bois Brule Combined Project
Federal and Non-Federal Cost Allocation
(Does not show Non-Federal Cash Contributions due to CAP on
Federal Section 205 Funds)
1 October 2002 Price Levels ($1,000)

3A Summary of Combined Project Fully Funded Costs from Table 2

Federal	
11 Levees and Floodwalls	$31,467
13 Pumping Plants	$4,616
30 Planning, Engineering and Design	$5,746
31 Supervision and Administration	$3,971
Subtotal	**$45,800**
Non-Federal	
1 Lands and Damages	$4,524
2 Relocation	$546
30 Planning, Engineering and Design for Relocation	$74
31 Supervision and Administration for Relocation	$56
Subtotal	**$5,200**
TOTAL	**$51,000**

3B Summary of Design Deficiency Project Fully Funded Costs from Table 1

Federal	$12,834
11 Levees and Floodwalls	$1,643
13 Pumping Plants	$2,756
30 Planning, Engineering and Design	$1,555
31 Supervision and Administration	**Subtotal $18,788**
Non-Federal	$452
1 Lands and Damages	
TOTAL	**$19,240**

3C
Summary of Section 205 Project Fully Funded Costs
(Combined Project Costs Less Deficiency Project Costs 3A - 3B)

Federal	
11 Levees and Floodwalls	$18,633
13 Pumping Plants	$2,973
30 Planning, Engineering and Design	$2,990
31 Supervision and Administration	$2,416
Subtotal	**$27,012**
Non-Federal	
1 Lands and Damages	$4,072
2 Relocation	$546
30 Planning, Engineering and Design for Relocation	$74
31 Supervision and Administration for Relocation	$56
Subtotal	**$4,748**
TOTAL	**$31,760**

TABLE 4

FULLY FUNDED COST SHARING FOR COMBINED DESIGN DEFICIENCY AND SECTION 205 PROJECT
(1 Oct 2002 Price Levels)

	Summary of Table 3A Combined Project	Summary of Table 3B Design Deficiency Project	Cost Sharing with Federal CAP Section 205 Project	Cost Sharing No Federal CAP Combined Project 2/	Cost Sharing with Federal CAP Combined Project 3/
Non-Federal					
LERRDS	$5,200	$452	$4,748	$5,200	$5,200
Project Cash Contribution	ND	NA	$3,192 1/	$3,192	$3,192
Contributions Due to Federal Section 205 CAP	ND	NA	$9,239 3/	ND	$9,239
Subtotal	**$5,200**	**$452**	**$17,179**	**$8,392**	**$17,631**
Federal					
Section 205 Project	ND	$0	$14,581	$23,820	$14,581
	ND	$18,788	NA	$18,788	$18,788
	$45,800	NA	NA	AA	AA
Subtotal	**$45,800**	**$18,788**	**$14,581**	**$42,608**	**$33,369**
TOTAL	**$51,000**	**$19,240**	**$31,760**	**$51,000**	**$51,000**

1/ Computations for Section 205 Cash Contributions
Total Section 205 Project Cost = $31,760.
Non-Federal Project Contributions include LERRDS + Cash Contributions.
Cash Contributions include 5% x Project Cost plus Additional Cash to meet 25% minimum.
LERRDS = $4,748. 5% x $31,760 = $1,588. LERRDS + 5% = %6,336.
25% x Project Cost = 25% x $31,760 = $7,940, which is greater than (LERRDS + 5%).
Cash Contributions = 25% - LERRDS = $7,940 - $4,748 = $3,192.

2/ Non-Federal Sponsor pays for all LERRDS for the Combined Project and the Cash Contributions required for the Section 205 Project.

3/ Cost Sharing with the $15,000,000 CAP on Federal Section 205 Funds. This CAP applies to Federal Section 205 Feasibility Study Funds (Federal share is 50% = $838,000 x 50% = $419,000) and Section 205 Project Costs. Federal CAP for Section 205 Project = $15,000,000 = $419,000 = $14,581,000. Extra Sponsor Contribution due to the Federal Funding CAP = the Federal Section 205 Project Costs without the CAP ($23,820,000) - the Federal Section 205 Project Cost with the CAP ($14,581,000) = $9,292,000.

TABLE 5

Bois Brule, Deficiency Correction Features
Federal and Non-Federal Cost Allocation
Fully Funded, 1 October 2002 Price Levels

	Federal ($000)	Non-Federal ($000)	Total ($000)
Lands & Damages		$452	$452
Relocations		$0	$0
Levees and Floodwalls	$12,834		$12,834
Pumping Plants	$1,643		$1,643
Planning, Engineering & Design **1/**	$2,756	$0	$2,756
Supervision and Administration	$1,555	$0	$1,555
Subtotal	**$18,788**	**$452**	**$19,240**
Cash Contributions **2/**	$0	$0	$0
TOTAL FEATURE COSTS	**$18,788**	**$452**	**$19,240**

1/ Includes $135 of Design Deficiency Costs incurred in the Section 205 Feasibility Study and then transferred to the Design Deficiency Component.

2/ Based on original Project Cost Sharing (ABC's) as authorized by PL 107-66.

TABLE 6

Bois Brule, Section 205 Features
Federal and Non-Federal Cost Allocation
Fully Funded, 1 October 2002 Price Levels

	Federal ($000)	Non-Federal ($000)	Total ($000)
Lands & Damages		$4,072	$4,072
Relocations		$546	$546
Levees and Foodwalls	$18,633		$18,633
Pumping Plants	$2,973		$2,973
Planning, Engineering & Design **1/**	$2,990	$74	$3,064
Supervision and Administration	$2,416	$56	$2,472
Subtotal	**$27,012**	**$4,748**	**$31,760**
Cash Contributions	-$3,192	$3,192	
Subtotal	$23,820	$7,940	$31,760
Additional Cash Contributions due to Federal Cost Limit for 205 features **2/**	-$9,239	$9,239	
TOTAL FEATURE COSTS	**$14,581**	**$17,179**	**$31,760**

1/ Based on WRDA 86 cost sharing (25 percent minimum non-Federal costs) as authorized by PL 107-66.

2/ Based on $15 million Federal limit as authorized by Sec 332 of WRDA 99. The Federal limit applies to Federal funds for the Feasibility Report ($419) and the Section 205 Project Features ($14,581)

Section 205 Study Costs	$419	$419	$838

TABLE 7

Bois Brule, Total Project
Federal and Non-Federal Project Cost Allocation
Fully Funded, 1 October 2002 Price Levels

	Federal ($000)	Non-Federal ($000)	Total ($000)
Lands & Damages	$0	$4,524	$4,524
Relocations	$0	$546	$546
Levees and Floodwalls	$31,467	$0	$31,467
Pumping Plants	$4,616	$0	$4,616
Planning, Engineering & Desig	$5,746	$74	$5,820
Supervision and Administratio	$3,971	$56	$4,027
Subtotal	**$45,800**	**$5,200**	**$51,000**
Cash Contributions **1/**	-$3,192	$3,192	
Subtotal	**$42,608**	**$8,392**	**$51,000**
Feasibility Study Costs	$419	$419	$838
Additional Cash Contributions due to Federal Cost Limit for 205 Proj. **2/**	-$9,239	$9,239	
TOTAL PROJECT COSTS	**$33,369**	**$17,631**	**$51,000**

1/ Based on WRDA 86 cost sharing (25 percent minimum non-Federal costs) as authorized by PL 107-66.

2/ Based on $15 million Federal limit as authorized by Sec 332 of WRDA 99. The Federal limit applies to Federal funds for the Feasibility Report ($419) and the Section 205 Project Features ($14,581)

Section 205 Study Costs	$419	$419	$838

TABLE 8

FEDERAL/NON-FEDERAL ALLOCATION OF FUNDS BY FISCAL YEAR

FULLY FUNDED DESIGN DEFICIENCY PROJECT
(1 Oct 2002 Price Levels)

COLUMN	1	2	3	4	5	6
YEAR	TPC[1]	NON-FED LERRD	SCHED. CONST	PERCENT[3]	NON-FED CASH[5]	FED CASH[6]
Prior to first year of construction (FY 04)	$1,052,000	$52,000	$1,000,000 [2]	NA	NA	$1,000,000
FY 04	$3,400,000	$400,000	$3,000,000	NA	NA	$3,000,000
FY 05	$11,000,000	NA	$11,000,000	NA	NA	$11,000,000
FY 06	$3,000,000	NA	$3,000,000	NA	NA	$3,000,000
FY 07	$788,000	NA	$788,000	NA	NA	$788,000
TOTAL	$19,240,000	$452,000	$18,788,000	NA	NA[4]	$18,788,000

[1] Total Project Cost (TPC) = Non-Fed LERRD (Col 2) plus Sched. Const (Col 3).
[2] Represents all "sunk" PED costs.
[3] The percentage is based on the proportion of scheduled construction cost to total construction cost.
[4] Non-Federal cash not required per Federal law.
[5] Non-Federal cash not required per Federal law.
[6] Fed cash = Sched. Const (Col 3) - Non-Fed cash (Col 5).

TABLE 9

FEDERAL/NON-FEDERAL ALLOCATION OF FUNDS BY FISCAL YEAR

FULLY FUNDED SECTION 205 PROJECT
(1 Oct 2002 Price Levels)

COLUMN	1	2	3	4	5	6
YEAR	TPC[1]	NON-FED LERRD	SCHED. CONST	PERCENT	NON-FED CASH[5]	FED CASH[6]
Prior to first year of construc (FY04)	$1,948,000	$448,000	$1,500,000 [2]	NA	NA	$1,500,000
FY 04	$7,100,000	$4,100,000	$3,000,000	16.7%	$2,312,000 [7]	$688,000
FY 05	$9,200,000	$200,000	$9,000,000	33.3%	$5,432,000	$3,568,000
FY 06	$12,000,000	NA	$12,000,000	44.4%	$4,065,000	$7,935,000
FY 07	$1,512,000	NA	$1,512,000	5.6%	$622,000	$890,000
TOTAL	$31,760,000	$4,748,000	$27,012,000	100.0%	$12,431,000 [4]	$14,581,000

[1] Total Project Cost (TPC) = Non-Fed LERRD (Col 2) plus Sched. Const (Col 3).
[2] Represents all "sunk" PED costs.
[3] The percentage is based on the proportion of scheduled construction cost to total construction cost.
[4] Total Non-Fed cash = Project cash contributions + contribution due to Fed Section 205 cap (TABLE
[5] Non-Fed cash based on total Non-Fed cash x percentage (Col. 4).
[6] Fed cash = Sched. Const (Col 3) - Non-Fed cash (Col 5).
[7] Includes proportional Non-Federal share of sunk PED costs.

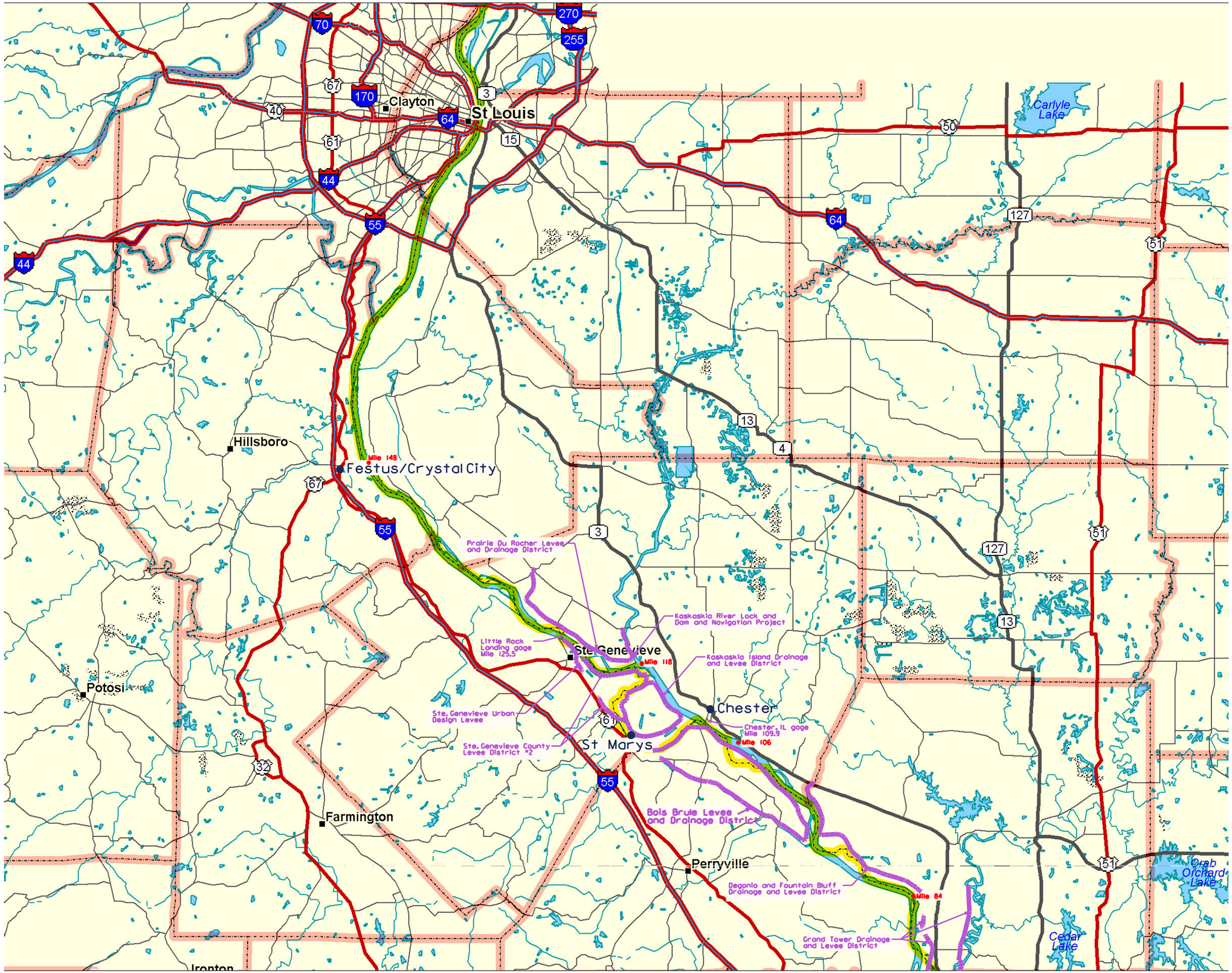
TABLE 10

FEDERAL/NON-FEDERAL ALLOCATION OF FUNDS BY FISCAL YEAR

FULLY FUNDED COMBINED DESIGN DEFICIENCY AND SECTION 205 PROJECT
(1 Oct 2002 Price Levels)

COLUMN	1	2	3	4	5	6
YEAR	TPC[1]	NON-FED LERRD	SCHED. CONST	PERCENT[3]	NON-FED CASH[5]	FED CASH[6]
Prior to first year of construction (FY 04)	$3,000,000	$500,000	$2,500,000 [2]	NA	NA	$2,500,000
FY 04	$10,500,000	$4,500,000	$6,000,000	18.6%	$2,312,000 [7]	$3,688,000
FY 05	$20,200,000	$200,000	$20,000,000	43.7%	$5,432,000	$14,568,000
FY 06	$15,000,000	NA	$15,000,000	32.7%	$4,065,000	$10,935,000
FY 07	$2,300,000	NA	$2,300,000	5.0%	$622,000	$1,678,000
TOTAL	$51,000,000	$5,200,000	$45,800,000	100.0%	$12,431,000 [4]	$33,369,000

[1] Total Project Cost (TPC) = Non-Fed LERRD (Col 2) plus Sched. Const (Col 3).
[2] Represents all "sunk" PED costs.
[3] The percentage is based on the proportion of scheduled construction cost to total construction cost.
[4] Total Non-Fed cash = Project cash contributions + contribution due to Fed Section 205 cap (TABLE 4).
[5] Non-Fed cash based on total Non-Fed cash x percentage (Col. 4).
[6] Fed cash = Sched. Const (Col 3) - Non-Fed cash (Col 5).
[7] Includes proportional Non-Federal share of sunk PED costs.



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

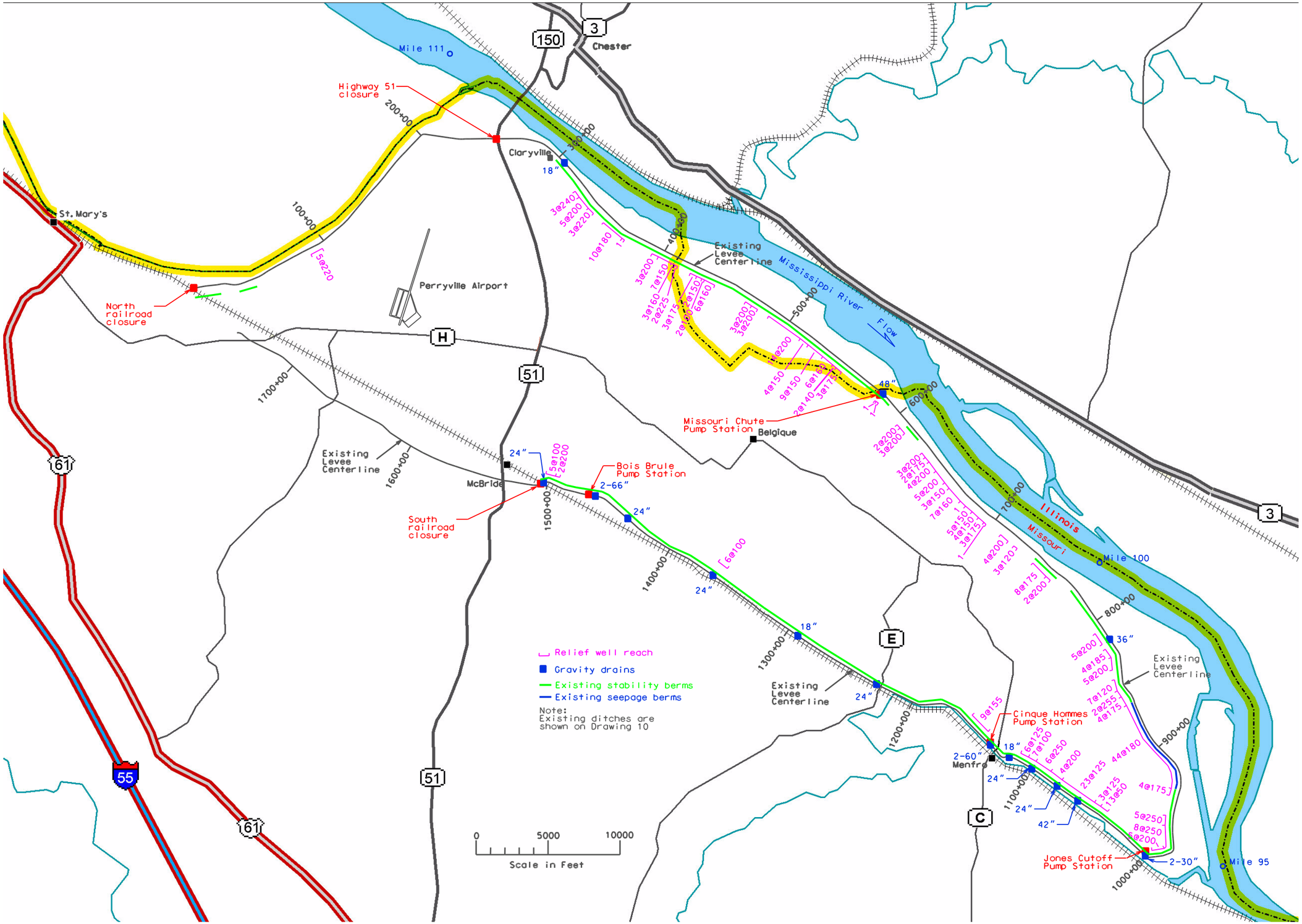
Designed by:
Drawn by: TKM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUGHEY, P.E. Chief, Design Branch
Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: ssDESIGN$FILE$SPECIFICATION$s
Plot date: ssssDATE-TIME$sss
SOL. NO. DACW43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT
VICINITY MAP AND NEARBY LEVEE DISTRICTS

1
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by:
Drawn by: TKM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. NUCKEY, P.E. Chief, Design Branch

Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil/ Specs. Section
File name: ...\DATA\SPECIFICATIONS\BRULE\DMF\BRULE\SPECIFICATIONS
Plot date: sssdDATE-TIMEssss
50.00.DACE43- -B-

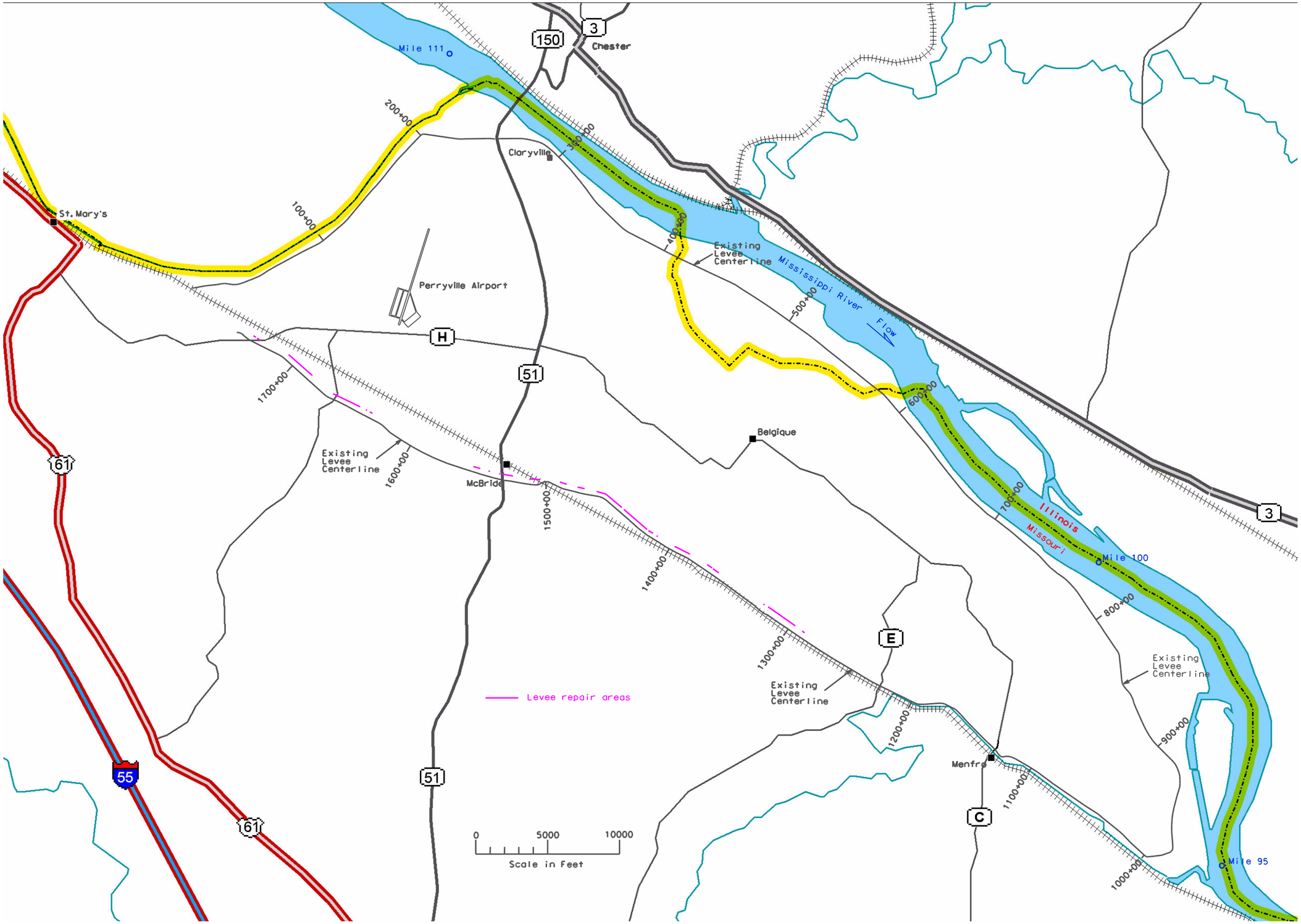
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

EXISTING PROJECT FEATURES

2
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E.
Chief, Civil / Specs. Section
File name: $$$$FILENAME$$$$SPECIFICATIONS
Plot date: $$$$DATE-TIME$$$$

Designed by:
Drawn by: TMM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUCKEY, P.E.
Chief, Design Branch

50.00.DACE43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

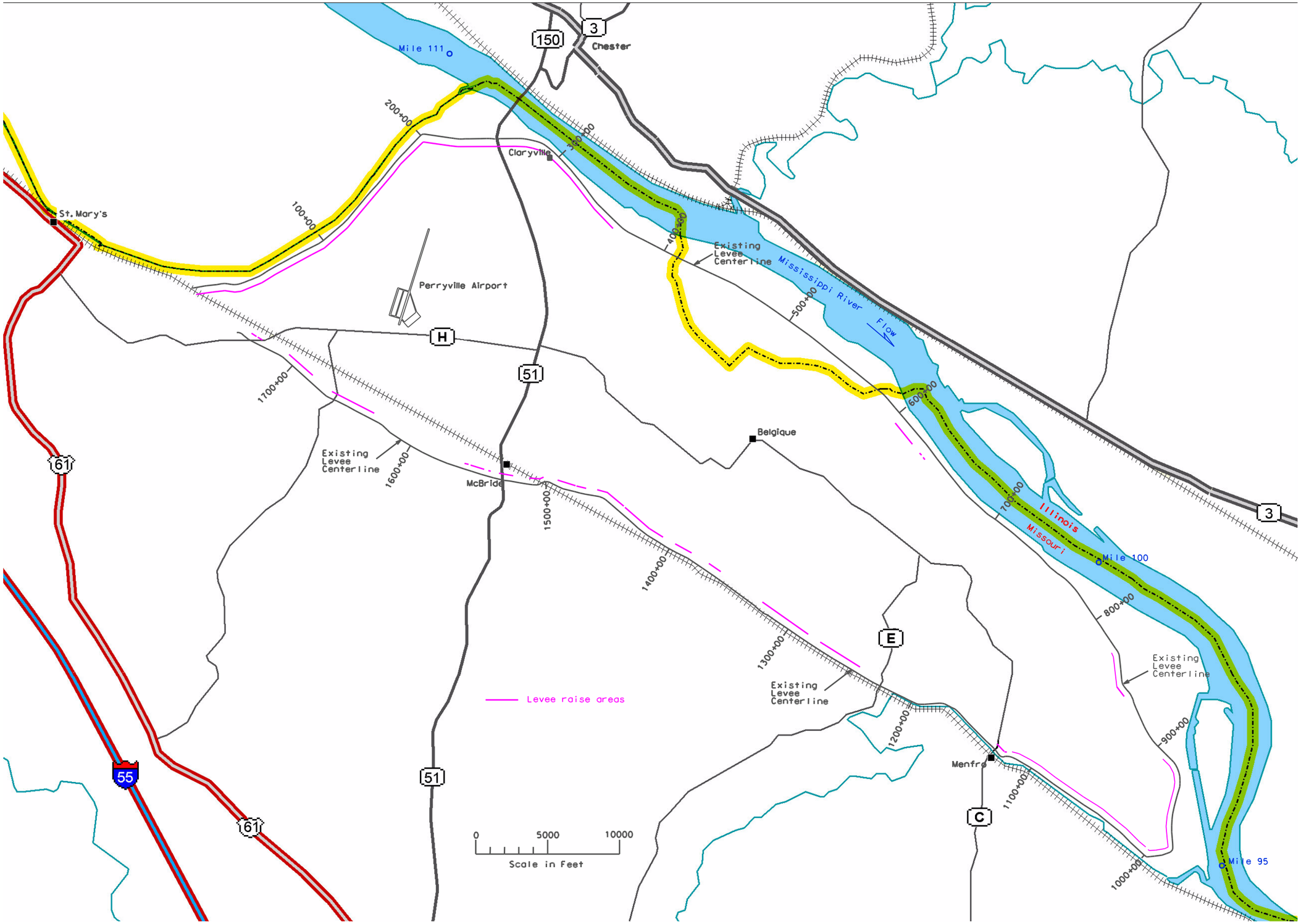
UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

DESIGN DEFICIENCY LEVEE REPAIRS

3

DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

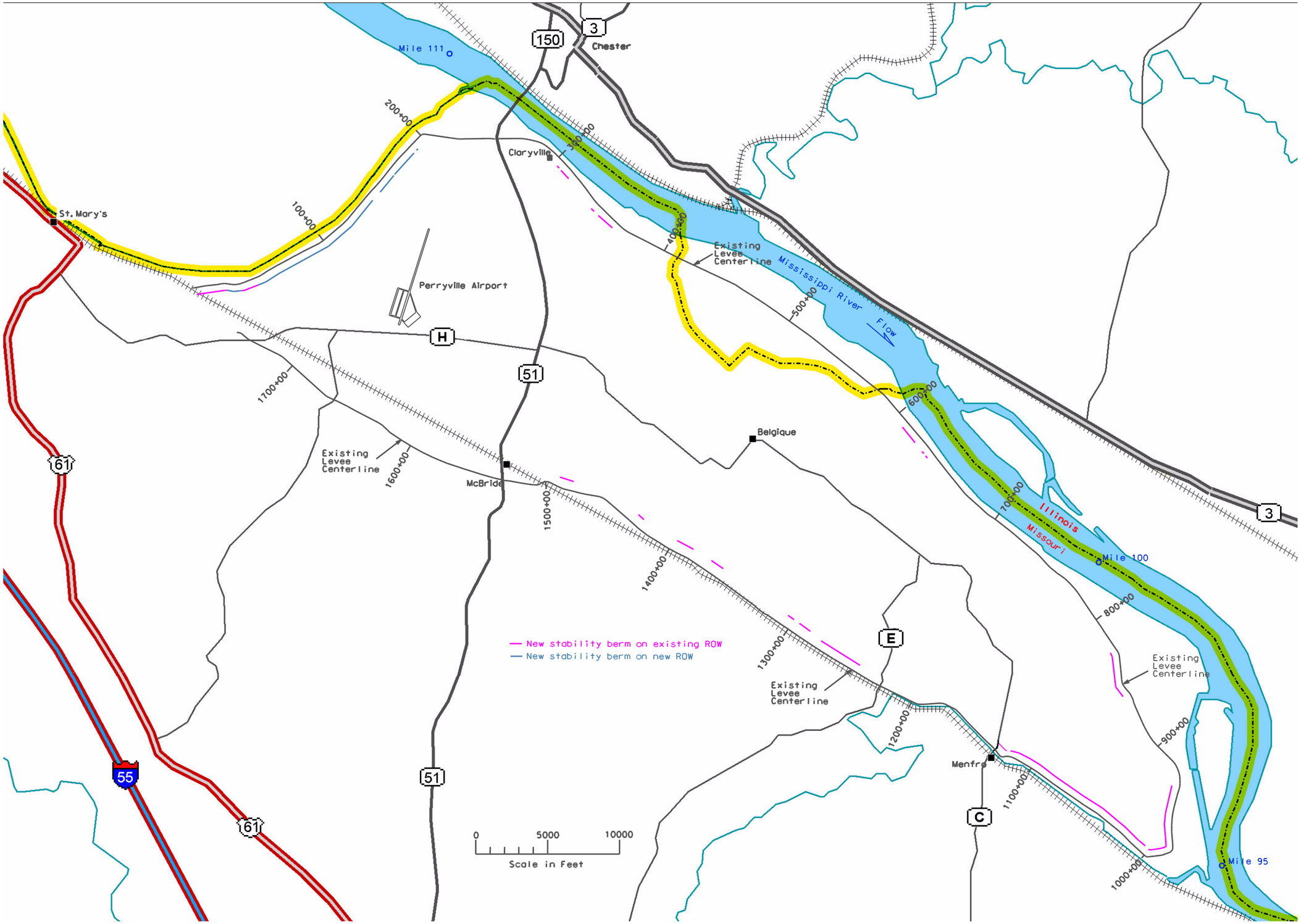
Designed by:
Drawn by: TKM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUGHEY, P.E. Chief, Design Branch
Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: ssDESIGN$FILE$SPECIFICATION$s
Plot date: ssssDATE-TIMEssss
SOL.NO.DACW43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT
100 YR LEVEE RAISE

4
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by:
Drawn by: TMM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUCKEY, P.E. Chief, Design Branch

Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: DMFILE\SPECIFICATIONS
Plot date: $$$$DATE-TIME$$$$
SOL-00.DWG43- -B-

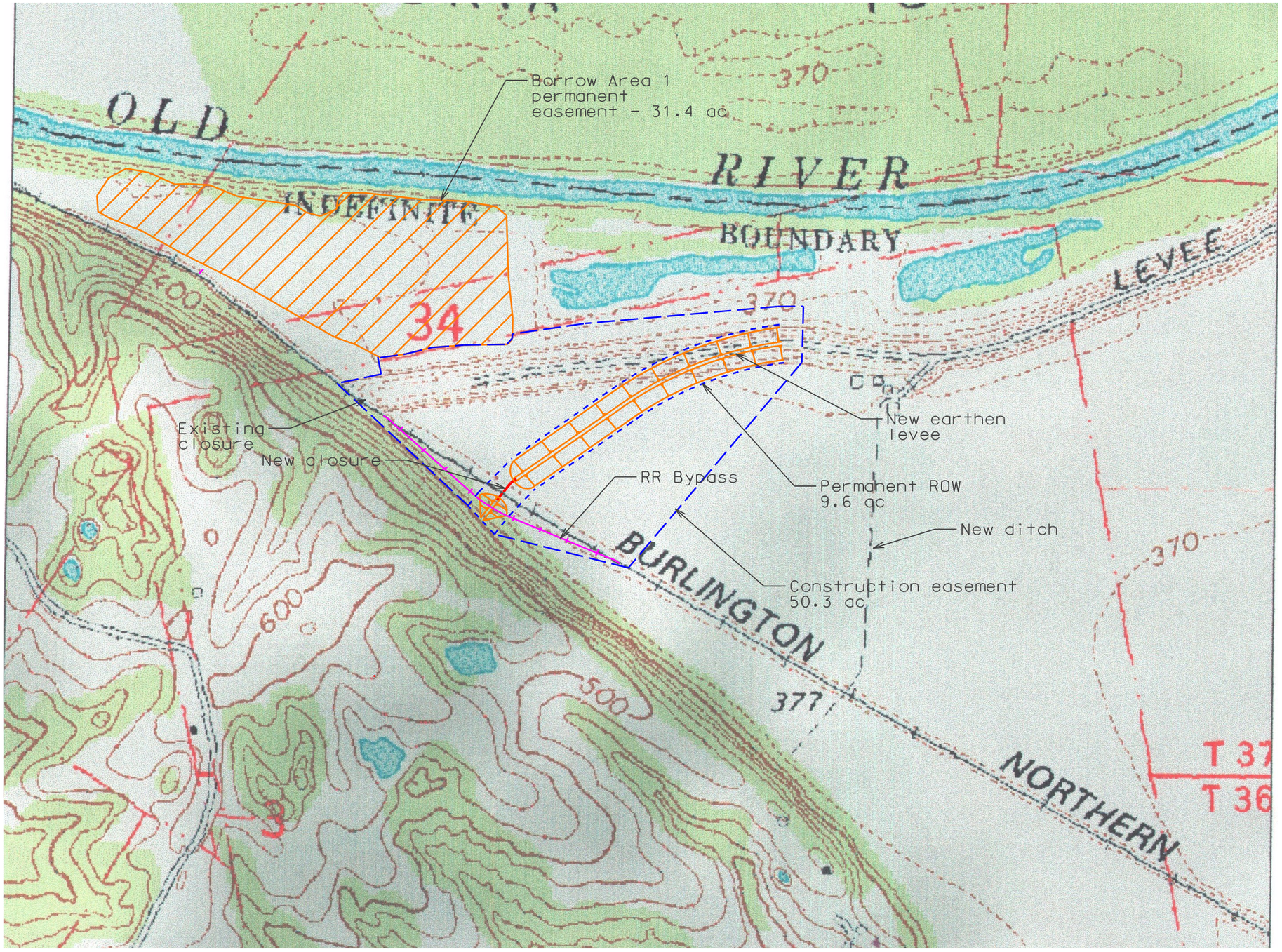
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

NEW STABILITY BERMS,
100 YR PROJECT ONLY

5
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

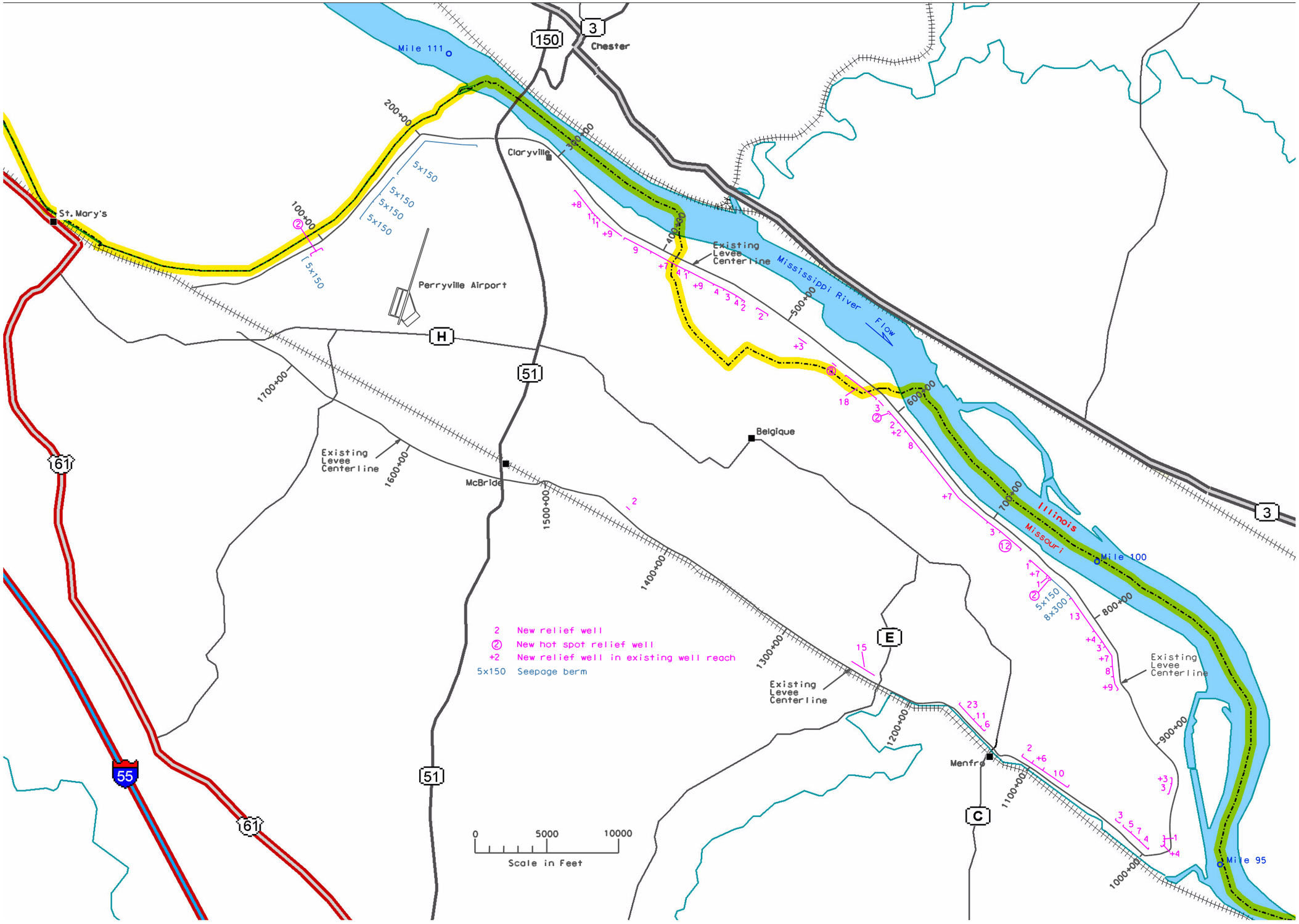
Designed by:
Drawn by: I&M
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUGHEY, P.E. Chief, Design Branch
Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: $$$DESIGN$FILE$SPECIFICATION$$
Plot date: $$$$DATE-TIME$$$$
SOL.NO.DACW43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT
NORTH RAILROAD CLOSURE LAYOUT

6
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by:
Drawn by: Ckd by:
Tsu
Reviewed by:
X
APPROVED:
BOBBY R. HUCHEY, P.E.
Chief, Design Branch

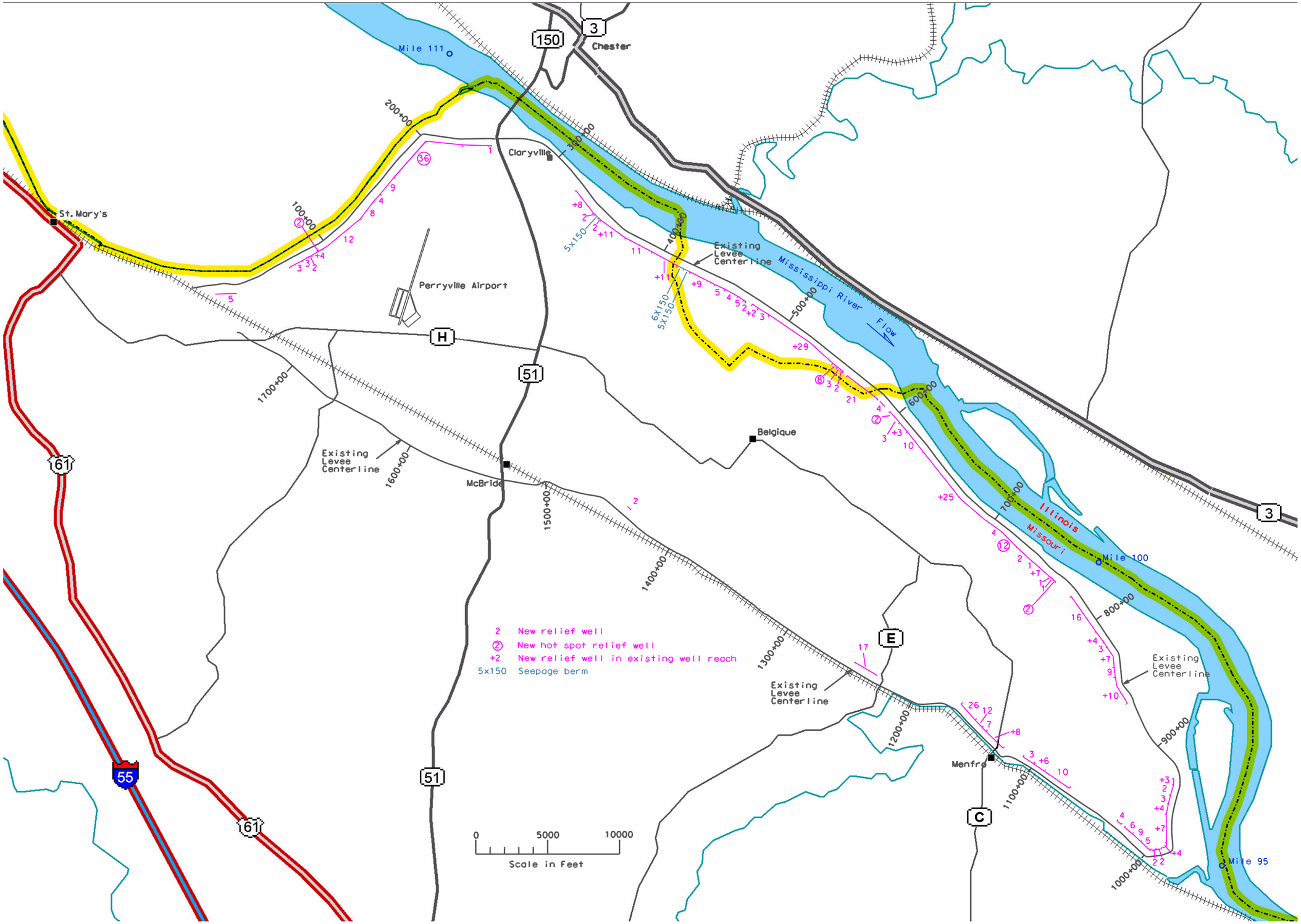
Date: 7 May 2002
SUBMITTED:
MICHAEL R. RECTOR, P.E.
Chief, Civil / Specs. Section
File:
Plot date: $$$$DATE-TIME$$$$
50k.00.DACR43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT
DESIGN DEFICIENCY RELIEF WELLS
AND SEEPAGE BERMS

7
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

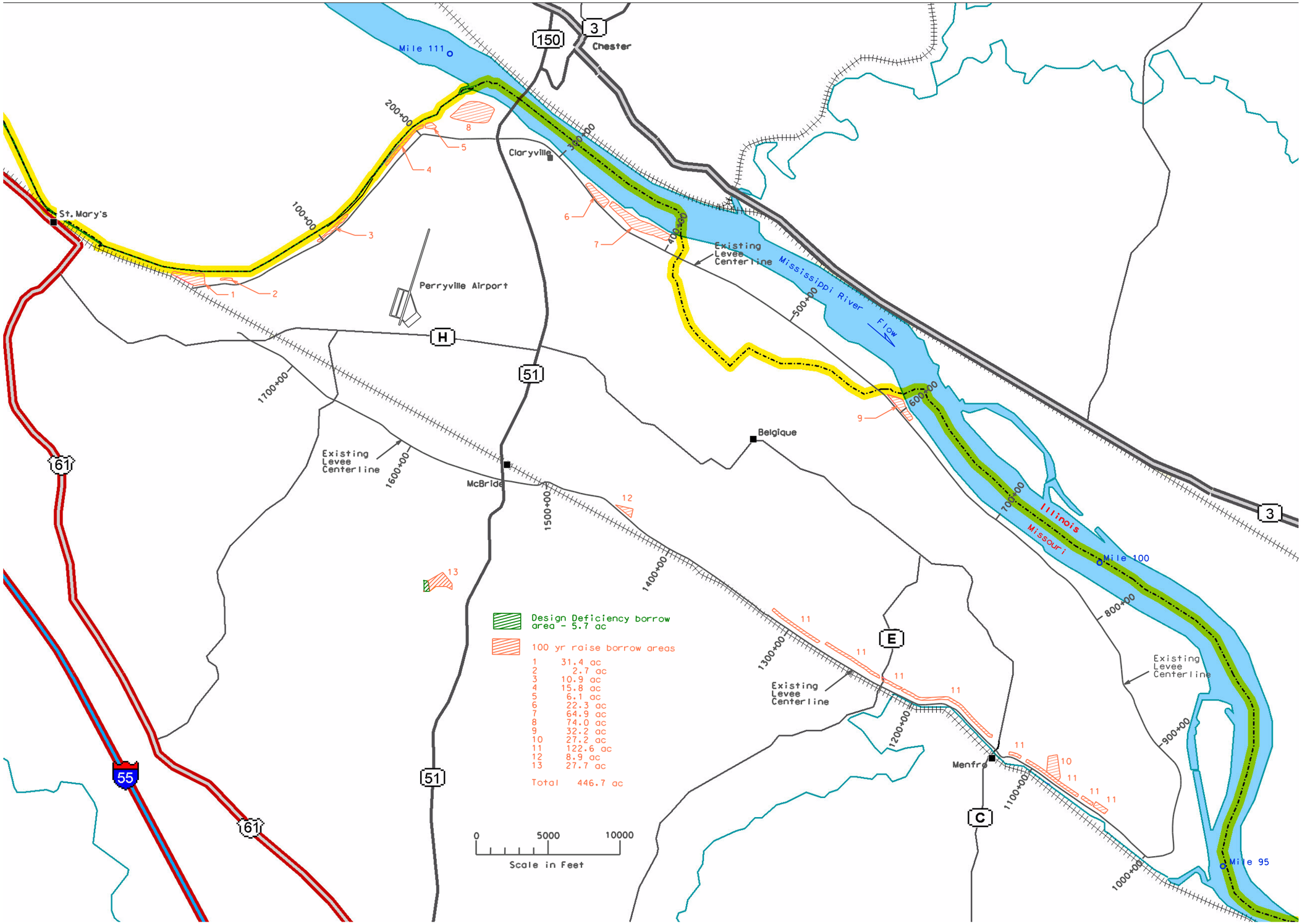
Designed by:
Drawn by: TKM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUGHEY, P.E. Chief, Design Branch
Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: ssDESIGN$FILE$SPECIFICATION$ss
Plot date: ssssDATE-TIMEssss
SOL.NO.DACW43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT
100 YR RELIEF WELLS & SEEPAGE BERMS

8
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by:
Drawn by: TMB
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUCKEY, P.E. Chief, Design Branch

Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: $$$$USERNAME$$$$SPECIFICATIONS
Plot date: $$$$DATE-TIME$$$$
50k.00.DACR43- -B-

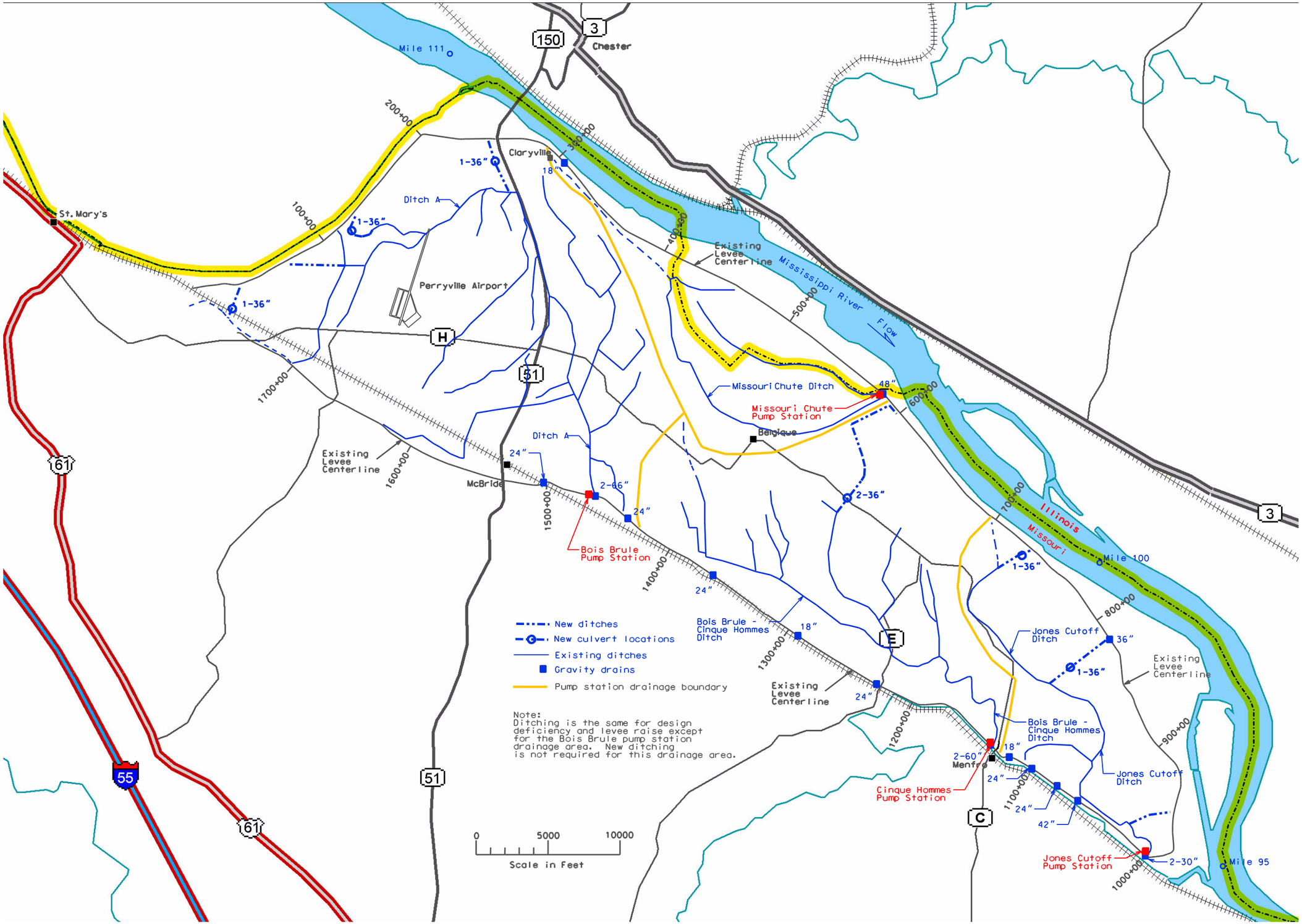
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

BORROW AREAS

9
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil/ Specs. Section
File name: ...\DESIGNFILE\SPECIFICATIONS
Plot date: sssDATE-TIMEssss

Designed by:
Drawn by: TM
Ckd by:
Reviewed by: X
APPROVED: BOBBY R. HUCKEY, P.E. Chief, Design Branch
50.00.DACE43- -B-

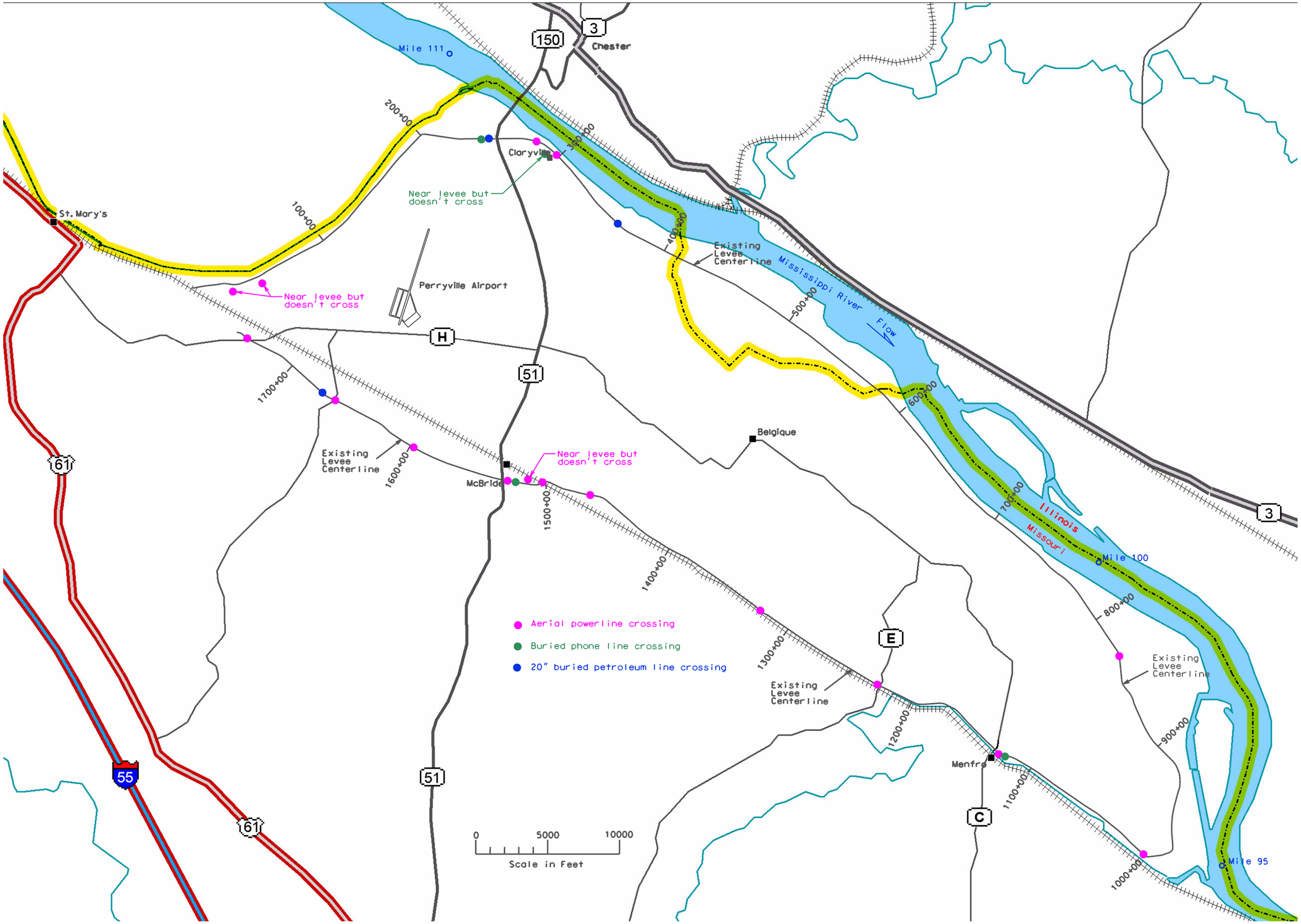
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

DITCHING

10
DRAWING NUMBER



US Army Corps of Engineers
ST. LOUIS DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by:
Drawn by: TMM
Ckd by:
Reviewed by: X
Date: 7 May 2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: ssssDATE-TIMEssss
Plot date: ssssDATE-TIMEssss
APPROVED: BOBBY R. HUCKEY, P.E. Chief, Design Branch
50k.00.DACR43- -B-

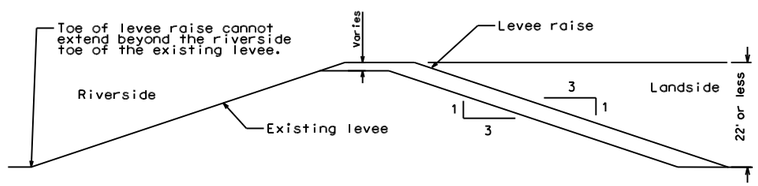
U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

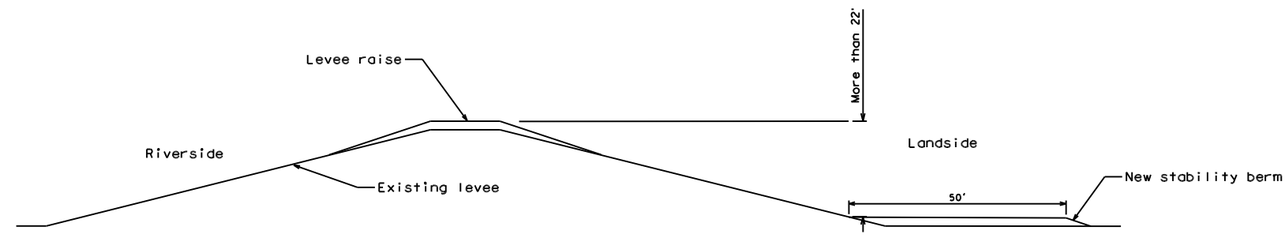
DESIGN DEFICIENCY/FEASIBILITY REPORT

EXISTING UTILITIES

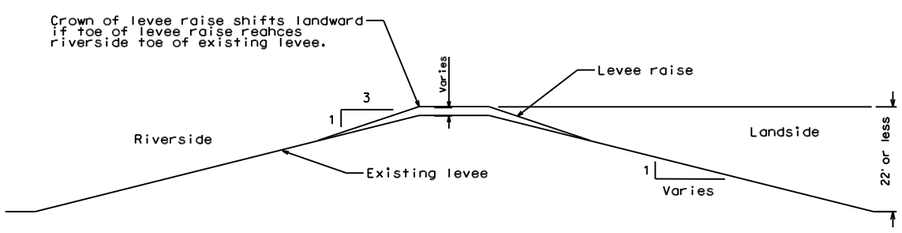
11
DRAWING NUMBER



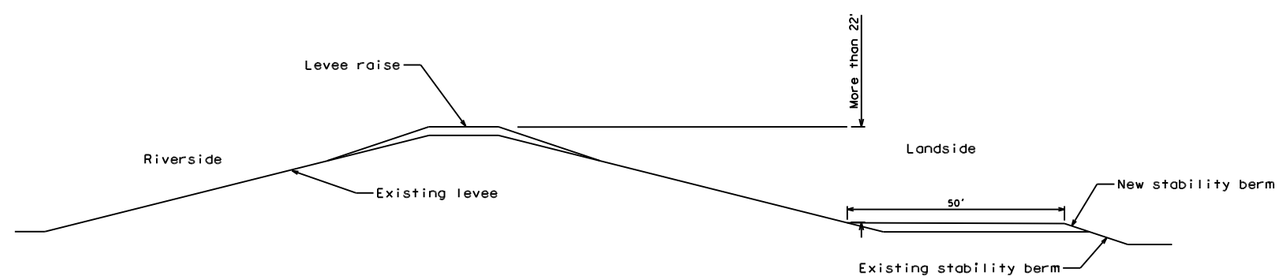
Levee raise - 1 on 3 existing levee slope



New stability berm on existing ground



Levee raise - less than 1 on 3 existing levee slope



New stability berm on existing stability berm

US Army Corps of Engineers
ST.LOUIS_DISTRICT

Symbol	Description	Date	Appr.
	Revisions		

Designed by: ----------
Drawn by: TKM
Ckd by: ----------
Reviewed by: X
APPROVED: BOBBY R. HUGHEY, P.E. Chief, Design Branch
Date: 7_May_2002
SUBMITTED: MICHAEL R. RECTOR, P.E. Chief, Civil / Specs. Section
File name: ssDESIGN$FILE$SPECIFICATION$s
Plot date: ssssDATE-TIME$sss
SOL.NO.DACW43- -B-

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN
BOIS BRULE LEVEE DISTRICT

DESIGN DEFICIENCY/FEASIBILITY REPORT

100 YR RAISE - TYPICAL SECTIONS

12

DRAWING NUMBER

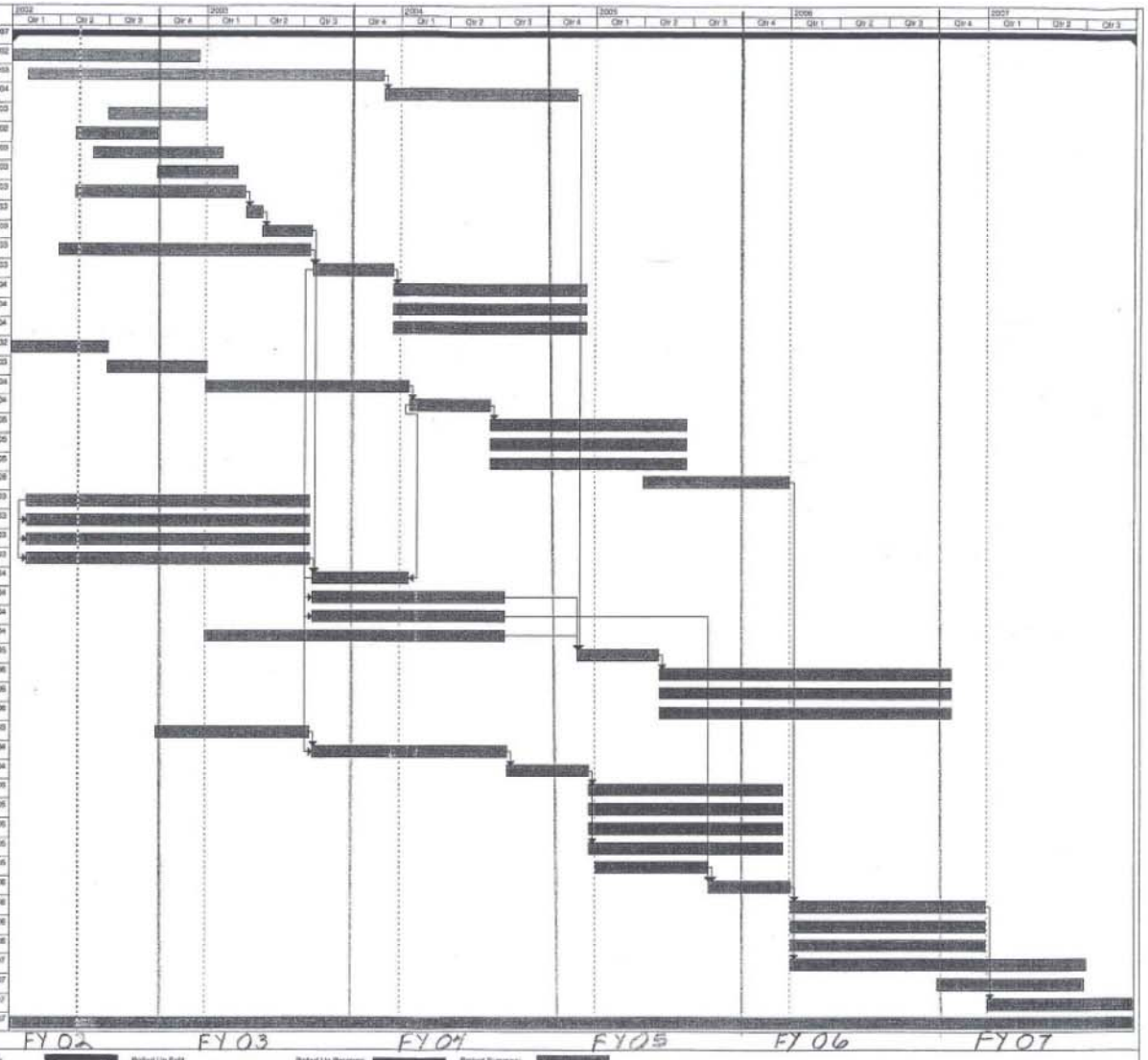
ID	Task Name	Duration	Start	Finish
1	**BOIS BRULE DESIGN DEFICIENCY PROJECT - JIM ZEREGA**	**1366 days**	**Thu 1/3/02**	**Thu 3/29/07**
2	COMBINED DESIGN DEFICIENCY/DETAILED PROJECT REPORT	249 days	Thu 1/3/02	Tue 12/17/02
3	PROJECT MANAGEMENT PLAN	133 days	Mon 7/1/02	Wed 1/1/03
4	SECTION 404 PERMIT	110 days	Wed 5/1/02	Tue 10/1/02
5	SPONSOR DEVELOPS FINANCING PLAN	175 days	Mon 6/3/02	Sat 2/1/03
6	CORPS REVIEWS/APPROVES FINC. PLAN	109 days	Tue 10/1/02	Sat 3/1/03
7	DEVELOP PROJECT COOP. AGREEMENT PKG	228 days	Wed 5/1/02	Sat 3/15/03
8	PROJ. COOP AGREEMENT PKG IN MVD	23 days	Mon 3/17/03	Wed 4/16/03
9	PROJ COOP AGRMNT APPROVED HQ/SIGNED	67 days	Thu 4/17/03	Fri 7/18/03
10	PLANS & SPECS FOR RELIEF WELLS #1/ROW CERT.	337 days	Mon 4/1/02	Tue 7/15/03
11	ADVERTISE & AWARD RELIEF WELLS #1 CONTRACT	109 days	Mon 7/21/03	Thu 12/18/03
12	CONSTRUCT RELIEF WELLS #1	259 days	Fri 12/19/03	Wed 12/15/04
13	RELIEF WELLS #1 CONSTRUCTION MANAGEMENT	259 days	Fri 12/19/03	Wed 12/15/04
14	RELIEF WELLS #1 ENGR DURING CONSTRUCTION	259 days	Fri 12/19/03	Wed 12/15/04
15	SURVEYS AND MAPPING	128 days	Thu 1/3/02	Mon 7/1/02
16	INTERIOR DRAINAGE ANALYSIS	136 days	Mon 7/1/02	Sat 1/4/03
17	PLANS & SPECS FOR PUMP STATIONS	273 days	Wed 1/1/03	Fri 1/16/04
18	ADVERTISE & AWARD PUMP STA. CONTRACT	109 days	Mon 1/19/04	Thu 6/17/04
19	CONSTRUCT PUMP STATIONS	262 days	Fri 6/18/04	Mon 6/20/05
20	PUMP STATION CONSTRUCTION MANAGEMENT	262 days	Fri 6/18/04	Mon 6/20/05
21	PUMP STATION ENGR DURING CONSTRUCTION	262 days	Fri 6/18/04	Mon 6/20/05
22	PUMP STATION OMRRR MANUAL & AS-BUILTS	196 days	Fri 4/1/05	Sun 1/1/06
23	DEV. ROW & UTILITY &ROAD RELO DWGS EMBANK & DITCHING	378 days	Fri 2/1/02	Tue 7/15/03
24	DEV ROW & UTILITY DRWNGS RELIEF WELLS #2	378 days	Fri 2/1/02	Tue 7/15/03
25	DEV. ROW & UTILITY DRAWINGS PUMP STA.	378 days	Fri 2/1/02	Tue 7/15/03
26	DEV ROW & UTILITY DRWNGS NORTH & SOUTH RR CLOSURES	378 days	Fri 2/1/02	Tue 7/15/03
27	SPONSOR ACQUIRE ROW/DO RELOS/PUMP STATIONS	130 days	Mon 7/21/03	Fri 1/16/04
28	SPONSOR ACQUIRE ROW, DO RELOS/EMBANKMENT & DITCH	359 days	Mon 7/21/03	Thu 7/15/04
29	SPONSOR ACQUIRE ROW, DO RELOS/RELIEF WELL 2	359 days	Mon 7/21/03	Thu 7/15/04
30	PLANS & SPECS FOR EMBANKMENT & DITCHING CONTRACT	402 days	Wed 1/1/03	Thu 7/15/04
31	ADVERTISE & AWARD EMBANKMENT & DITCHING CONTRACT	110 days	Fri 7/16/04	Thu 12/16/04
32	CONSTRUCT EMBANKMENT & DITCHING	275 days	Fri 12/17/04	Thu 1/5/06
33	EMBANKMENT & DITCHING CONSTRUCTION MANAGEMENT	275 days	Fri 12/17/04	Thu 1/5/06
34	EMBANKMENT & DITCHING ENGR DURING CONSTRUCTION	275 days	Fri 12/17/04	Thu 1/5/06
35	PLANS & SPECS FOR RELIEF WELLS #2 & PIEZOMETERS	151 days	Thu 12/18/03	Thu 7/15/04
36	ADVERTISE & AWARD RELIEF WELLS #2 & PIEZOMETERS	110 days	Fri 7/16/04	Thu 12/16/04
37	CONSTRUCT RELIEF WELLS #2 & PIEZOMETERS	280 days	Fri 12/17/04	Thu 1/12/06
38	RELIEF WELLS #2 & PIEZOMETERS CONSTRUCTION MANAGEMEN	280 days	Fri 12/17/04	Thu 1/12/06
39	RELIEF WELLS #2 & PIEZOMETERS ENGR DURING CONSTRUCTIO	280 days	Fri 12/17/04	Thu 1/12/06
40	LEVEE OMRRR MANUAL & AS-BUILTS	326 days	Fri 4/1/05	Fri 6/30/06
41	AUDIT SPONSOR'S LERRDS COSTS	195 days	Wed 2/1/06	Tue 10/31/06
42	FINANCIAL CLOSEOUT	154 days	Mon 7/3/06	Thu 3/29/07
43	PROJECT MANAGEMENT	1366 days	Thu 1/3/02	Thu 3/29/07

BOIS BRULE PROJECT
Tue 5/7/02

Task | Split | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Split | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary

SCHEDULE 1

ID	Task Name	Duration	Start	Finish
1	**BOIS BRULE COMBINED PROJECT - JIM ZEREGA**	**1487 days**	**Thu 1/3/02**	**Sun 9/30/07**
2	COMBINED DESIGN DEF/DETAILED PROJ RPT	348 days	Thu 1/3/02	Tue 12/17/02
3	BETTER DEFINE INDUCED FLOODING, EXTENT OF AND COST	476 days	Fri 2/1/02	Fri 11/28/03
4	SPONSOR PAYS AFFECTED INTERESTS FOR INDUCED FLOODING	280 days	Mon 12/1/03	Fri 11/26/04
5	PROJECT MANAGEMENT PLAN	133 days	Mon 7/1/02	Wed 1/1/03
6	SECTION 404 PERMIT	110 days	Wed 5/1/02	Tue 10/1/02
7	SPONSOR DEVELOPS FINANCING PLAN	175 days	Mon 6/3/02	Sat 3/1/03
8	CORPS REVIEWS/APPROVES FINC. PLAN	109 days	Tue 10/1/02	Sat 3/1/03
9	DEVELOP PROJECT COOP. AGREEMENT PKG	228 days	Wed 5/1/02	Sat 3/15/03
10	PROJ. COOP AGREEMENT PKG IN MVD	23 days	Mon 3/17/03	Wed 4/16/03
11	PROJ COOP AGRMNT APPROVED HQ/SIGNED	67 days	Thu 4/17/03	Fri 7/11/03
12	PLANS & SPECS FOR RELIEF WELLS #1/ROW CERT.	337 days	Mon 4/1/02	Tue 7/15/03
13	ADVERTISE & AWARD RELIEF WELLS #1 CONTRACT	109 days	Mon 7/21/03	Thu 12/18/03
14	CONSTRUCT RELIEF WELLS #1	259 days	Fri 12/19/03	Wed 12/15/04
15	RELIEF WELLS #1 CONSTRUCTION MANAGEMENT	259 days	Fri 12/19/03	Wed 12/15/04
16	RELIEF WELLS #1 ENGR DURING CONSTRUCTION	259 days	Fri 12/19/03	Wed 12/15/04
17	SURVEYS AND MAPPING	125 days	Thu 1/3/02	Mon 7/1/02
18	INTERIOR DRAINAGE ANALYSIS	135 days	Mon 7/1/02	Sat 1/4/03
19	PLANS & SPECS FOR PUMP STATIONS	273 days	Wed 1/1/03	Fri 1/16/04
20	ADVERTISE & AWARD PUMP STA. CONTRACT	109 days	Mon 1/19/04	Thu 6/17/04
21	CONSTRUCT PUMP STATIONS	262 days	Fri 6/18/04	Mon 6/20/05
22	PUMP STATIONS CONSTRUCTION MANAGEMENT	262 days	Fri 6/18/04	Mon 6/20/05
23	PUMP STATIONS ENGR DURING CONSTRUCTION	262 days	Fri 6/18/04	Mon 6/20/05
24	PUMP STATION OMRRR MANUAL & AS-BUILTS	195 days	Fri 4/1/05	Sun 1/1/06
25	DEV. ROW & UTILITY &ROAD RELO DWGS EMBANKMENT & DITCHING	376 days	Fri 2/1/02	Tue 7/15/03
26	DEV ROW & UTILITY DRAWGS RELIEF WELLS #2	376 days	Fri 2/1/02	Tue 7/15/03
27	DEV. ROW & UTILITY DRAWINGS PUMP STA.	376 days	Fri 2/1/02	Tue 7/15/03
28	DEV. ROW & UTILITY DRAWGS NORTH & SOUTH RR CLOSURES	376 days	Fri 2/1/02	Tue 7/15/03
29	SPONSOR ACQUIRE ROW/OD RELOS/PUMP STATIONS	130 days	Mon 7/21/03	Mon 1/19/04
30	SPONSOR ACQUIRE ROW, DO RELOS/EMBANKMENT & DITCHING	259 days	Mon 7/21/03	Thu 7/15/04
31	SPONSOR ACQUIRE ROW, DO RELOS/RELIEF WELL 2	259 days	Mon 7/21/03	Thu 7/15/04
32	PLANS & SPECS FOR EMBANKMENT & DITCHING CONTRACT	402 days	Wed 1/1/03	Thu 7/15/04
33	ADVERTISE & AWARD EMBANKMENT & DITCHING CONTRACT	110 days	Mon 11/29/04	Fri 4/29/05
34	CONSTRUCT EMBANKMENT & DITCHING	380 days	Mon 5/2/05	Fri 10/27/06
35	EMBANKMENT & DITCHING CONSTRUCTION MANAGEMENT	380 days	Mon 5/2/05	Fri 10/27/06
36	EMBANKMENT & DITCHING ENGR DURING CONSTRUCTION	380 days	Mon 5/2/05	Fri 10/27/06
37	PLANS & SPECS NEW NORTH RR CLOSURE	206 days	Tue 10/1/02	Tue 7/15/03
38	SPONSOR ACQUIRE ROW RR AGMT RELO NORTH RR CLOSURE	261 days	Mon 7/21/03	Mon 7/18/04
39	ADVERTISE & AWARD NORTH RR CLOSURE	110 days	Tue 7/20/04	Mon 12/20/04
40	CONSTRUCT NEW NORTH RR CLOSURE	260 days	Tue 12/21/04	Mon 12/18/05
41	NORTH RR CLOSURE STRUCTURE CONSTRUCTION MANAGEMENT	260 days	Tue 12/21/04	Mon 12/18/05
42	NORTH RR CLOSURE ENGR DURING CONSTRUCTION	260 days	Tue 12/21/04	Mon 12/18/05
43	SPONSOR PAY FOR RR RELO NORTH CLOSURE STRUCTURE	260 days	Tue 12/21/04	Mon 12/18/05
44	PLANS & SPECS FOR RELIEF WELLS #2 & PIEZOMETERS	151 days	Mon 1/3/05	Mon 8/1/05
45	ADVERTISE & AWARD RELIEF WELLS #2 CONTRACT & PIEZOMETERS	110 days	Tue 8/2/05	Mon 1/2/06
46	CONSTRUCT RELIEF WELLS #2 & PIEZOMETERS	259 days	Tue 1/3/06	Sat 12/30/06
47	RELIEF WELLS #2 & PIEZOMETERS CONSTRUCTION MANAGEMENT	259 days	Tue 1/3/06	Fri 12/29/06
48	RELIEF WELLS #2 & PIEZOMETERS ENGR DURING CONSTRUCTION	259 days	Tue 1/3/06	Fri 12/29/06
49	LEVEE OMRRR MANUAL & AS-BUILTS	392 days	Mon 1/2/06	Tue 7/3/07
50	AUDIT SPONSOR'S LERRDS COSTS	195 days	Mon 10/2/06	Fri 6/29/07
51	FINANCIAL CLOSEOUT	194 days	Tue 1/2/07	Sun 9/30/07
52	PROJECT MANAGEMENT	1487 days	Thu 1/3/02	Fri 9/28/07



BOIS BRULE PROJECT
Tue 5/7/02

Task | Split | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Split | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary

SCHEDULE 2

DRAFT

ENVIRONMENTAL ASSESSMENT
WITH
FINDING OF NO SIGNIFICANT IMPACT

BOIS BRULE

DESIGN DEFICIENCY AND LEVEE RAISE PROJECTS

PERRY COUNTY, MISSOURI, AND RANDOLPH COUNTY, ILLINOIS

U.S. Army Corps of Engineers
St. Louis District
Environmental Analysis Branch (CEMVS-PM-E)
1222 Spruce Street
St. Louis, Missouri 63103-2833
Commercial Telephone Number: (314) 331-8148

October 2002

DRAFT ENVIRONMENTAL ASSESSMENT
BOIS BRULE DESIGN DEFICIENCY AND LEVEE RAISE PROJECTS
PERRY COUNTY, MISSOURI, AND RANDOLPH COUNTY, ILLINOIS

TABLE OF CONTENTS

Section Page

I. INTRODUCTION....EA-1
A. Project Location....EA-1
B. Purpose of Proposed Project....EA-1

II. PROJECT AUTHORIZATION....EA-1

III. ALTERNATIVE PLANS....EA-1

IV. PROJECT DESCRIPTION....EA-1

V. DESCRIPTION OF RESOURCES....EA-4
A. Topography, Geology, and Soils....EA-4
B. Cultural Resources....EA-4
C. Prime Farmland....EA-4
D. Wetlands/Aquatic Resources....EA-4
E. Water Quality....EA-5
F. Threatened and Endangered Species....EA-5
G. Terrestrial Resources....EA-5
H. Aesthetics....EA-5
I. Socio-Economic Resources....EA-5

VI. ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES....EA-6
No Federal Project....EA-6
Levee Raise With Other Improvements....EA-6
A. Topography, Geology, and Soils....EA-6
B. Cultural Resources....EA-6
C. Prime Farmland....EA-7
D. Wetlands/Aquatic Resources....EA-7
E. Water Quality....EA-8
F. Threatened and Endangered Species....EA-8
G. Terrestrial Resources....EA-9
H. Aesthetics....EA-9
I. Socio-Economic Resources....EA-9

VII. RELATIONSHIP OF PREFERRED PLAN TO ENVIRONMENTAL REQUIREMENTS....EA-10

VIII. ISSUES AND CONCERNS....EA-11
A. Floodplain Management....EA-13
B. 404 Evaluation and 401 State Certification....EA-13
C. Hazardous and Toxic Wastes....EA-13
D. Induced Flooding....EA-13

IX. LITERATURE CITED....EA-14

X. ENVIRONMENTAL ASSESSMENT PREPARERS....EA-15

XI. COORDINATION, PUBLIC VIEWS, AND RESPONSES....EA-15

APPENDIX

Finding of No Significant Impact.....EA-17

TABLE

TABLE **Page**

EA-1 Boise Brule Levee and Drainage District's Levee sections that will be raised to provide 100-year protection.....EA-2

EA-2 Bois Brule Levee Raise Project borrow site dimensions.....EA-2

EA-3 Relationship and compliance status of recommended plan to environmental requirements.....EA-10

DRAFT ENVIRONMENTAL ASSESSMENT
BOIS BRULE DESIGN DEFICIENCY AND LEVEE RAISE PROJECTS
PERRY COUNTY, MISSOURI, AND RANDOLPH COUNTY, ILLINOIS

I. INTRODUCTION

A. Project Location. Bois Brule Levee and Drainage District is located in Perry County, Missouri, and Randolph County, Illinois, on the right bank of the Mississippi River between River Miles 91 and 110 above the Ohio River. The nearest major cities are St. Louis, Missouri approximately 77 miles to the north and Cape Girardeau, Missouri, approximately 44 miles to the south. The District is bounded on the north and east by the Mississippi River, on the south and west by the Bois Brule Creek and Cinque Holmes Creek and on the northwest by the Old River channel. The Bois Brule levee is 33.1 miles in length and protects approximately 26,000 acres of highly productive, intensely farmed row crop operations within the Levee District. The village of McBride is located within the boundaries of the District.

B. Purpose of Proposed Project. The purpose of the authorized Bois Brule flood control project is to correct design deficiencies and restore the Bois Brule levee system to the 50-year level of protection, and to raise the level of protection to 100-year.

II. PROJECT AUTHORIZATION

The design deficiency component of the project falls within the purview of the original project authorization because it meets the criteria specified in Engineering Regulation 1165-2-119 regarding a design or construction deficiency. The Bois Brule flood control project was originally authorized and constructed under the authority of the Flood Control Act of 1936. In addition, the Energy and Water Development Appropriations Act of 2002 authorized the design deficiency and the 100-year components.

III. ALTERNATIVE PLANS

The Energy and Water Development Appropriations Act of 2002 directs the Corps of Engineers to undertake the design deficiency repairs and increase the level of protection for the levee district to 100-year. Included in this effort is the consideration of alternative plans focused on finding the least cost plan to meet the requirements of the law. A levee raise with a uniform 2 feet of free board was considered, but a levee with 3 feet of freeboard at the north end tapering to 2 feet at the south end was selected so the levee would not overtop at the upstream end. Alternative replacements were considered for the railroad closure structure at the northwest end of the levee. Two measures to control underseepage were considered, relief wells and seepage berms, with the cost comparison including measures to handle increased interior flows, new pump stations and ditches.

IV. PROJECT DESCRIPTION

The authorized project includes several measures that combine to correct the design deficiency and raise the level of protection to 100-year. The design deficiency option merely restores the levee as originally authorized and as it existed until the 1993 failure, and as it has existed since the levee was repaired following the 1993 flood. Additional relief wells, seepage berms and pump stations are proposed to bring the levee back

to a 50-year level of protection. The section 205 option would raise the levee to a 100-year level of protection by; raising the height of the levee where needed, installing a larger number of relief wells than required by the design deficiency option, increasing pumping capacity, and improving interior drainage. Borrow is required as detailed in the report from as many as 13 possible sites. In addition, easements will be required to improve interior drainage and provide stability berms, and for additional relief wells. The 205 option would also cause induced flooding and allow for additional development in the floodplain. All of the latter two impacts have not been quantified, but are expected to be controversial and in violation of Corps policy and an executive order. The 205 option incorporates measures needed to implement the design deficiency option. The impact of the "no project" option is that the levee will fail again, due to underseepage, at a lower than 50-year level of protection. Public health and safety issues are associated with this option.

The levee reaches that will be raised are listed in Table EA-1 and depicted in Drawing 4 of the main report. The higher levee will require interior stability berms along much of its length. Borrow material will come from 13 borrow sites and total about 2.4 million cubic yards. The approximate size, depth and capacity of the borrow sites are listed in Table EA-2 and their locations depicted in Drawing 9 of the main report. Site 13 contains over-burden to be removed from a quarry located just west of the levee district on high ground. In addition to the levee raise, one railroad closure structure located at Station 00+00 will be replaced. The current closure structure across Highway 51 will be removed and the highway raised up and over the new levee. The Missouri Department of Transportation will do the Highway 51 work.

Table EA-1. Boise Brule Levee and Drainage District's Levee sections to be raised to provide 100-year protection.

	Station Limits	Length (feet)
1	00+00 to 360+00	36,000
2	605+00 to 625+00	2,000
3	630+00 to 640+00	1,000
4	820+00 to 857+00	3,700
5	906+00 to 1325+00	41,900
6	1362+00 to 1372+00	1,000
7	1384+00 to1397+00	1,300
8	1407+00 to 1559+00	15,000
9	1634+00 to 1666+00	3,200
10	1684+00 to 1707+00	2,300

Table EA-2. Bois Brule Levee Raise Project borrow site dimensions.

Borrow Area	Size (acres)	Depth (feet)	Volume (cubic yards)
1	31.40	4	197,540
2	2.70	4	15,702
3	10.90	4	65,097
4	15.80	4	95,010

Borrow Area	Size (acres)	Depth (feet)	Volume (cubic yards)
5	6.10	4	37,652
6	22.30	4	139,636
7	64.90	4	409,993
8	74.00	4	471,047
9	32.20	4	203,047
10	27.20	4	171,444
11	122.60	4	741,461
12	8.90	4	54,537
13	27.70	8	430,000
Total	446.70	-	3,032,166

The Bois Brule Levee and Drainage District levee failed during the 1993 flood due to underseepage as a result of a deficiency in the original levee design. Underseepage occurs where the levee is constructed on a clay blanket that covers a sandy or gravelly aquifer and an adjacent river channel provides a hydraulic connection to the underlying aquifer. This stratigraphy is present in much of the Bois Brule Levee and Drainage District. When flooding occurs, river water flows into the aquifer to the point of complete saturation. When the floodwaters are higher than the landside ground surface, the water in the aquifer, under pressure from the river, exerts an upward pressure on the bottom of the clay blanket. This causes water from the aquifer to seep upward into the clay blanket and, over time, may cause water to seep through the blanket and appear on the landside of the levee. Excessive seepage will manifest itself with sand boils, and "piping" of the material from under the levee and may cause the levee to collapse. Relief wells and/or seepage berms are commonly used to control underseepage. A relief well allows groundwater to flow out of the aquifer thereby reducing the pressure within, and resulting in a reduction in seepage through the landside clay blanket, thus preserving the integrity of the blanket. Increased flows out of the wells into the interior of the levee are pumped out through a pump station. Seepage berms increase weight at the landside levee toe, providing more resistance to the upward seepage pressures. Consequently, seepage berms reduce the requirement for increased pumping capacity.

There are currently 339 relief wells, 1.4 miles of seepage berms, and four pump stations within the levee district. The combined design deficiency and levee raise project adds 488 wells, modifies five wells, and adds 1,300 linear feet of seepage berms. See Drawing 8 of the main report. The combined project includes four new pump stations and additional ditching. See Drawing 10 of the main report.

Mitigation may be required for borrow areas, ditching, and placement of seepage and stability berms for the 205 portion of the project. Minimal mitigation, if any, is thought to be required for the design deficiency portion of the project because:

- only one borrow area is required and it utilizes overburden from a nearby quarry,

- construction and placement of wells, seepage berms, and pump stations are in areas previously disturbed by the original project and in farmed areas in the interior of the levee,
- seepage berms will utilize sand dredged from the Mississippi River, but environmental guidelines will be followed and no mitigation will be required.

Mitigation costs are included in the project cost as a "worst case" scenario. The total number of acres potentially impacted was multiplied by the per acre cost to purchase easements or borrow, if needed. However, the borrow sites outside of the levee are located in what we expect to be delineated as "farmed wetlands" (they were previously so identified for the 1990 Farm Bill), borrow sites interior of the levee are adjacent to artificial wetlands created by borrowing to construct the existing levee. As such, borrowing from the "farmed wetlands" will enhance their wetland characteristics and may create permanent or semi-permanent wetlands; borrowing adjacent to the artificial wetlands can be done in such a way that it will be an enhancement of the existing artificial wetland (increased size and tapered to provide a littoral zone). There may not be a requirement for wetland mitigation, per se, associated with the combined project. Wetlands enhanced and used for mitigation may require a permanent conservation easement.

V. DESCRIPTION OF RESOURCES

A. Topography, Geology, and Soils. The levee district lies in the flood plain of the Mississippi River. The landscape is typical ridge and swale topography created by the river as it migrated across its flood plain. The low ridges in the flood plain typically are composed of sandy or silty material, while the lower swales have surface soils that are typically silty clays.

B. Cultural Resources. The proposed borrow sites are located in 13 separate tracts. Borrow sites 1 through 9 are located outside of the levee and were not surveyed for cultural material because the areas were once part of the river channel. Borrow sites 10 through 12 were surveyed in June 1998 and the surveys did not reveal any archaeological remains in the vicinity of the proposed sites. Borrow site 13 is over-burden from an existing quarry and has already been disturbed.

C. Prime Farmland. Approximately 26,000 acres are protected by the Bois Brule Levee and Drainage District levee. Nearly all of the area is dedicated to row-crop production with corn, soybeans, and wheat being the dominant crops grown.

The Natural Resources Conservation Service-Farmland Conversion Impact Rating Form AD-1006 (11 May 1998) reported that the project impact area has 312 total acres of soil impacted that is rated as "prime and unique farmland." This acreage may increase slightly as a result of project features that differ from the 1998 study.

D. Wetlands/Aquatic Resources. Aquatic habitats landward of the levee are small and generally low habitat quality, consisting mainly of standing water in drainage ditches, low areas, a few ponds, and artificial wetlands created when borrow material was taken for the levee. All of the artificial wetlands are located along the west levee. Most of these aquatic areas can be considered permanent wetlands, although some crop acreage in lower swales

can be classified as non-permanent "cyclic wetlands". Permanent and semi-permanent wetlands are common adjacent to the levee (riverward side) within and adjacent to the bands of forest. (USCOE 1994) Wildlife commonly found in these areas includes a variety of duck species, Canada goose Branta canadensis, herons (Ardeidae Family), shore birds, muskrat Ondatra zibethicus, mink Mustela vison, and beaver Castor Canadensis, (USDA 1982).

E. Water Quality. The Bois Brule Levee and Drainage District occasionally impounds storm water in the interior drainage ditches, in low-lying areas, and in the southeastern end in the old borrow pits used to create the levee. There are no known water quality problems in the levee district.

F. Threatened and Endangered Species. The Bois Brule Levee and Drainage District lies within the range of five Federally listed threatened or endangered species. Those species include: pallid sturgeon Scaphirhynchus albus, (Endangered); Indiana bat Myotis sodalis, (Endangered); bald eagle Haliaeetus leucocephalus, (Threatened); small whorled pogonia Isotria medeoloides, (Threatened); and decurrent false aster Boltonia decurrens, (Threatened). The following Missouri State protected species and/or natural communities/areas are known to occur in the vicinity of the project area: Alabama shad, Alosa alabamae, (Rare); pallid sturgeon, (Endangered); and the Red Rock Landing Conservation Area.

G. Terrestrial Resources. Habitat for open land wildlife in the Bois Brule Levee and Drainage District consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas are important food sources for area wildlife by providing grain and seed crops, grasses and legumes, and a variety of wild herbaceous plants. Wildlife that may be attracted to these areas includes common bobwhite Colinus virginianus, eastern meadowlark Sturnella magna, field sparrow Spizella pusilla, cottontail rabbit Sylvilagus floridanus, and red fox Vulpes vulpes. (USDA 1982)

Habitat for woodland wildlife includes areas of deciduous or coniferous plants and/or grasses, legumes, and wild herbaceous plants. Wildlife utilizing this terrestrial habitat type includes wild turkey Meleagris gallopavo, American woodcock Philohela minor, thrushes (Turdidae Family), woodpeckers (Picidae Family), squirrels (Sciurus spp.), gray fox Urocyon cinereoargenteus, raccoon Procyon lotor, and white-tailed deer Odocoileus virginianus. (USDA 1982)

H. Aesthetics. The aesthetics of the Bois Brule Levee and Drainage District is nearly all representative of agricultural fields. The village of McBride is situated on the edge of the expansive Mississippi River floodplain. The floodplain is dedicated to agriculture, whereas the village is comprised of a few residences, few small businesses and an industrial facility. The levee district also includes an airport that has an adjacent industrial facility.

I. Socio-Economic Resources. The majority of the Bois Brule Levee and Drainage District is located in Perry County, Missouri. Due to the meandering of the Mississippi River, a small portion of the District is in Randolph County, Illinois. This study will focus on Perry County, which includes the town of Perryville and the surrounding areas. The 2000 population of Perry County was 18,132 with a density of 37.4 people per square mile. The age distribution for Perry County has 26.0 percent of the

population under the age of 18 and 15.7 percent over the age of 65. Perry County in 2000 was 99.0 percent white and 1.0 percent black, American Indian, or Asian. Of the adults age 25 or over, 71.2 percent have graduated from high school and 9.9 percent have graduated from college. The unemployment rate for 16 years of age or older in Perry County was 2.0 in 2000. Per capita income for Perry County, Missouri in 2000 was $16,554. A total of 9.0 percent of all persons had income below the poverty level in Perry County. Median family income in 2000 for Perry County was $43,240 with 5.2 percent of all families having income below the poverty level. Perry County had 7,815 housing units in 2000 of which 5,627 were owner occupied, 1,277 renter occupied, and 911 vacant (U.S. Department of Commerce 1996).

The Bois Brule Levee and Drainage District has two industrial facilities within its boundaries, Sabreliner Corporation adjacent to the airport and Gilster-Mary Lee Corporation at McBride. Each company employs approximately 175 persons.

VI. ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

No Federal project

In the absence of the combined design deficiency and levee raise project, the levee is likely to fail again due to underseepage as it did in 1993. Levee failure would likely occur at river levels below the 50-year flood. Highway 51 would be inundated and access to the Chester Bridge would be cut off. Individuals living in Missouri or Illinois and working in the neighboring state would have to travel to either Cape Girardeau (104 miles out-of-the-way) or St. Louis (170 miles out-of-the-way). Agricultural production on 26,000 acres would either be destroyed or severely damaged, depending on the time and duration of flooding. Workers at the two industrial facilities (350 people) within the levee district would be without work as long as the area is both inundated and while the facilities are being repaired. Expansion of these industries is not expected to occur as long as the levee is below the 100-year level of protection. No substantial additional development is expected in the levee district due to floodplain restrictions.

Land use changes in the community are not expected to be significant. The economy will continue to rely on agriculture and existing businesses.

Levee raise and associated closure structure, relief wells, seepage berms, ditches and increased pumping capacity - Authorized combined design deficiency and levee raise project.

A. Topography, Geology, and Soils. The authorized project will not have a major effect upon existing conditions within and adjacent to the levee district. The borrow sites will change the topography and may increase the amount of aquatic habitat. A carefully thought out borrow plan will likely reduce the amount of mitigation that may be required for the combined design deficiency and levee raise project.

B. Cultural Resources. All potential sources for earthen fill required to increase the height of the Bois Brule levee have been surveyed for the presence of potentially significant archaeological remains. There were no such sites present, so no cultural resources will be affected due to borrow activity. Construction related to the installation or modification of relief wells and construction of levees and berms shall be accomplished

within previously disturbed areas, as will the construction of pump stations and related ditches. The probability of encountering potentially significant archaeological remains within those areas is extremely low. Therefore, no on-site archaeological surveys were conducted within those contexts.

C. Prime Farmland. It was assumed that all areas impacted by the combined project would result in permanent removal from agricultural use. This is a worst-case scenario and would not likely happen in borrow areas where only a few feet of material are removed from existing high ground. The combined Boise Brule project will impact approximately 412.5 acres of farmed soil. Of those, 312 acres have soils rated as "Prime and Unique Farmland." The Farmland Conversion Impact Rating Form AD-1006 (11 May 1998) reported a "Land Evaluation Criterion Relative Value of Farmland to be Converted" score of 89. A "Site Assessment Criteria" score of 85 was calculated, for a "Total Point" score of 174. According to 7 CFR Ch. VI (1-1-93 Edition) Part 658-Farmland Protection Policy Act, sites receiving a total score of more than 160 are to be given increasingly higher levels of consideration for protection. The majority of the levee district is rated as "Prime and Unique Farmland", and placing the interior borrow sites in areas that are not farmland is not an option. Generally borrow sites are located in areas adjacent to the levee-reach being raised to minimize the haul distance and cost. The majority of the borrow sites were positioned on the riverside of the levee where flooding is much more frequent, and they are less valuable as agricultural ground. The authorized project will have minimal additional impact to prime and unique farmland, and then only in the vicinity of relief wells, seepage and stability berms and pump stations and related ditches.

D. Wetlands/Aquatic Resources. The Bois Brule project will have minimal impacts to the Wetland/Aquatic Resources of the area. Borrow areas located riverside of the levee are currently being farmed. Based on an unofficial wetland delineation from NRCS files and based upon the 1990 Farm Bill determinations, many of the riverside borrow areas are classified as "farmed wetlands." Removal of material from these borrow areas will likely enhance the Wetland/Aquatic Resources of the area by increasing storage capacity and surface area. These areas will be wet longer and will be less likely to be farmed. Any wetlands created by borrowing will be allowed to regenerate into emergent wetlands. Shallow excavations will result in improved habitat for shorebirds, wading birds, and waterfowl, as well as a variety of reptiles and amphibians. Probable mitigation for impacting some of these farmed wetlands will be to permanently remove them from production by placing a conservation easement on the property.

Borrowing adjacent to existing interior wetlands along the land side of the levee can be conducted to enhance the existing wetland by increasing their size and tapering the shape of the new borrow area landward. This will create a shallow littoral area that is more productive for aquatic organisms and simulates conditions typically found in shallow wetlands. The tapered slopes could still be farmed above the wetland edge.

Mitigation may be required for borrow areas, ditching, and placement of seepage and stability berms if they are determined to be in wetlands. Minimal mitigation is thought to be required for the project and can take place on site, through enhancement of farmed wetlands and existing interior wetlands. Wetlands enhanced and used for mitigation may require a permanent conservation easement.

The U.S. Fish and Wildlife Service suggested in the Draft Coordination Act Report, that the riverside borrow sites be excavated to 20 foot and be connected to the river. This would provide additional backwater areas for spawning fish. The depths of the riverside borrow areas will be kept under 4 feet because of underseepage concerns. The borrow areas cannot be connected to the river by ditches because the ditches would provide a path for the river and encourage erosion. However, the borrow areas will be connected to the river during times of flooding. The draft report also recommended two conservation measures that could be incorporated into the project:

- Islands - This conservation measure will be incorporated into the design of the borrow area, if appropriate, when depths of the various borrow sites has been determined.
- Buffer Areas - This conservation measure will be incorporated into the design of the interior borrow areas, and in fact, already exists and will not be disturbed next to the existing levee. It is anticipated that borrow areas landward of the existing interior borrow sites will be tapered from the current maximum depth up to zero to create a shallow littoral zone. This should provide for more than a 50-foot buffer, especially in the spring during seasonally wet conditions.

E. Water Quality. The Bois Brule levee raise and design deficiency project will have only minor, if any, short-term water quality impacts during construction. Slight elevations in turbidity levels may occur in drainage ditches and storm water impoundment areas during construction if there is heavy rain before seeding is established. Contractors are required to abide by an Environmental Protection Plan; therefore, any erosion will be minimized. Excavation of borrow material will result in enhanced storm water storage capacity.

F. Threatened and Endangered Species. In compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Army Corps of Engineers requested the U.S. Fish and Wildlife Service (USFWS) to provide a listing of Federally threatened or endangered species, currently classified or proposed for classification, that may occur in the vicinity of the Bois Brule project. In a letter dated 23 April 1997, the USFWS provided a species list for the vicinity of the proposed project area (USFWS 1997), in response to which the following biological assessment was prepared. Recent coordination with the USFWS has confirmed that the list provided is still current for the project area.

The project will have no or minimal impact on the following threatened or endangered species:

Indiana bat. Myotis sodalis is currently classified as an endangered species by the USFWS. Indiana bats hibernate in caves beginning in mid October. The bats begin to leave the caves in search of summer habitat by late March or April. Summer habitat includes mature trees with an open under story that provide roosting and foraging areas (Schwartz and Schwartz 1981). Optimum summer habitat for the bat consists of the riparian and floodplain corridors of small streams. Since the project will not impact caves or any mature trees, no adverse effects are expected to the Indiana bat.

Bald eagle. Haliaeetus leucocephalus may be present in the Bois Brule project area. The bald eagle is a bird of aquatic ecosystems (Marshall and

Nickerson 1976). They commonly use large trees adjacent to rivers and lakes as foraging perches, day resting sites, and night roosts. They feed mainly on fish, but muskrats, small mammals, water birds, and carrion are also eaten (Christopher 1990). It is not expected that project construction work will adversely impact either bald eagle habitat or food sources. An active bald eagle nest is located immediately adjacent to the Bois Brule levee at approximate river mile 98. Construction in this area will be timed so that impacts to the nest do not occur.

Pallid Sturgeon. Scaphirynchus albus is currently classified as an endangered species by the USFWS and the Missouri Department of Conservation. Pallid sturgeon requires large, turbid, free-flowing riverine habitat with rocky or sandy substrate (Federal Register 1989). This species is most frequently found over a sand bottom. Spawning is suspected to occur over rock, rubble or gravel bottoms in the main channel of large rivers and major tributaries or on wing dams in large rivers. Spawning is thought to occur from May through August. Modifications of the pallid sturgeon's habitat have blocked its movements, reduced its food sources or its ability to obtain food, destroyed or altered its spawning areas, altered water temperatures and changed the hydrograph. Construction activities associated with the Bois Brule project may result in a slight increase of localized turbidity in the Bois Brule and Cinque Hommes Creek and the old river channel and Mississippi River. The species is well adapted to turbid waters and would not be impacted by construction related activities (USFWS 1993).

Small whorled pagonia. Isotria medeoloides is currently classified as threatened by the USFWS and the Illinois Department of Natural Resources. This species can be found in dry woodland habitat in both fairly young forests and in maturing stands. In Randolph County, this species has been found on a forested slope of a vertical sandstone bluff (USFWS 1995). The Bois Brule project will not impact any dry woodland habitat.

Decurrent false aster. Boltonia decurrens is currently classified as a threatened species by the USFWS. This species is typically found in disturbed alluvial soils such as fallow or abandoned agricultural fields, roadside ditches, and disturbed lakeshores. No such habitat will be impacted by the Bois Brule project; therefore, no adverse impacts to the decurrent false aster are anticipated as the result of borrow excavations or construction activities associated with the project. This species is endemic to the Illinois River valley with only a few populations associated with the Mississippi River and these are immediately below the mouth of the Illinois. Habitat conditions within and adjacent to the Bois Brule Levee and Drainage District are not considered to conducive to the establishment of Boltonia populations, and it has never occurred in either Illinois or Missouri near the location of the drainage district, nor within the area anticipated to be impacted by induced flooding.

G. Terrestrial Resources. Habitat for open land and woodland wildlife should remain unchanged with the exception of some short-term impacts due to the removal of borrow material from 419 acres of agriculture fields.

H. Aesthetics. Aesthetics should remain generally the same with the project, except for the new development in the floodplain due to the higher level of flood protection resulting from the levee raise.

I. Socio-Economic Resources. As farming technology has improved, and the attainment of higher levels of education has increased, national

migratory trends over the past 20 years have been away from rural communities. Fewer workers are needed to produce agricultural products and large cities offer better job opportunities. It is expected that this trend will continue with or without the project. Both industries that are currently within the levee district have suggested that they would expand their operations and increase their work force if the levee is raised. New development in the levee district due to the project will increase economic activity in the area. The induced flooding along the Mississippi and Kaskaskia Rivers outside the levee district caused by the project will have negative social and economic impacts.

VII. RELATIONSHIP OF PROJECT TO ENVIRONMENTAL REQUIREMENTS

TABLE EA- 3. Relationship and compliance status of project to environmental requirements.

GUIDANCE	DEGREE OF COMPLIANCE
Federal Statues	
Archaeological and Historic Preservation Act, as Amended, 16 U.S.C. 469, et seq.	PC
Bald Eagle Protection Act, 42 U.S.C. 4151-4157	FC
Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	FC
Clean Water Act, as amended, 33 U.S.C. 1251, et seq.	PC(1)
Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601-9675	FC
Endangered Species Act, as amended, 16 U.S.C. 1531, et seq.	FC
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. 661, et seq.	FC
Food Security Act of 1985, 7 U.S.C. varies	FC
Land and Water Conservation Fund Act, as Amended, 16 U.S.C. 4601, et seq.	
National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq.	FC
National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.	PC(2)
Noise Pollution and Abatement Act, 42 U.S.C. 7641-7642	FC
Resource Conservation and Recovery Act (RCRA), 40 C.F.R. 261	FC
Resource, Conservation and Rehabilitation Act, 42 U.S.C. 6901-6987	FC
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	FC
Executive Orders	
Floodplain Management, E.O. 11988 as amended by E.O. 12148	FC/NC(3)
Protection and Enhancement of the Cultural Environment, E.O. 11593	PC(2)
Protection and Enhancement of Environmental Quality, E.O. 1991	FC
Protection of Wetlands, E.O. 11990 as amended by E.O. 12608	FC

FC = Full Compliance
PC = Partial Compliance
NC = Non-Compliance

(1) Full compliance will be attained upon completion of any permitting requirements.
(2) Full compliance will be attained after all required archaeological investigations, reports, and coordination have been completed for each potential borrow site location.
(3) Full compliance for the design deficiency project, non-compliance for the levee raise.

VIII. ISSUES AND CONCERNS

A. Floodplain Management. Executive Order 11988 outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency shall evaluate the potential effects of actions on flood plains, and should avoid undertaking actions that directly or indirectly induce growth in the floodplain or adversely affect natural floodplain values. Engineer Regulation 1165-2-26 states:

The Corps is required to provide leadership and take action to.

- Avoid development in the base flood plain unless it is the only practicable alternative;
- Reduce the hazard and risk associated with floods;
- Restore and preserve the natural and beneficial values of the base flood plain.

The Corps is required to follow the general procedures listed below to address the requirements of Executive Order 11988.

a. Determine if the proposed action is in the base flood plain.

The project is in the base flood plain of the Mississippi River. The Bois Brule levee district includes 26,060 flood plain acres.

b. If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain.

One practical alternative is completion of a design deficiency project that restores the 50-year level of protection, but does not remove a large part of the 26,060 acres from the base flood plain. New development can occur on flood free land near the levee district. Future actions by the state of Missouri could provide flood protection for Highway 51 across the Mississippi River to the 50-year flood level.

c. If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments.

The area affected by the levee raise component of the project includes the levee district itself and the areas along the Mississippi and Kaskaskia Rivers in Missouri and Illinois

impacted by the induced flood heights caused by the levee raise. The general public in these areas will be advised about the project and their views and comments will be requested as part of the project's public review process. Comments will be addresses in the final report.

d. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.

Economic evaluations presented in the main report show that 400 acres are expected to be developed in the flood plain due to the levee raise component of the project. This development may be a negative impact to natural flood plain values, which include ground water recharge and water quality. The levee raise project will affect the base flood plain in other areas. It will raise the level of the 100-year flood, which will increase flood damage and change flood plain zoning maps.

e. If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.

The levee raise component of the project will induce development in the base flood plain according to economics studies presented in this report. Practical non-flood plain alternatives for this development exist adjacent to the levee district in Perry County, Missouri and in other nearby areas in Missouri and Illinois.

f. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore tan preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.

The "no action" alternative is possible, but without the design deficiency component of the project, the levee district is left with a lower level of protection than originally authorized. As stated under b. above the most viable method to minimize adverse impacts is to implement the design deficiency component of the project.

g. If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.

The Corps of Engineers has been directed to raise the level of protection for the Bois Brule levee district to 100-year, and will advise the general public in the affected area through the public review process.

h. Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.

No recommendation is required by the Corps of Engineers. Federal law directs the Corps to provide 100-year level protection.

B. 404 Evaluation and 401 State Certification. A 404 (b)(1) Evaluation will be prepared for the Bois Brule project if appropriate. As currently described the project has no material deposited into any jurisdictional waters of the U.S. Wetland impacts associated with borrow removal from the farmed wetland borrow areas river side of the levee will be considered an enhancement and will fall under Nationwide Permit No. 27. Since all construction material is considered to be free of contaminants and only short-term impacts may occur during construction, no violation of State Water Quality Standards is expected.

C. Hazardous and Toxic Wastes. A Phase I Environmental Site Assessment was completed in July 1998. The assessment revealed no evidence of recognized environmental concerns in connection with the property. If during construction, hazardous materials are found, the Corps of Engineers will notify the Missouri Department of Natural Resources, Environmental Services Office and the hazardous materials will be removed in an approved manner before work on the project proceeds.

D. Induced Flooding. The Unsteady Flow Network (UNET) model was run to determine the impact of raising the Bois Brule levee to a 100-year recurrence interval level of protection. The UNET model computed a revised water profile based on the effects of lost storage behind a levee system assuming no levee failure. For the 100-year flood event, induced flooding was calculated to be 0.9 foot increase in water levels immediately upstream at River Mile 109.0 and 0.1 foot or greater as far downstream as River Mile 23.6 and upstream as River Mile 156.0.

A meeting was held on 11 February 1998 with the Missouri State Emergency Management Agency (MO SEMA) and the Federal Emergency Management Agency (FEMA), Region VII, to discuss the issue of floodway delineation. Both agencies agreed that, although the lost flood storage is real, there are no regulations by either agency regarding the lost storage within the flood plain. The floodway limit is at the riverside toe of the levee and a landside enlargement is allowable with induced flood heights identified as a negative benefit.

The Bois Brule levee is one of the higher "50-year" levees in the area because of the subsequent reduction in the 50-year design discharge. Higher levees include the urban design levee and floodwall in Cape Girardeau, Missouri, the Ste. Genevieve, Missouri urban design levee, the 100-year Prairie du Rocher and Modoc levees in Illinois, and the planned urban design levee in Festus-Crystal City, Missouri. Lower levees include the East Cape Girardeau and Clear Creek levee in Illinois, the North Alexander levee in Illinois, the Clear Creek levee in Illinois, the Miller Pond levee in Illinois, the Preston levee in Illinois, the Grand Tower levee in Illinois, the Degognia and Fountain Bluff levee in Illinois, the Kaskaskia Island levee in Illinois, the Ste. Genevieve County Levee District Number 2 in Missouri, the Fort Chartres and Ivy Landing levee in Illinois, the Stingtown levee in Illinois, and the Harrisonville and Ivy Landing levee in Illinois. Of the higher levees, the Bois Brule levee raise would affect only the Prairie du Rocher and Modoc levee. The freeboard for the 100-year Prairie du Rocher and Modoc levee would be reduced because of the increase in the 100-year flood profile at that location. The urban design levees protect against the 500-

year flood or higher and would not be impacted by a 100-year Bois Brule levee because the Bois Brule levee would no longer be functioning when flooding reached the 500-year level. Because the lower levees will be overtopped before the existing Bois Brule levee is overtopped, the additional height on the Bois Brule levee would not cause these levees to be overtopped but would cause deeper flooding in an already flooded levee district. The flooded areas along the landward edge of the 100-year flood plain would be larger.

Unprotected areas with significant induced flood heights include the town of St. Marys, Missouri and the vicinity of Chester, Illinois at the upstream end of the Bois Brule levee (0.9 feet rise for the 100-year flood), and the backwater effect up the Kaskaskia River (0.6 feet), which extends about 36 miles upstream in Illinois.

The state of Illinois requires a different methodology to define the increase in flood levels caused by levee projects. Using this methodology the induced flood height is 1.1 feet at the upstream end of the Bois Brule levee, and the limits of the 0.1-foot rise are at Mississippi River Miles 101.6 and 145.3.

IX. LITERATURE CITED

Bass, R. E. and A. I. Heron. 1993. MASTERING NEPA: A Step-by-Step Approach. Sloan Press Books. 233pp.

Christopher, R. ed. 1990. Book of North American birds. Reader's Digest Assoc. Inc, Pleasantville, New York. 576pp.

Federal Register. 1989. August 30, 1989. Vol. 54, No. 167. pp. 35901-904.

Marshall, D. B., and P. R. Nickerson. 1976. The bald eagle: 1776-1976. National Parks and Conservation Magazine. July:14-19.

Schwartz, C. W., and E. R. Schwartz. 1981. The wild mammals of Missouri. University of Missouri Press and Missouri Department of Conservation.

U.S. Army Corps of Engineers, St. Louis. 1994. Prairie du Rocher, Illinois Reconnaissance Report.

U.S. Dept. of Agriculture - Soil Conservation Service. 1982. Soil Survey of Randolph County, Illinois.

U.S. Dept. of Commerce. 1990. 1990 Census of Population and Housing, "Summary Social, Economic and Housing Characteristics", Illinois.

U.S. Fish and Wildlife Service. 1995. Official correspondence dated 31 July 1995.

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

X. ENVIRONMENTAL ASSESSMENT PREPARERS

The St. Louis District staff members responsible for preparing this document are as follows:

Mr. Terry Norris, Archaeologist
Experience: 25 years Environmental Planning Branch, SLD
Role: Historic Properties Compliance

Mr. Mike Daily, Regulatory Project Manager
Experience: 17 years, St. Louis District
6 years, Regulatory Branch, SLD
Role: Regulatory Permits, Section 10 and 404

Mr. Ron Dieckmann, Civil Engineer
Experience: 31 years, Hydraulics Branch, SLD
Role: Hydraulics

Ms. Tori Foerste, Civil Engineer
Experience: 1 year, Hydraulics Branch, SLD
Role: Environmental Quality

Mr. T. Miller, Ecologist
Experience: 10 years Environmental Planning Branch, SLD
27 years, Fish and/or Wildlife Biologist, Illinois Department of Natural Resources
Role: EA Coordinator/Environmental Impact Analysis/Endangered Species

Mr. Pat Conroy, Geotechnical Engineer
Experience: 23 years
Role: Geotechnical Engineering

Mr. Richard Andersen, Economist
Experience: 24 years
Role: Economic Studies

Mr. Ted Moore, Civil Engineer PE
Experience: 32 years experience
15 years, SLD
Role: Civil Engineering

Mr. Jim Zerega, PE
Experience: 29 years, SLD
33 years, Corps of Engineers
Role: Study Manager

XI. COORDINATION, PUBLIC VIEWS, AND RESPONSES

The St. Louis District has coordinated with the U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, and Natural Resources Conservation Service (NRCS) on a site visit of the proposed project area. The NRCS was consulted concerning the preparation of the Farmland Conversion Impact Rating and on the classification of wetlands. All associated letters, comments, and responses will be filed with this document (APPENDIX A).

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:

Elected Officials:

- **Honorable Kit Bond**
- **Honorable Jean Carnahan**
- **Honorable Jo Ann Emerson**
- **Honorable Peter Kinder**
- **Honorable Patrick Naeger**
- **Mayor of St. Marys, Missouri**
- **Mayor of Ste. Genevieve, Missouri**
- **Mayor of Chester, Illinois**

Federal Agencies:

- **U.S. Fish and Wildlife Service**
- **U.S. Environmental Protection Agency**
- **Natural Resources Conservation Service**
- **Federal Emergency Management Agency**

State and Local Agencies:

- **Missouri Department of Natural Resources**
- **Missouri Department of Transportation**
- **Missouri Historic Preservation Agency**
- **Missouri State Emergency Management Agency**
- **Illinois Department of Natural Resources**
- **Illinois Office of Water Resources**

Drainage and Levee Districts:

- **Bois Brule Levee and Drainage District**
- **Degognia and Fountain Bluff Levee District, Illinois**
- **Kaskaskia Island Levee District, Illinois**
- **Ste. Genevieve County Levee District Number 2, Missouri**
- **Prairie du Rocher and Modoc Levee District, Illinois**

Other Groups of Interest:

- **Perry County Industrial Development**

To assure compliance with the National Environmental Policy Act, Endangered Species Act and other applicable environmental laws and regulations, coordination with these agencies will continue as required throughout the planning and construction phases of the proposed Bois Brule flood control project.

FINDING OF NO SIGNIFICANT IMPACT

COMBINED DESIGN DEFICIENCY AND LEVEE RAISE PROJECT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT
PERRY COUNTY, MISSOURI
RANDOLPH COUNTY, ILLINOIS

I. I have reviewed and evaluated the documents concerning the authorized design deficiency and levee raise project for the Bois Brule Levee and Drainage District located in Perry County, Missouri and Randolph County, Illinois.

II. As part of this evaluation, I have considered:

a. Existing Resources and Future without Authorized Plan (No Action) Alternative.

b. Impact to Existing Resources with Recommended Plan (Action Alternative).

III. The possible consequences of these alternatives have been studied for physical, environmental, cultural, social and economic effects, and engineering feasibility. Significant factors evaluated as part of my review included:

a. The authorized project is a combined project that includes correction of design deficiencies in the original design of the Bois Brule levee and a levee raise and other improvements that would increase the level of flood protection from the current 50-year level to a 100-year level through increased levee height, installation of relief wells, seepage berms and pump stations and related ditching, and replacement of an existing railroad closing structure.

b. There would be no significant affects to the physiography-topography of the areas.

c. Development in the flood plain will result from this project.

d. Induced flooding will occur as a result of the levee raise.

e. Federally listed endangered and threatened species will not be adversely impacted.

f. There would be no adverse impacts to cultural resources.

g. Prime farmland will be removed from production, but the existing levee and drainage district is partly responsible for the prime farmland designation since the entire area is in the floodplain of the Mississippi River.

h. There would be no appreciable degradation to the physical environment (e.g., noise, air quality, and water quality) due directly to the flood control project, and there may not be any significant degradation due to the projected development in the flood plain.

i. No significant adverse impacts to the aesthetic value, social, or recreational resources would result.

j. The proposed project will not have an adverse impact on wetlands, and may result in an enhancement.

k. The "no action" alternative was evaluated and determined to be unacceptable since there is a public health and safety issue unless the design deficiency is corrected.

IV. Based on the disclosure of the impacts contained within the Environmental Assessment, no significant impacts to the environment are anticipated. The proposed action has been coordinated with the appropriate resource agencies, and there are no significant unresolved issues. Therefore, an Environmental Impact Statement will not be prepared prior to proceeding with the proposed combined design deficiency and levee raise project for the Bois Brule Levee and Drainage District, Perry County, Missouri and Randolph County, Illinois.

Date	**C. Kevin Williams** **Colonel, U.S. Army** **District Engineer**

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX A

HYDROLOGY AND HYDRAULICS

APPENDIX A - HYDROLOGY & HYDRAULICS

Description Of Study Area

Bois Brule Levee and Drainage District (formerly the Perry County Drainage and Levee Districts 1, 2, & 3) is located along the right bank of the Mississippi River in Perry County, Missouri and Randolph County, Illinois, between river miles 94 and 111 above the mouth of the Ohio River. The district is bounded on the northwest by bluffs, on the north by the old Mississippi River channel, on the east and south by the Mississippi River, and on the west by Bois Brule - Cinque Hommes Creeks. See DRAWING 2 in the main report.

The existing Federally constructed levee system, approximately 33.1 miles in length, provides flood protection against direct flooding by the Mississippi River. There are 26,000 acres of primarily cultivated bottomland within the district. In addition, there are several major industries and the town of McBride located in the district, as well as an important state highway crossing the levee district that connects to the only bridge across the Mississippi River between St. Louis and Cape Girardeau.

Existing Conditions

The current Bois Brule Levee and Drainage District levee system is not certified as providing protection against a 1 percent recurrence interval flood. Without this certification it is very difficult to comply with rules concerning the National Flood Insurance Program administered by the Federal Emergency Management Agency. The existing Bois Brule levee was built as an agricultural type levee that provided protection up to the 2 percent recurrence interval flood (50-year) with 2 feet of freeboard.

During the Reconnaissance phase of the study, the riverfront, the old Mississippi River channel along the upper flank, and the back levee along Bois Brule - Cinque Hommes Creeks were investigated to determine the current protection provided by the levee system. A very long reach of the riverfront levee and back levee have significant overbuild and provide 1 percent recurrence interval flood protection. The entire upper flank along the old Mississippi River channel, the lower riverfront and lower back levee, however, were found to need raising. The railroad closure structure at the beginning of the upper flank levee does not have a top of gate elevation high enough to provide 100-year protection. It will have to be modified or replaced.

The back levee along Bois Brule - Cinque Hommes Creeks was originally designed for a 2 percent flow coincident with the 50-year water surface elevation on the Mississippi River of 379.9 feet NGVD. The existing 100-year elevation on the Mississippi River at the mouth of Bois Brule - Cinque Hommes Creek is 383.0 feet NGVD. Detailed hydraulic analysis was performed during the Reconnaissance study to determine the 1 percent water surface profile for Bois Brule - Cinque Hommes Creeks from the Mississippi River to the bluff line.

Seventeen sections and 8 bridge or culvert sections were taken along Bois Brule - Cinque Hommes Creeks between the levee and the bluffs.

The water surface profiles for the 100-year flow for Bois Brule - Cinque Hommes Creek indicates the existing levees are high enough to provide 100-year protection along the back levee except where the Mississippi River backwater controls the water surface profile at the lower end of Bois Brule Creek. The railroad closure structure along the back levee is upstream of the Mississippi River backwater control and its top of gate elevation is sufficient to provide 100-year protection.

Major Floods Of Record

Numerous floods have occurred along the Mississippi River since the federal construction of the Bois Brule levee. No floods between the federal construction of the Bois Brule levee and the record 1993 flood have caused failure of the levee. Failure of the Bois Brule levee along the lower riverfront did occur during the 1993 flood event. However, the failure initially occurred from foundation failure rather than overtopping. In all likelihood, the levee would have been overtopped at a later date during the flood. The 1993 flood was estimated to be the one percent exceedence probability flood at the Bois Brule levee. Flash flooding on Bois Brule - Cinque Hommes Creeks has also occurred.

Risk-Based Analysis

The design freeboard deemed acceptable for the Bois Brule Drainage and Levee District when it was constructed was two feet added to the design water surface. All the federally constructed levees within the Alton to Gale system, whether agricultural or urban, have been built with 2 feet of freeboard. However, under current Corps regulations risk-based analysis is to be used to establish the minimum levee design elevations during the Reconnaissance phase and the term and concept of freeboard should no longer be used in levee projects. Since the Reconnaissance Study had been completed before risk-based analysis was required, risk analysis was performed on the proposed levee raise project in this feasibility phase.

Risk-based analysis was performed in this feasibility phase using the HEC developed analysis tool that includes a worksheet template and the use of two commercially available computer programs, Lotus 1-2-3 (Lotus Development Corporation) and @Risk (Palisade Corporation). By using this analysis, the levee profile proposed in the recommended plan for this DPR will provide 95 percent reliability of containing the one percent exceedence flood. This is shown in TABLE 1, whereby at a stage of 51.8 feet at the Chester gage there is a 5% chance for exceedence by a 0.01 event (a 5% chance of exceedence is equivalent to a 95% chance of not being exceeded). This analysis follows the "Guidance on Levee Certification for the National Flood Insurance Program," dated 25 March 1997. For this proposed project the FEMA criteria results in a reliability of greater than 95%, therefore the levee may be certified at the stage corresponding to a 95% chance of non-exceedence. Therefore, a levee built to a stage of 51.8 feet at Chester would be 2.1 feet above the 100-year water surface of 49.7 feet. See TABLE 1.

TABLE 1
RELIABILITY OF LEVEE STAGE(ELEVATION)
FOR VARIOUS EVENTS
BOISE BRULE D&DL
@ MISSISSIPPI RIVER MILE 109.9
CHESTER GAGE ZERO = 341.05 FEET NGVD

Top of Levee (Stage-Feet)	Percent Chance Exceedence for .04 Event	Percent Chance Exceedence for .02 Event	Percent Chance Exceedence for .01 Event	Percent Chance Exceedence for .005 Event	Percent Chance Exceedence for .002 Event
39.0	100.00				
40.0	99.50	100.0			
41.0	96.80	99.9			
42.0	87.50	99.6	100.0		
43.0	69.50	98.3	99.9		
43.8	52.00	94.7	99.7		
44.0	47.00	93.0	99.6	100.0	
45.0	26.80	82.0	99.0	99.9	
46.0	12.90	65.9	96.0	99.7	100.0
46.9	6.10	49.7	90.7	99.2	99.9
47.0	5.70	47.6	89.1	99.1	99.8
48.0	2.50	29.7	75.4	96.1	99.7
49.0	0.90	15.0	56.5	86.7	97.9
49.7	0.50	8.5	39.7	72.7	93.3
50.0	0.40	6.3	32.9	65.4	90.3
50.5	0.20	4.5	25.9	51.1	82.6
51.0	0.10	2.0	13.0	36.8	72.4
51.7	0.02	0.7	5.4	20.5	56.0
52.0		0.5	3.5	15.5	48.0
53.0		0.2	0.8	4.9	22.0
54.0			0.1	0.9	5.9
55.0					0.9

Probability Distributions based on 4500 iterations of Latin Hypercube sampling using @Risk (Palisades Corporation, 1992)
The standard deviation of error in stage corresponding to the one-percent chance event used in the sampling analyses equals 1.0 feet.
The nominal .04 event stage = 43.8 feet
The nominal .02 event stage = 46.9 feet
The nominal .01 event stage = 49.7 feet
The nominal .005 event stage = 50.5 feet
The nominal .002 event stage = 51.7 feet

An additional 1-foot of levee height was added to the levee between station 0+00 and the Chester bridge and then 1 foot additional from the Chester bridge tapering to zero additional at station 867+00. This will insure overtopping for an event greater than the 100-year will occur on the lower end of the levee district.

Interior Drainage

The interior area of Bois Brule can be separated into four sub-areas. Each of these sub-areas has an existing principal ditch, a primary gravity outlet, and a pumping station associated with it. See DRAWING 10 in the main report. Each pump station was optimized and designed to minimize the impacts of interior flood damages.

Existing Pump Stations

The four pump stations in the levee district were designed to handle rainfall in the interior of the levee plus flow from the original relief wells. The design of the pump stations is considered adequate for the original number of relief wells and seepage berms in the levee district.

Missouri Chute Pumping Station

The Missouri Chute Pumping Station is located at levee station 580+93.51 and has a nominal capacity of 50 cfs provided by one pump. The pump discharges through a 36-inch discharge pipe over the levee with a siphon breaker to a saxophone discharge pipe at the outlet structure. A 48-inch gravity drain is located adjacent to the pump station at levee station 582+22.52. The area draining to this pump station is 3,570 acres.

Jones Cutoff Pumping Station

The Jones Cutoff Pumping Station is located at levee station 1001+52.20 and has a nominal capacity of 125 cfs provided by two pumps. The pumps discharge through two 36-inch discharge pipes over the levee with siphon breakers to saxophone discharge pipes at the outlet structure. Two 30-inch gravity drains are located adjacent to the pump station at levee stations 999+36.23 and 999+83.25. The area draining to this pump station is 3,855 acres.

Cinque Hommes Pumping Station

The Cinque Hommes Pumping Station is located at levee station 1131+60.22 and has a nominal capacity of 125 cfs provided by two pumps. The pumps discharge through two 36-inch discharge pipes over the levee with siphon breakers to saxophone discharge pipes at the outlet structure. Two 60-inch gravity drains are located adjacent to the pump station at levee station 1133+27.73. The area draining to this pump station is 8,687 acres.

Bois Brule Pumping Station

The Bois Brule Pumping Station is located at levee station 1466+56.28 and has a nominal capacity of 215 cfs provided by three pumps. The pumps discharge through three 36-inch discharge pipes over the levee with siphon breakers to saxophone discharge pipes at the outlet structure. Two 66-inch gravity drains

are located adjacent to the pump station at levee station 1464+73.24. The area draining to this pump station is 10,799 acres.

Existing Ditches

There are four principal ditches and several lateral drainage ditches feeding each primary ditch within the Bois Brule Levee and Drainage District. The principal ditches are Ditch "A", the Cinque Hommes-Bois Brule, the Jones Cutoff, and the Missouri Chute. These main ditches in the drainage system generally traverse the lowest areas in the district. See DRAWING 10 in the main report. Each principal ditch is further described below.

Ditch "A" originates in the northwestern section of the levee district south of the St. Louis - San Francisco railroad and follows a northeasterly course for about five miles, roughly parallel to the levee until it passes under Missouri State Highway 51. It then circles back in a southerly direction for a distance of four miles until it discharges through two 66-inch Corrugated Metal Pipe (CMP) at Station 1474+75. The ditch is approximately 8.8 miles long. During blocked drainage periods, flow in Ditch "A" is pumped by the Bois Brule pump station.

Missouri Chute is an old tributary of the Mississippi River encompassing Pucket and Crains Islands. Originating at Mississippi River mile 107.1 the ditch makes a crescent shaped path south through the levee district before terminating at Mississippi River mile 103.2. It discharges through a 48 inch C.M.P. at approximate levee station 582+22.52. The ditch is approximately 5.2 miles long. During periods of blocked drainage, flow in the Missouri Chute Ditch is pumped by the Missouri Chute pump station.

Jones Cutoff begins at approximate levee station 700+00 and meanders in a southeasterly direction until it terminates into the landside borrow pits at the lower end of the district. The total length of the ditch is 5.1 miles. The borrow pits are drained by five gravity outlets extending through the levee and ranging in size from 24 inches to 42 inches in diameter. During periods of blocked drainage, flow in the Jones Cutoff ditch is pumped by the Jones Cutoff pump station.

Bois Brule - Cinque Hommes originates at approximate levee station 1469+15 on the back levee and meanders in a southeasterly direction roughly paralleling the back levee for a total distance of 6.6 miles to its terminus at a double 60-inch structure at approximate levee station 1142+15. During periods of blocked drainage, flow from the Bois Brule-Cinque Hommes Ditch is pumped by the Cinque Hommes pump station.

Increased Pump Capacity for Design Deficiency Project

The additional relief wells proposed for the Design Deficiency phase of the project will add additional flow to each of the four interior areas. An estimate of the increased seepage was determined for each drainage area (pump station) using the differential head between the 5-year Mississippi River elevation and the landside toe elevation at the levee and multiplying it by the average flow per foot of differential head determined by the Corps' Geotech Branch. See TABLE 2. A detailed period of record interior drainage analysis using the HEC-IFH interior flood hydrology computer package, will be used to determine the actual needed increased final capacity prior to final design. Trial and error simulations will be made with varying pump increases until the ponded storage elevation versus frequency curve for the design deficiency

project matches the existing condition ponded storage elevation versus frequency curve.

Additional Increased Pump Capacity for the 1% Flood Design Levee Raise (Section 205) Project

The additional relief wells proposed for the levee raise phase of the project will add another increment of additional flow to each of the four interior areas. Similarly, the same trial and error method using the period of record interior flood analysis program will be used to determine the incremental increase in pumping caused by the levee raise.

TABLE 2

Estimated Additional Pumping Capacity Required

Pump Station	Existing Capacity (cfs)	For Design Deficiency Project (cfs)	Incremental Increase for 100-Year Project (cfs)	Total for 100-Year Project (cfs)
Bois Brule	215	22	19	41
Clinque Hommes	125	10	6	16
Jones Cutoff	125	30	27	57
Missouri Chute	50	25	23	48

Induced Flooding

While the Design Deficiency Project has no impact on flood levels outside the levee, the Section 205 project to raise the level of protection to 100 year does impact the flood levels on the Mississippi River and on the lower part of the Kaskaskia River. The Unsteady Flow Network (UNET) model was run to determine the impact of raising the Bois Brule Levee and Drainage District to a 100-year recurrence interval level of protection. The UNET model computed a revised water profile based on the effects of lost storage behind a levee system assuming no levee failure. For the 100-year flood event, induced flooding was calculated to be 0.9 foot increase in water levels immediately upstream of the Bois Brule levee at River Mile 109.0 and 0.1 foot or greater as far downstream as River Mile 23.6 (south of Cape Girardeau) and upstream as River Mile 156.0 (north of Festus/Crystal City).

As stated in the previous paragraph, increasing the flood protection from the 50-year level to the 100-year level increases flood elevations and must be mitigated as part of the project. However, since the levee raise impacts lands in the State of Illinois, the state has its own required analysis to determine the effects of the levee raise. This analysis requires the determination of the maximum discharge that will be confined by the levee raise with no regard for the frequency of the discharge. Once this discharge is determined, it is then analyzed with the existing condition levee. The water surface profiles for these two scenarios are compared in order to calculate the increase water level caused by the levee raise. This analysis was done using the HEC-RAS computer program and run in the steady state mode. The maximum increase water

level from this analysis is 1.1 feet immediately upstream of the Bois Brule levee. The increase reduces to 0.3 feet at river mile 134 and reduces to 0.1 foot at river mile 145.

`

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX B

GEOTECHNICAL ENGINEERING

APPENDIX B - GEOTECHNICAL ENGINEERING

General

This appendix provides the results of detailed underseepage studies performed during the study of the Bois Brule Drainage and Levee District. All figures referred to in this appendix may be found at the end of the appendix.

Existing Project

General. The Bois Brule Drainage and Levee District is located in Perry County, MO. and Randolph County, Ill. The town of Chester, IL lies across the Mississippi River at the upstream end of the district. The district lies in the floodplain of the Mississippi River and is bounded on the north by an abandoned channel of the Mississippi River, on the south and east by the Mississippi River and on the west by the Bois Brule Creek and the valley wall. Drawing 1 shows the alignment and general features of the existing levee district.

The district is currently protected by a 32-mile long levee designed to provide protection to the 50-year Mississippi River flood level with 2-feet of freeboard. The levee starts at/about station –1+00 at the valley wall, extends as upstream flank levee along the right bank of the abandoned Mississippi River channel to about station 210+00 where it becomes riverfront levee. This riverfront levee continues downstream along the right bank of the Mississippi River to about station 990+00 where it becomes a back levee on the left bank of the Bois Brule Creek. The levee extends upstream along the Bois Brule Creek to its terminus at the high ground at/about station 1750+00.

The upper flank levee varies in height from 16 to 20-feet and is located 400 to 900 feet from the abandoned river channel. The riverfront levee varies in height from 15 to 25 feet and lies from 500 to 2000 feet from the Mississippi River. The back levee varies in height from 15 to 30 feet and lies from 100 to 300 feet from the Bois Brule Creek.

Appurtenant Structures. The levee contains two railroad closure structures and one highway closure structure. The railroad closure structures allow passage of the Burlington Northern railroad tracks through the levee district and are located at station 0+11 and at station 1502+55. State Highway 51 falls from the town of Perryville on the Missouri bluff, passes over the back levee at the Bois Brule creek (station 1532+73), crosses through the levee district and passes through the riverfront levee closure structure (station 252+23). Riverside of this closure structure, Highway 51 crosses the Mississippi River and climbs the Illinois bluff into Chester Illinois. There are four pumping stations in the levee district; the Missouri Chute pumping station at project station 580+93, the Jones Cutoff station at project station 1001+52, the Cinque Hommes at station 1131+60, and the Bois Brule at 1466+56.

Existing Underseepage Control. Approximately 339 relief wells provide the necessary underseepage protection to this levee, landside seepage berms were generally not used in the original construction. One seepage berm was designed and installed as part of the levee repairs constructed in 1994. The relief wells were originally designed in 1952 and are built of wooden stave

well screens and riser pipes. The 97 relief wells between project stations 87+20 to 549+80 were installed by Luhr Brothers Inc, Columbia ILL, between April 1954 and July 1954, under contract number DA-23-065-Eng-5651. Gibbar Brothers Inc of Perryville MO installed 87 wells between stations 582+10 and 862+25 between August 1964 and June 1965 under contract DA-23-065-Eng-64-587. Gibbar Bros. Inc. also installed 150 relief wells from station 863+25 to 1500+00 between June 1965 and December 1965 under contract DA-23-065-Eng-65-628. The design is presented in TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*. The reaches of existing relief wells are shown on Table 1 and Drawing 1.

There are two reaches of relief wells that have been installed since the original work was completed. 41 relief wells were installed between project stations 863+00 and 937+00 and 3 wells were installed between stations 288+00 and 305+00 as part of the 1994 levee repairs.

Geology Of Project Site

The underlying deposits can be described as abandoned channel deposits and point bar deposits. As stated in TM 3-430, Investigation of Underseepage, Mississippi River Levees, Alton to Gale, Illinois: 'Several reaches of the levee are underlain by rather deep and wide deposits of clay. The levee crosses numerous swales and a number of rather large sloughs at stations 582, 818, 1005 and 1031, 1065, and several sloughs between stations 1110 and 1120.' The reader is directed to TM 3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*, April 1956, for a thorough discussion regarding the clay, sloughs and swales.

The point bar type deposits are generally equal distributions of silty clays and plastic clays with high quantity of silts and some silty sands. Point bar deposits are lateral accretion deposits that formed during the horizontal migration of the Mississippi. The river migrates laterally by building a lateral bar of silt and sand on its inside (point bar) bank, shifting to the outside (cut) bank through periodic failure of the outside bank. This results in a series of corrugated silty sand ridges and alternating clay filled depressions or swales. Hydraulic conductivities of the point bar deposits vary greatly, dependent on soil type.

Abandoned channel deposits are characterized as a heterogeneous mixture of highly plastic clays to medium plastic clays with varying amounts of silts and silty sands in neck areas. These deposits are the result of gradual infilling of lakes formed by the lateral migration of the Mississippi River. The thickness of the fine-grained deposits is generally greatest at the cutbank or outside edge of the abandoned channel at a point most distant from the points of the abandonment (the ends of the abandoned channel).

Below the alluvium, coarser sands and gravels are common. These deposits are much older, being deposited as valley train deposits during several of the Pleistocene stages of continental glaciation. The substratum sands vary in thickness from 75 to 135 feet and are highly pervious.

The bedrock beneath the site belongs to the Chesterian Series of the Mississippian System in the northern ½ of the district, and to the Cincinnatian Series of the Ordovician System in the southern ½ of the district. The Chester formations consist of successions of limestone, sandstone and shale. These beds are considerably faulted, dip steeply, and are hard to trace. The Cincinnatian Series consists of fossiliferous shales

and limestones. Bedrock can occur at a maximum depth of 135 feet below the ground surface.

Stratigraphy Of Project Site

The floodplain in the Bois Brule District varies from 2 to 4.5 miles wide and the soil stratigraphy is consistent with the previous geological discussion. Much of the surface geology is similar to the channel and sand bar deposits and deep clay deposits underlie several reaches of the levee. The levee crosses large, clay filled sloughs at project stations 582+00, 818+00, 1005+00, 1031+00 and 1065+00 and several smaller sloughs between station 1110+00 and 1120+00.

The soil profile along the levee toe shows a thick clay layer from stations 0+00 to 87+00 and 97+00 to 165+00. A rather continuous deposit of silt underlain by clay underlies the levee from station 200+00 to 280+00. Thick deposits of clay underlie the levee along the Bois Brule Creek and adjacent to the valley wall from station 1207+00 to 1755+00. The top stratum under the rest of the levee is highly irregular with numerous clay and silt filled swales.

The valley floor within the project area is fairly regular and the top of rock varies from elevation 229 to 285 feet NGVD. The deepest point of the valley floor is 135 feet below the ground surface at about station 814+00.

Existing Underseepage Protection

The Corps of Engineers designed the Bois Brule relief well system in 1952 and documented these results in TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*, dated April 1956. Two critical factors of this original design may be found in paragraphs #61 and #108 on pages 36 and 63. These paragraphs are reproduced here:

> **'61. The need for seepage control measures was based on a study of the thickness and characteristics of the top stratum landward of the levee, the thickness and permeability of the pervious substratum, the maximum possible net head on the levee, and the source of seepage. If the hydrostatic head at the landside toe of the levee computed from these factors and the following formulas was greater than 0.85 (0.67 in the East St. Louis levee district), some seepage control measures were considered warranted; if between 0.67 sand 0.85 (0.50 and 0.67 in the East St. Louis levee district), check piezometers were installed, and if less than 0.67 (0.50 in East St. Louis levee district), no piezometers or seepage control measures were considered warranted.'**
>
> **'108. The spacing of relief wells where a landside top stratum is present was set so that the head above tailwater or ground surface midway between wells a the design flood stage would not exceed 0.67 z in agricultural areas or 0.50 z in the East St. Louis levee district.'**

The selection of 0.85 as the critical vertical seepage gradient resulted in only 10-miles of the levee being protected by relief wells. At that same time, the Corps was considering using a lower critical gradient. The Waterways Experiments Station published TM-3-424, *Investigation of Underseepage and Its Control, Lower Mississippi River*; October 1956 for the President, Mississippi River Commission. Paragraph #675 on page 276 of this TM is reproduced below;

‘675. Seepage control measures are considered necessary where observed or estimate values of ho may be expected to equal or exceed h_c (approximately 0.75 z_t) at design flood stages.’

The design spacing of the Bois Brule relief wells was set so that the maximum gradient between the wells was no more than 0.67 z. At the same time, the Corps was considering a more conservative well spacing criterion. Paragraph number 675.a.(2) in TM 3-424 is reproduced below;

‘Where no control measures are present, relief wells should be designed so that imax midway between wells or landward from the well line does not exceed 0.5 to 0.6. Where landside berms wider than 100 ft are present, but additional control measures are considered necessary, relief wells should be designed so that imax = 0.6 to 0.7.’

The authors of TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*, may have tacitly acknowledged the more conservative criteria in the Lower Mississippi River TM. Page xvii of TM 3-430’s Summary contains the following paragraph;

‘At the time of this report, installation of relief wells is essentially compete in 13 of the 16 levee districts. Sixteen hundred and twenty-six of 2113 relief wells have been installed and pump-tested. Eight of the 14 landside seepage berms have been constructed. Installation of piezometers is essentially complete in 13 levee districts.’

Although the relief well installation in the Bois Brule drainage and levee district was not completed until 1965, by 1954, over half of the wells had been installed. It seems that no effort was going to be made to redesign the entire Alton to Gale system according to the more conservative criteria because most of the system was already installed.

Table 1 identifies the existing relief wells at the project. Each line represents a well reach in which the designers concluded that each of the variables in the underseepage analyses were homogenous throughout that reach. A blank line indicates a non-well reach. Groups containing more than one well subreach are contiguous, i.e. there is a continuous line of wells although the design spacing will vary from subreach to subreach. The variables in each column are identified below.

The first two columns in the table identify the beginning and ending project station of each well reach, or subreach of relief wells.

Column 3 shows the Net Levee Grade used in that reach.

H, is the total head (difference between design river height and the landside tailwater, tailwater is usually the landside ground surface) and h_o is the excess head at the landside levee toe.

z, is the calculated blanket thickness.

The Design Spacing is the well spacing for an infinite line of wells.

The Adjusted Spacing is the adjusted well spacing taking into account that the well reach may be less than infinitely long.

The Proposed Final Spacing is the final spacing after fitting the Reach Length Adjusted spacing into the actual length of that particular well reach.

The As-Built Spacing and Number of Wells columns describe the wells that were actually installed. Where the As-Built spacing is substantially smaller than the Proposed Final Spacing, the field engineers encountered more critical foundation conditions than assumed during the design.

Table 1

Reach Station From	Reach Station To	1956 50-yr NLG	H	h_o	z	Design Spacing	Adjusted Spacing	Proposed Final Spacing	As-Built Spacing	Number of Wells
87	96	391	19	7.8	8	260	240	220	220	5
325	330	389	24	13.8	13	235	235	200	240	3
330	340	389	23.5	12.2	10	205	205	200	200	5
340	345	389	22	11.6	10	220	220	220	180-220	3
353	370	389	21	10.7	8	180	180	180	180	10
370	372	389	20	10.9	11	285	285	250	250	1
393	398	389	24	11.4	9.5	240	240	200	200	3
398	408	389	24	12.2	8	155	155	150	130-150	7
408	411	389	25	10.6	11	230	230	160	160	3
411	413	388.5	21	8.7	7	225	225	225	225	2
423	428	388	21.5	8	7	170	170	175	175	3
428	432	388	21	10.3	7	155	155	150	135	2
432	434	388	23	10	5	100	100	100	100-120	2
434	442	388	23	11.5	8	160	160	160	160	6
467	472	388	22	10.6	11	250	240	200	200	3
472	477	388	21	10.1	10	230	220	200	185-200	3
486	513	388	22	10.4	9.5	210	210	200	200	14
513	520	387.5	23	10.3	7	145	145	200	150	4
520	533	387.5	20.5	7.3	8	205	205	200	130-160	9
533	545	387.5	24	11.8	10	200	200	200	160	6
545	550	387.5	27	10.2	9	170	170	175	160-175	3
605	608	386.5	19	8.2	8.5	185	170	200	200	2
608	613	386.5	20	11.3	10	185	170	200	200	3
631	635	386	19	12.5	15	225	225	200	200	3
635	639	386	18	11	10	170	170	175	175	2

Reach Station From	To	1956 50-yr NLG	H	h_o	z	Design Spacing	Adjusted Spacing	Proposed Final Spacing	As-Built Spacing	Number of Wells
639	647	386	21	13.8	15	195	195	200	200	4
647	657	386	20	13.4	15	215	215	200	200	5
657	662	386	19.5	12.5	10	145	145	150	150	3
662	674	386	18	11.2	10	160	160	160	160	7
674	679	386	20	9.7	10	150	150	210	210	1
679	685	386	17	8.5	9	150	150	150	150	5
685	691	386	20	10.3	12	160	160	150	150	4
691	696	385.5	18.5	10.9	12	165	165	175	175	3
696	698	385.5	16	8.5	11.5	200	200	225	225	1
709	716	385.5	19	11	12.5	225	195	200	200	4
721	724	385.5	20	10.4	9	160	110	120	125	3
739	752	385	19.5	10.4	10	175	175	175	175	8
752	756	385	20	9.4	12	250	250	200	200	2
807	816	385	21	9.6	8	235	210	200	200-225	5
820	827	384.5	18.5	7.2	6.5	185	185	185	150-200	4
827	836	384.5	22	9.4	8	190	190	200	200	5
843	851	384.5	22.5	10.1	5	115	115	120	120	7
851	856	384.5	20	10.5	11	285	285	255	255	2
856	863	384.5	21	7.3	7	175	175	175	175	4
863	876	384.5	22.5	7.5	5	120	120	125	See Note for wells destroyed or abandoned during/after 1993 flood.	
876	879	384.5	22	8.2	7	165	165	170		
879	884	384	23	8.4	6.5	145	145	155		
884	890	384	20	7.8	8	210	210	275		
890	900	384	23	9	8	180	180	175		
900	907	383.5	22.5	8.4	7	160	160	175		
907	924	383.5	21.5	8.2	7.5	180	180	175		
924	931	383	23.5	9.1	8	180	180	175		
931	934	383	24	7.1	5.5	155	155	175		
934	937	383	24	11.2	10	250	250	250		
937	942	383	24	7.2	6.5	180	180	175	150-175	3
956	963	382.5	25.5	12.4	13	310	280	300	250	5
967	986	382.5	26	12.3	11.5	265	265	250	250	8
986	995	382.5	27	12.3	10	215	215	200	150-200	5
1038	1039	Added during construction, not in original design							50	4
1040	1046	382.5	30	5.5	4	125	120	125	50	13
1046	1051	382.5	30	6.6	6.5	200	200	200	125	3
1051	1078	Added during construction, not in original design							125	23
1079	1086	382.5	29	9.5	8.5	190	170	200	200-214	4
1087	1100	Added during construction, not in original design							250	6

Reach Station From	To	1956 50-yr NLG	H	h_o	z	Design Spacing	Adjusted Spacing	Proposed Final Spacing	As-Built Spacing	Number of Wells
1101	1107	382.5	29	8.4	6	135	130	125	100	7
1107	1113	382.5	29	7.1	8.5	280	275	200	40-200	6
1141	1157	382.5	22	8.8	10	245	245	250	120-250	9
1359	1367	382.5	22	9.2	7.5	210	190	200	100	6
1490	1500	382.5	18	8.7	8	215	2.5	200	100-200	7

The wells between project station 863+00 and 937+00 were washed away or abandoned during the 1993 flood damage repairs. These wells were replaced with 41 new wells along the new levee that was setback landside of the original alignment.

Recent Underseepage Analyses

General. Recent underseepage analyses were performed using guidance found in EM 1110-2-1913 *Design and Construction of Levees*, EM 1110-2-1914 *Design, Construction and Maintenance of Relief Wells*, and DIVR 1110-1-400, Section 8, Part 6, Item 1 – *Design Procedures for Landside Seepage Berms for Mississippi River Levees* incorporating Change 2. These analyses evaluated the effectiveness of the existing seepage control measures (relief wells) for the 50-yr and 100-yr floods. These analyses also evaluated the seepage potential of all areas not protected by positive seepage control measures for the 50-yr and 100-yr floods. These analyses also considered the experience of the flood fight personnel in the Bois Brule levee district during the 1993 flood.

Hot Spot Wells. The flood fight team identified 9 'hot-spot' areas during the 1993 flood, areas that exhibited heavy or excessive seepage with attendant sand boils. The exploration and underseepage analyses completed in the 1950's and documented in TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois* do not indicate excess seepage or gradients in these hot-spot areas. Obviously, there are some physical conditions, stratigraphic or otherwise, that were not identified in the original work that are causing the excess seepage in these areas. The nine areas are listed in Table 2 prioritized by observed seepage conditions.

The conditions in the hot-spot areas assigned priorities 1 through 7 were deemed important enough to require corrective actions. Since the conditions causing the excess seepage are unknown, the St. Louis District chose to control the excess seepage in these hot spots with relief wells installed on spacings varying from 150 to 225 feet. The horizontal extent of hot spots priority nos. 1 and 2 encompass existing well reaches. In these reaches, new wells are proposed to be installed midway between the existing wells. The proposed work at the 7 hot spots envisions installation of 62 new relief wells.

Table 2

	Reach			
	From	To	Description of Seepage	Proposed Repairs
1	709+00	728+00	Heavy seepage with ringed sand boils. Additional flooding in 1995 causes more than 40 sand boils to occur.	709+00 to 716+00; 4 Existing Wells in Reach; Add 3 new wells. 716+00 to 721+00; Add 4 new wells at 150’ ctrs 721+00 to 724+00; 3 Existing Wells in Reach; Add 2 new wells. 724+00 to 728+00; Add 3 new wells at 150’ ctrs
2	542+00	556+00	Heavy seepage with sand boils ringed with sand bags. Constructed gravel weir (in landside ditch) to pond water. Problems mainly in landside ditch with sandy bottom. Problem reappeared in 1995.	542+00 to 545+00; 2 Existing Wells in Reach; Add 1 new well. 545+00 to 550+00; 3 Existing Wells in Reach; Add 2 new well 550+00 to 556+00; Add 5 new wells at 150’ ctrs
3	288+00	305+00	Heavy seepage with numerous small sand boils.	Installed 3 new wells as part of 1995 levee repairs.
4	170+00	240+00	Heavy seepage with numerous sand boils.	170+00 to 200+00; Higher levee, greater head. Add Minimum Seepage Berm for 50-Yr flood. Add 18 new wells at 175’ctrs for 100-yr flood. 200+00 to 240+00; Lower levee, less head. Add Minimum Seepage Berm for 50-Yr flood. Add 18 new wells at 225’ctrs for 100-yr flood.
5	758+00	760+00	Small sand boils noted in reach.	Add 2 new wells at 150’ ctrs
6	595+00	597+00	Small sand boil noted in reach.	Add 2 new wells at 150’ center
7	92+00	93+00	Pin boils at levee toe.	Add 2 new wells at 150’ center
8	859+00	860+00	Pin boils throughout.	No work proposed
9	667+00		6’ by 14’ by 3’ deep hole developed 300-feet landside of the landside levee toe.	No work proposed

Existing Relief Wells

Per the previous discussion, the existing relief wells were installed because the computed seepage gradient without the wells was higher than 0.85. The well spacing was computed to keep the maximum gradient (at the midway point between the wells) to no more than 0.67. Current guidance requires that positive underseepage protection be installed when the calculated gradient exceeds 0.50. Current guidance requires that the well spacing be such that the maximum gradient (at the midway point between the wells) is no more than 0.50.

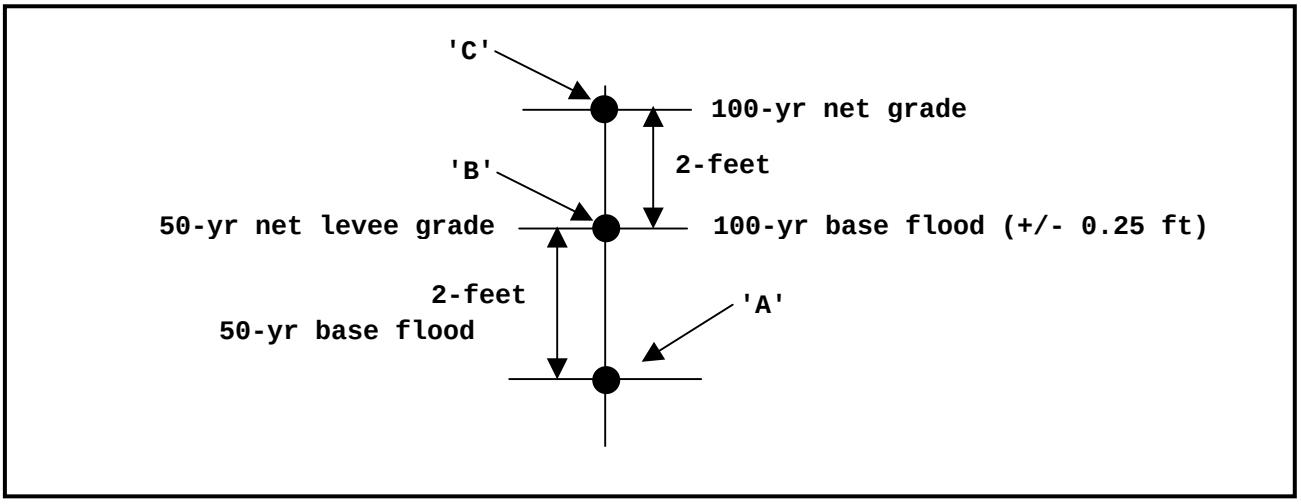
Discussion with Mr. Tony Young of MVD (meeting August 1998) clarified and slightly modified this requirement. The action level for installation of new positive underseepage protection was set to a combination of computed gradients for the base flood and net levee grade flood elevations. If the computed gradient at the landside levee toe substantially exceeded 0.50 for the base flood and 0.60 for the net levee grade, then positive underseepage control was considered warranted. A flood to the net levee grade is considered a more rare event, and a slightly higher gradient can be tolerated. Where relief wells were installed, the well spacing was designed to limit the maximum allowable gradient between the wells to 0.50 at the base flood elevation.

The existing wells are constructed of wooden stave riser pipes and screen sections. The friction head losses in these wells were based on flow measurements made on new, wooden-stave well screens. It is documented that the effectiveness of the relief wells is considerably less than when the wells were installed due to incrustation of the well screens and bio fouling of the gravel pack and aquifer. Although the screen incrustation can be removed by scrubbing, and the gravel pack can be cleaned by redevelopment with food grade acids, the rehabilitated wells rarely achieve more than 75 or 80% of their original effectiveness. These analyses have taken this into account, assigning 80% effectiveness to all wells within a given well reach.

Where existing wells did not reduce the maximum gradient to 0.50 at the base flood elevation or 0.60 at the net levee grade, new wells were proposed to increase the seepage protection. The new wells would be installed within the existing well line, split-spacing the existing well spacing. The existing relief wells were designed assuming a 50% penetration into the underlying coarse-grained aquifer. The new wells have been assumed to be shorter, with aquifer penetrations of 30%. The average penetration of the well reach (with old wells and new wells) was set to 40% in these analyses.

The existing well reaches were analyzed for the 50-yr and 100-yr flood elevations. Within each event, the effectiveness of the well reaches was analyzed for the base flood elevation and flood elevation to the net levee grade elevation. Convenient relationships between the 50-yr and 100-yr base flood and net levee grade elevations eased the number of calculations that were made in these analyses. The original design assumed 2-feet of freeboard for the 50-yr flood. Thus the 50-yr net levee grade is 2-feet higher than the 50-yr base flood. The high water marks obtained from the 1993 100-yr flood are very close (within 0.20 or 0.30 feet) to the original 50-yr net levee grade. These analyses assumed a constant 2-feet of freeboard for the 100-yr design, so the 100-yr net levee grade is two feet higher than the 100-yr base flood. Figure 1 illustrates these relationships:

Figure 1



The calculated gradient for the 50-yr net levee grade is also the gradient for the 100-yr base flood (both at point 'B'). The calculation for the gradient at the landside levee toe is a closed form solution and it is linear with respect to the flood height. This linearity and the fact that the various flood heights differ by a constant 2-feet allow for simple calculation of the gradient at the 100-net levee grade (point 'C'). This gradient is achieved by adding the difference in gradients between points 'A' and 'B' to the calculated gradient at point 'B'.

The computations were done according to the methods described in TM-3-424, *Investigation of Underseepage and Its Control, Lower Mississippi River*; October 1956. A DOS based, computer program written by Patrick J. Conroy (CEMVS-ED-GF, 1984) in the BASIC language was used to analyze the 54 separate existing well reaches identified in TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*. All of the original well design assumptions documented in TM 3-430 were used in this analysis. These recent well analyses were completed for the 50 and 100-yr base flood and net levee grade river heights, and for 80% well effectiveness. The results of these analyses are documented on Table 3. Where the calculated gradient for the existing well system in a given reach exceeds 0.50 for the base flood and 0.60 for the net levee grade flood, new wells are recommended. The new wells would be installed halfway between the existing wells, be built of stainless steel risers pipes and continuous wire wrap well screens and installed to an aquifer penetration of 30%. These analyses show that 91 additional wells must be added to the existing system for the 50-yr flood and 166 wells added to the existing system (75 wells over and above the 50-yr requirement) for the 100-yr flood.

Non-Well Reaches

Although there are 339 relief wells currently installed in the Bois Brule Drainage and Levee District, they protect only 10-miles of the 32-mile long levee district - 22 miles of the levee district have no positive underseepage protection. These 22 miles of levee were analyzed for underseepage potential. Information on the stratigraphy was obtained from:

TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*. Plates 139 to 151 entitled 'Soil Profiles, Relief Wells and Piezometers'.

Drawings from contract documents for *Improvements to Levees, Item V-a* dated 10 March 1961.

Drawings from contract documents for *Improvements to Levees, Item V-b* date unavailable.

Drawings from contract documents for *Improvements to Levees, Item V-c* dated 2 April 1956.

Drawings from contract documents for *Improvements to Levees, Item VI-a* dated 2 August 1955.

Drawings from contract documents for *Improvements to Levees, Item VI-b* dated 30 April 1953.

Drawings from contract documents for *Improvements to Levees, Item VI-c* dated 30 April 1953.

The data in the above documents was studied to determine the start/end of the sub-reaches for the well analyses. A sub-reach is a length of levee wherein each of the variables involved in the well analyses are substantially constant throughout that length. A new subreach was identified where any of the following variables changed:

Stratigraphy. Where the coarse-grained aquifer changed thickness or the permeability of the material in the aquifer changed. Or where the thickness of the landside or riverside blanket changed or the permeability of the material in either the landside or riverside blanket changed.

Geometry. Where the levee height changes abruptly or where the levee width changes due to change in side slope or riverside or landside berms start or end. Or where the prevailing landside or riverside elevations changes abruptly due to changes in landform or borrow pits.

River or creek. Where the distance from the riverside levee toe to the near edge of the river or creek changes abruptly. Or where the direct hydraulic connection between the river or creek with the underlying aquifer is blocked by clay or other relatively impermeable material.

Borrow pits. Where riverside or landside borrow pits start or end.

Blocked exits. Where the aquifer is blocked landside or the levee by the valley wall or where there is a significant increase in the landside blanket thickness a short distance landside of the levee.

This study yielded approximately 70 sub-reaches between project station 0+00 and 1250+00, these are in addition to the previously identified 57 existing well reaches. No sub-reaches are necessary beyond station 1250+00 because the exploration indicates that the Bois Brule Creek has a clay bottom and is not hydraulically connected to the aquifer. These sub-reaches are

identified by project station on Table 4 (for 50-yr flood) and Table 5 (for 100-yr flood).

The seepage potential of each of these sub-reaches was analyzed using the methods and guidance found in EM 1110-2-1913 *Design and Construction of Levees*; EM 1110-2-1914 *Design, Construction and Maintenance of Relief Wells*; and DIVR 1110-1-400, Section 8, Part 6, Item 1 – *Design Procedures for Landside Seepage Berms for Mississippi River Levees* incorporating Change 2. CEMVS-ED-GF developed a Microsoft Excel workbook to complete the underseepage analyses. The workbook has multiple worksheets in it including the Basic Data sheet, the Well Design sheet, the Seepage Berm design sheet and various other worksheets dealing with costs, interior flows and water berms. .

Basic Data

The Basic Data sheet includes all of the geotechnical design parameters necessary to complete an underseepage analyses for each subreach. The Basic Data sheet calculates the vertical seepage gradient at the landside levee toe for each sub-reach for the base flood and net levee grade flood height of the 50 and 100-yr floods. This calculation was done assuming that positive underseepage controls (i.e. relief well or seepage berms) were not in-place. If the computed gradient at the landside levee toe substantially exceeded 0.50 for the base flood and 0.60 for the net levee grade, then positive underseepage controls were considered warranted. The basic data and the results of these initial analyses for all of the sub-reaches are shown on Table 4 for the 50-yr flood and on Table 5 for the 100-yr flood. The right hand column on each sheet shows whether or not underseepage controls are considered necessary for that reach.

Well Design

Relief wells were designed assuming new wells constructed of stainless steel riser pipes and continuous wire wrap well screens and installed to an aquifer penetration of 50% at spacings that limit the maximum gradient between the wells to 0.50 for the base flood elevation. The trial well spacing that limits the maximum gradient between the wells to 0.50 is computed assuming the well sub-reach is infinitely long. The reach length adjustment adjusts the trial well spacing downward, adjusting for 'wrap-around' and other 3-dimensional flow effects at the ends of 'short' well reaches. The adjusted well spacing is then adjusted so that an integer number of wells can be installed within the finite length of the sub-reach.

The results of the analyses are shown on Table 6 for the 50-yr flood and on Table 7 for the 100-yr flood. These analyses show that 235 additional wells must be added to the existing non-well reaches for the 50-yr flood and 279 wells added to the existing non-well reaches (44 wells over and above the 50-yr requirement) for the 100-yr flood.

Seepage Berms

Seepage berms were designed for all of the non-well reaches according to the guidance in DIVR 1110-1-400, Section 8, Part 6, Item 1 – *Design Procedures for Landside Seepage Berms for Mississippi River Levees* incorporating Change 2. The results of these analyses are shown on Table 8 for the 50-yr flood and on Table 9 for the 100-Yr flood. A cost comparison was done for both methods of positive underseepage control using the following unit costs:

Relief Wells: Cost of wells per sub-reach is equal to the required number of wells multiplied by $15,000.00 per well. This cost is the well construction cost quoted to the St. Louis District by the Vicksburg District.

Seepage Berms: The volume of the berm (in ft^3) was multiplied by $4.00/$ft^3$ to account for construction costs. The planar area of the berm (in acres) was multiplied by $2,200/acre to account for real estate costs.

In most sub-reaches, there was only a slight difference in the cost of berms vs. the cost of relief wells and in these cases; relief wells were the seepage control method of choice. In a few sub-reaches, the landside seepage berms were much more economical than the relief wells and the plan has incorporated these berms. The following tables list the proposed berm locations for the 50-yr and 100-yr flood.

Proposed Seepage Berms for 50-Yr Flood				
Station From	Station To		Berm Width	Berm Thickness
170+00	240+00		150*	5
716+00	720+00		150	5
758+00	774+00		150	5
774+00	777+00		300	8

*This berm was added to Hot Spot area No. 5 after qualitative review. See discussion below.

Proposed Seepage Berms for 100-Yr Flood				
Station From	Station To		Berm Width	Berm Thickness
347+50	350		150	5
413+00	420+00		150	6
420+00	423+00		150	5
716+00	720+00		150	6
720+00	721+00		150	5
758+00	774+00		170	6
774+00	777+00		300	9

An additional qualitative cost study was completed on the four pumpstation areas. Within the Jones Cutoff, Cinque Hommes and Missouri Chute pumpstation areas, there will be substantial numbers of new relief wells that must be installed within the existing well reaches. It has been assumed that the flows from these wells and additional wells installed within the existing non-well areas will require additional pumping capacity in these three areas.

In the area that drains to the Bois Brule pumpstation, there are only 5 existing relief wells. The underseepage requirements require only 4 additional wells to be installed within this existing well reach. Although the cost of relief wells and seepage berms are very comparable in the non-well reaches, installation of relief wells for the 50-yr deficiency study will increase interior flows and possibly require additional pumping capacity. If seepage berms are installed in the existing non-well reaches for the 50-yr deficiency study, the interior flows will stay approximately the same and no additional pumping capacity is necessary. The 50-yr

deficiency study includes a minimum seepage berm in the hot spot from station 170+00 to 240+00.

Interior Flow Analyses

Although a detailed interior flow analyses has not been completed for this report, one will be completed when the survey data is completed. Only then will the need for additional pumping capacity at the four pumpstations be know with any certainty.

Probable Non-Failure Point (PNP) and Probable Failure Point (PFP)

General. The purpose of this analysis is to determine the Probable Non-Failure Point (PNP) and the Probable Failure Point (PFP). The PNP is the flood elevation at which there is a 15% chance of unsatisfactory performance and the PFP is the elevation at which there is an 85% chance of unsatisfactory performance. 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, the guidance presented in ETL 1110-2-328, *Reliability Assessment of Existing Levees for Benefit Determination* and the results of 35+ years of flood fight experience to determine the PFP and the PNP of the existing Bois-Brule levee.

Observations of Levee Performance

The St. Louis District has substantial 1st-hand knowledge of the Bois Brule levee district, having participated in its design and construction, and participated in and directed numerous flood fights since the levee's construction in the 1950's. Inspection, piezometers readings, relief well flow measurements and/or levee repairs during recent flood fight operations in 1973, 1982, 1986, 1993 and 1995 have provided the St. Louis District with a solid base of experience and knowledge on the performance aspects of the Bois Brule drainage and levee district. This experience tells us that the overriding concern during a flood fight, the failure mechanism that drives all aspects of any flood fight operation in the Bois Brule levee district is excessive underseepage and the formation of sand boils.

TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*, set the action level for installation of positive seepage protection as a calculated upward seepage gradient of 0.85. This action level resulted in the installation of relief wells along about 10-miles of the levee. Flood fights in 1973, 1982, 1986, 1993 and 1995 have clearly demonstrated that many areas not protected from underseepage continue to be a source of concern to the St. Louis District and the levee district.

The 1973 and 1993 floods are the best documented of the recent floods. In June 1976, the St. Louis District published its *Performance of Underseepage Controls During the 1973 Flood*. This publication lists 'Priority I Reaches'; levee reaches that showed excessive gradients (based on calculations from piezometers readings) or exhibited obvious underseepage problems (heavy seepage or sand boils) during the 1973 flood or predictions of extremely high gradients at design flood. This publication also lists 'Priority II Reaches'; levee reaches whose measured piezometric levels were predicted to approached the critical gradient at design flood. The Priority I and II reaches are:

Sta 270+00 to 325: Heavy seepage was reported in this vicinity. Seepage was reported early in the flood. Piezometer readings suggest that the critical gradient was attained.

Sta 325+00 to 330+00: Piezometers read in excess of the actual conditions on the well line.

Sta 353+00 to 370+00: Wells 17 through 26 are in this reach. Extrapolation of data from piezometers P-11 to design flood indicated a gradient of 0.88. This gradient is considerably above the allowable design gradient for a well reach.

Stat 423+00 to 434+00: Using piezometers data and a design tailwater of 365.0 ft., the gradient is 1.02.

Sta 545+00 to 550+00: Wells 90 through 92 are in this reach. Data from piezometers P-34 extrapolated to design flood yields a gradient of 1.38.

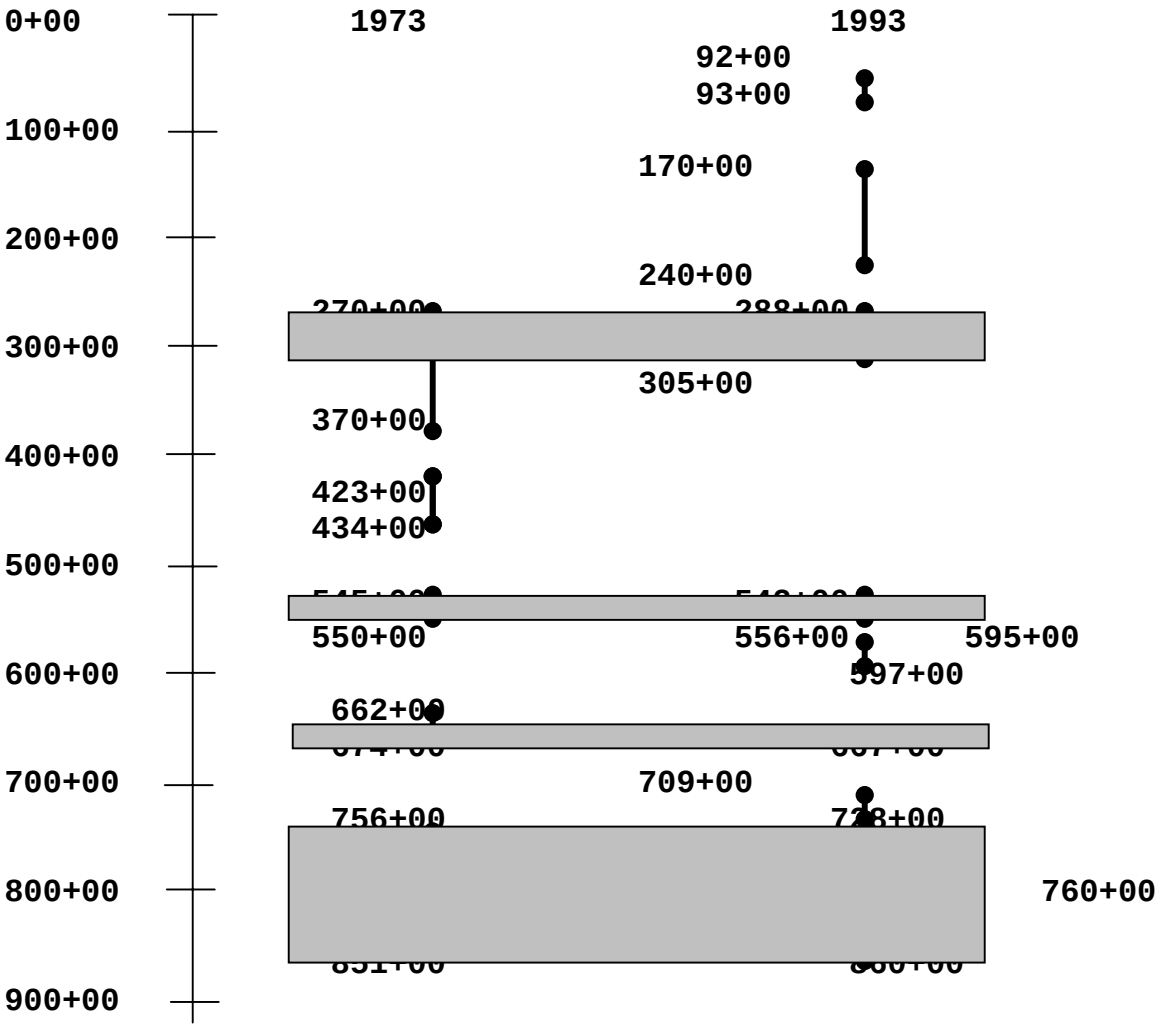
Sta 662+00 to 674+00: Piezometer P-53 fluctuated very little suggesting that it may be installed in a sand layer surrounded by clays or that the device is damaged.

Sta 756+00 to 807+00: Maximum measurements obtained during the flood from four piezometers in this reach showed gradients from 0.20 to 0.39. Predicted gradients extrapolated to design flood heights ranged from 0.58 to 0.68. The area requires additional study to determine a need for an additional relief.

Sta 843+00 to 851+00: The gradient in 1973 was calculated to be 0.76 and the measured 'S' distance, the distance from the landside levee toe to the effective entrance) was calculated to be 350 feet, substantially less than the design value.

A graphical representation of the 1973 Priority I and II reaches and the 1993 Hot Spot areas is shown on Figure 2. Note the strong correlations between four of the 1973 priority I and II areas and the 1993 hot spot areas.

Figure 2



After the 1993 flood, the district hired Mr. Charles Mansur, as a consultant through Shannon and Wilson Inc. to evaluate the performance of the Alton to Gale Illinois underseepage control measures during the 1993 flood. Mr. Mansur was one of the original authors of TM-3-430, *Investigation of Underseepage Mississippi River Levees, Alton to Gale, Illinois*. Table 5 from Mansur's 'Summary of Underseepage Study of Mississippi River Levees Alton to Gale, Illinois' is shown on Figure 3.

TABLE 5

SUMMARY OF UNDERSEEPAGE STUDY OF MISSISSIPPI RIVER LEVEES
ALTON TO GALE, ILLINOIS

		Berms	Without Relief Wells						Relief Wells					
Levee District	Total Levee Footage (feet)	Levee Footage with Seepage Berms (feet)	Levee Footage without Relief Wells (feet)	Percent of Levee District without Relief Wells	Length of Levee without Relief Wells and Uplift Gradient i > 0.7 (feet)	Percent of Levee without Relief Wells and Uplift Gradient, i > 0.7	Length of Levee without Relief Wells and Sand Boils or Piping (feet)	Percent of Levee without Relief Wells with Sand Boils or Piping	Levee Footage with Relief Wells (feet)	Percent of Levee District Protected with Wells	Levee Footage with Relief Wells and Uplift Gradient, i > 0.7	Percent of Well Reaches with Gradient, i > 0.7	Levee Footage with Relief Wells and Sand Boils or Piping (feet)	Percent of Relief Well Reaches with Sand Boils or Piping
Prairie DuPont	54,600	?	38,820	71%	0	0%	2,000	5%	15,780	29%	5,300	34%	900	6%
Columbia	104,644	?	86,744	83%	1600	2%	3,100	4%	17,900	17%	8,900	50%	600	3%
Harrisonville	113,214	?	79,289	70%	3,900	5%	8,575	11%	33,925	30%	13,200	39%	300	1%
Fort Chartres	68,390	?	42,540	62%	3,000	7%	1,250	3%	25,850	38%	9,600	37%	0	0%
Prairie DuRocher	87,094	?	64,194	74%	500	1%	3,220	5%	22,900	26%	3,500	15%	950	4%
Bois Brule	174,620	?	119,990	69%	10,440	9%	100	0%	54,630	31%	13,850	25%	0	0%
Degognia	82,700	?	52,500	63%	9,770	19%	2,400	5%	30,200	37%	13,470	45%	0	0%
Grand Tower	93,800	?	69,950	75%	0	0%	100	0%	23,850	25%	7,450	31%	0	0%
Preston	77,200	?	77,200	100%	---	No information	8,500	11%	0	0%	0	No information	0	No information
East Cape Girardeau	57,000	?	43,100	76%	3,250	8%	3,050	7%	13,900	24%	2,400	17%	0	0%
Clear Creek	114,914	?	114,914	100%	---	No information	4,675	4%	0	0%	0	No information	0	No information
North Alexander	27,200	?	27,200	100%	---	No information	1,300	5%	0	0%	0	No information	0	No information
Totals	1,028,176	No information	789,241		32,460		36,970		238,935		77,670		2750	
Average				77%		4%		5%		23%		33%		

The sixth line in Mansur's Table 5 shows that of the 119,990 feet of Bois Brule levee without relief wells, 10,440 feet exhibited gradients greater than 0.70. In other words, over 2-miles of levee exhibited gradients greater than the allowable gradient typically used in underseepage calculations.

Calculations of PNP

Probabilistic underseepage analyses were completed to determine a PNP for the priority #1 hot spot between project stations 709+00 and 728+00. The probabilistic models used in these analyses are based on the Corps' traditional, deterministic method of underseepage analyses, a method that has been widely published in Corps Engineering and Technical Manuals. 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.

Variable	Expected Value	Coeff of Variability
Landside Blanket Thickness, Z_{BL} and Z_t	Transformed Thickness varies with stratigraphy and flood history	.25
Based on Permeability, K_f	Dependant on D_{10} Coeff of Variability Based on Harr's recommendation	.90
LS Blanket Permeability, K_{BL}	Dependant on Z_{BL} and flood history. Coeff of Variability based on Harr's recommendation	.90

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.

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.

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}.

In these probabilistic seepage analyses, unsatisfactory performance is defined as underseepage gradients that exceed a value of 0.50. This seepage gradient value is generally accepted within the St. Louis District and the Mississippi Valley Division Office as being an action level for excess underseepage. If the seepage analyses predicts gradients of 0.50 or above then positive underseepage controls are considered warranted.

A river elevation of 379.3 creates a 15% probability that the seepage gradient exceeds 0.50.

Calculations of PFP

Using the technique described above for the PNP, the St. Louis District calculated the river elevation that creates an 85% probability that the seepage gradient exceeds 0.50. In the early part of the year 2000, Congresswoman Emerson requested that CEMVD perform a technical review of the work that the St. Louis District had completed on the Bois Brule study. During this review, Mr. Tony Young wrote the following:

> 'In 1993, the levee failed at a Chester gage elevation 388.3 before the levee was overtopped. Although the levee actually failed downstream of station 709+00, the fact that there were more than 100 sand boils between stations 709+00 and 728+00 in 1993, and about 40 sand boils again at a lower stage in 1995 is strong evidence that the PFP should be based on underseepage rather than overtopping. Assuming a 100 percent probability of failure at elevation 388.3, which did in fact occur in 1993, interpolation between this elevation and PNP elevation 379.3 results in a PFP at 85 percent probability of failure at about elevation 387.0 on the Chester gage. Therefore, a PFP elevation of 387.0 at the Chester gage should be used and incorporated into the economic analysis.'

Slope Stability Analyes

General. The stability of the levee section at project station 248+00 was analyzed to determine the feasibility of increasing the levee height and steepening the landside levee slope. The analysis was completed at this particular location because there was detailed survey information and site-specific geotechnical information on hand. The survey information was obtained in 1996 and the boring was completed in 1992.

SLD performed slope stability analyses of circular, trial failure surfaces using the computer program Utexas4. Spencer's method was utilized to assure that moment and force equilibrium was determined in the solutions. The searching capability of Utexas was used to find the critical failure surface. These analyses were done according to methods set forth in EM 1110-2-1902 *Stability of Earth and Rockfill* Dams and EM 1110-2-1913, *Design and Construction of Levees*. The specific details of the stability analyses are described in the following.

Geometry. The existing levee cross section consists of an 18-foot tall riverside slope with an average slope of 1v:3.5h. The landside slope is 16-feet tall with an average slope of 1v:3.3h. The crown at this station is 25-feet wide.

Stratigraphy. Boring BB-07U-92 was drilled from the levee centerline and undisturbed soil samples were obtained on approximate 5-foot centers to a 45-foot depth. These samples consist of clays (CL and CH) from the top of the levee to a depth of 21-feet, just below the landside toe. Subjacent to this is a silt (ML) layer from 21 to 27-feet and then clay (CH) from 27-feet to the bottom of the boring. Undrained strengths of the clay were obtained from unconfined compression tests completed on selected samples of the clays. Drained strength of the clays were inferred from plasticity index relationships developed by the US Navy and Ladd as published in *An Introduction to Geotechnical Engineering* by Holtz and Kovaks 1981; figure 11.27.

After Construction Case. Inspection of the testing showed that the averages undrained strengths for the various fine-grained layers ranged between 1100 and 1450 psf. Based on experience, the St. Louis district considered these strengths to be high enough to provide adequate factors of safety for the after-construction case. No detailed stability analyses were performed for this case.

Steady Seepage Case. Stability analyses were completed on the landside slopes for the drained case. Analyses were performed on the existing cross section and on revised cross sections including 16, 18, 20, 22 and 24-foot tall levees with 1v:3h and 1v:4h slopes. The design flood height was set to 1-foot below the top of the levee. Given the expected long duration of Mississippi River floods, SLD modeled through-seepage through the embankment for each levee height and landside slope using Casagrande's parabolic construction. In all cases, deep, shallow and slope circles were used to initiate the UTexas search routines.

Discussion of Results. The first point that must be emphasized in this discussion is that the Bois Brule levee has been in-place for almost 30-years and, from a slope stability point of view, has successfully withstood many floods, including the 1993 100-year flood. Occurrences of slope instability are rare, there being 5 instances of shallow failures in the landside slope since 1975 and these have happened during non-flood times.

The results of this drained-case stability analyses on the landside slopes are shown below:

Slope Height	Crit FS 1v:3h slope	Crit FS 1v:3.3h slope	Crit FS 1v:4h slope	Location of Critical Surface
Existing Slope				
16		1.10		Under discharge face at levee toe.
Revised Slopes				
16	.98		1.21	Under discharge face at levee toe.
18	.88		1.10	Under discharge face at levee toe.
20	.84		1.03	Under discharge face at levee toe.
22	.75		1.00	Under discharge face at levee toe.

Although this stability analyses predicts factors of safety in excess of 1.0 for the existing 1v:3.3h slope and 1v:4h slopes, none of these computed factors of safety meet the Corps criteria stated in the Engineering Manuals referenced above. This should not be construed to infer that the existing slopes are unsafe. As stated earlier, the Bois Brule levee has exhibited solid performance for almost 30-years, with only a few, minor occurrences of slope instability on the landside slope. The computed factors of safey may illustrate shortcomings in the empirical drained strength relationship or in the assumption of purely undrained behavior.

SLD believes levee raises up to 24-inches may be safely made by capping the crown of the existing levee assuming that the crown width after the raise is wide enough to pass vehicular traffic. The recent analyses show that the critical surfaces are under the discharge face at the levee toe and adding 24-inches of clay on the levee crown will not impact this area. Additionally, there do exist levee sections that are already as high as the raised levee would be, and these existing sections are successful.

Levee raises higher than 24-inches should be done using landside enlargements. The slopes of the sliver fills on the landside should not be constructed steeper than the slope of the existing levee where the enlargement is made. In many cases, the existing levee includes a 50-foot wide, landside stability berm, and the sliver fill could 'land' on the stability berm. The minor shortening of the stability berm (by 3 or 4-feet) should be of no consequence to the section's stability.

Table 3: Analyses of Existing Wells 1

Reach Station From	Reach Station To	Data Presented in TM 3-430: 1956 50-yr NLG	H	h0	z	Design Spacing	Reach Len Adj	As Built Spacing	No. Wells in Reach	Fix Hot Spots	# Add'l Wells	eff = 80% I@50 Yr WS	eff = 80% i@50Yr NLG = 100yr WS	Need New Wells?	# Add'l New Wells	eff = 80% i@50Yr NLG = 100yr WS	eff = 80% i@100yr NLG	Need New Wells?	# Add'l New Wells	
87	96	391	19	7.8	8	260	240	220	5			0.46	0.58	N	0	0.58	0.7	Y	4	
92	93	Problem non-well reach in '93 flood. Add 2 wells.								Y	2									
170	200	Problem non-well reach in '93 flood. Add 18 wells.								Y	18									
200	240	Problem non-well reach in '93 flood. Add 18 wells.								Y	18									
255	300	Problem non-well reach in '93 flood. Added 3 wells in '94								Y	0									Wells added in 1994 levee repairs.
325	330	389	24	13.8	13	235	235	240	3			0.59	0.7	Y	2	0.7	0.81	Y	2	
330	340	389	23.5	12.2	10	205	205	200	5			0.63	0.76	Y	4	0.76	0.89	Y	4	
340	345	389	22	11.6	10	220	220	220	3			0.59	0.72	Y	2	0.72	0.85	Y	2	
353	370	389	21	10.7	8	180	180	180	10			0.6	0.74	Y	9	0.74	0.88	Y	9	
370	372	389	20	10.9	11	285	285	250	1			0.51	0.63	N	0	0.63	0.75	Y	2	
393	398	389	24	11.4	9.5	240	240	200	3			0.54	0.66	N	0	0.66	0.78	Y	2	
398	408	389	24	12.2	8	155	155	150	7			0.65	0.79	Y	6	0.79	0.93	Y	6	
408	411	389	25	10.6	11	230	230	160	3			0.52	0.6	N	0	0.6	0.68	Y	2	
411	413	388.5	21	8.7	7	225	225	225	2			0.68	0.8	Y	1	0.8	0.92	Y	1	
423	428	388	21.5	8	7	170	170	175	3			0.6	0.73	Y	2	0.73	0.86	Y	2	
428	432	388	21	10.3	7	155	155	150	2			0.61	0.75	Y	1	0.75	0.89	Y	1	
432	434	388	23	10	5	100	100	100	2			0.72	0.87	Y	1	0.87	1.02	Y	1	
434	442	388	23	11.5	8	160	160	160	6			0.6	0.73	Y	5	0.73	0.86	Y	5	
467	472	388	22	10.6	11	250	240	200	3			0.46	0.54	N	0	0.54	0.62	N	0	
472	477	388	21	10.1	10	230	220	200	3			0.48	0.57	N	0	0.57	0.66	Y	2	
486	513	388	22	10.4	9.5	210	210	200	14			0.53	0.62	N	0	0.62	0.71	Y	13	
513	520	387.5	23	10.3	7	145	145	150	4			0.48	0.72	Y	3	0.72	0.96	Y	3	
520	533	387.5	20.5	7.3	8	205	205	150	9			0.33	0.49	N	0	0.49	0.65	Y	8	
533	542	387.5	24	11.8	10	200	200	160	6			0.48	0.57	N	0	0.57	0.66	Y	5	
542	545	387.5	24	11.8	10	200	200	140	2	Y	1	0.44	0.53	N	0	0.53	0.62	N	0	Wells included in Hot Spots

		Data Presented in TM 3-430																								
Reach Station		1956 50-yr				Design	Reach	As Built	No. Wells in Reach		Fix	# Add'l		eff = 80%	eff = 80%				eff = 80%	eff = 80%		# Add'l New Wells					
From	To	NLG	H	h0	z	Spacing	Len Adj	Spacing			Hot Spots	Wells		l@50 Yr WS	i@50Yr NLG = 100yr WS	Need New Wells?	# Add'l New Wells		i@50Yr NLG = 100yr WS	i@100yr NLG	Need New Wells?						
545	550	387.5	27	10.2	9	170	170	175	3		Y	2		0.54	0.63	N	0		0.63	0.72	Y	0	Wells included in Hot Spots.				
550	556	Problem non-well reach in '93 flood. Add 5 wells.									Y	5															
582	583								3																		
583	585	n/a - well at gravity drain							3																		
595	597	Problem non-well reach reach in '93 flood. Add 2 wells.									Y	2															
605	608	386.5	19	8.2	8.5	185	170	200	2					0.52	0.64	N	0		0.64	0.76	Y	1					
608	613	386.5	20	11.3	10	185	170	200	3					0.55	0.67	Y	2		0.67	0.79	Y	2					
631	635	386	19	12.5	15	225	225	200	3					0.41	0.51	N	0		0.51	0.61	N	0					
635	639	386	18	11	10	170	170	175	2					0.56	0.69	Y	1		0.69	0.82	Y	1					
639	647	386	21	13.8	15	195	195	200	4					0.47	0.57	N	0		0.57	0.67	Y	3					
647	657	386	20	13.4	15	215	215	200	5					0.45	0.55	N	0		0.55	0.65	Y	4					
657	662	386	19.5	12.5	10	145	145	150	3					0.57	0.7	Y	2		0.7	0.83	Y	2					
662	674	386	18	11.2	10	160	160	160	7					0.52	0.64	N	0		0.64	0.76	Y	6					
674	679	386	20	9.7	10	150	150	210	1					0.58	0.68	Y	2		0.68	0.78	Y	2					
679	685	386	17	8.5	9	150	150	150	5					0.48	0.58	N	0		0.58	0.68	Y	2					
685	691	386	20	10.3	12	160	160	150	4					0.53	0.63	N	0		0.63	0.73	Y	3					
691	696	385.5	18.5	10.9	12	165	165	175	3					0.55	0.64	Y	2		0.64	0.73	Y	2					
696	698	385.5	16	8.5	11.5	200	200	225	1					0.4	0.51	N	0		0.51	0.62	N	0					
709	716	385.5	19	11	12.5	225	195	200	4		Y	3		0.5	0.61	N	0		0.61	0.72	Y	0	Wells included in Hot Spots				
716	721	Problem non-well reach in '93 flood. Add 4 wells.									Y	4															
721	724	385.5	20	10.4	9	160	110	120	3		Y	2		0.52	0.63	N	0		0.63	0.74	Y	0	Wells included in Hot Spots				
724	728	Problem non-well reach in '93 flood. Add 3 wells.									Y	3															
739	752	385	19.5	10.4	10	175	175	175	8					0.56	0.68	Y	7		0.68	0.8	Y	7					
752	756	385	20	9.4	12	250	250	200	2					0.42	0.51	N	0		0.51	0.6	N	0					
758	760	Problem non-well reach reach in '93 flood. Add 2 wells.							3		Y	2															
807	816	385	21	9.6	8	235	210	200	5					0.56	0.67	Y	4		0.67	0.78	Y	4					
820	827	384.5	18.5	7.2	6.5	185	185	185	4					0.59	0.72	Y	3		0.72	0.85	Y	3					
827	836	384.5	22	9.4	8	190	190	200	5					0.67	0.79	Y	4		0.79	0.91	Y	4					

		Data Presented in TM 3-430																										
Reach Station		1956 50-yr				Design	Reach	As Built	No. Wells in Reach		Fix	# Add'l		eff = 80%	eff = 80%				eff = 80%	eff = 80%		# Add'l New Wells						
From	To	NLG	H	h0	z	Spacing	Len Adj	Spacing			Hot Spots	Wells		I@50 Yr WS	i@50Yr NLG = 100yr WS	Need New Wells?	# Add'l New Wells		i@50Yr NLG = 100yr WS	i@100yr NLG	Need New Wells?							
843	851	384.5	22.5	10.1	5	115	115	120	7					0.81	0.96	Y	6		0.96	1.11	Y	6							
851	856	384.5	20	10.5	11	285	285	255	2					0.5	0.59	N	0		0.59	0.68	Y	1							
856	863	384.5	21	7.3	7	175	175	175	4					0.57	0.65	Y	3		0.65	0.73	Y	3							
863	937	Replace w/41 new wells designed to 100-yr NLG							41																				
937	942	383	24	7.2	6.5	180	180	175	4					0.56	0.67	Y	3		0.67	0.78	Y	3							
956	963	382.5	25.5	12.4	13	310	280	250	5					0.47	0.56	N	0		0.56	0.65	Y	4							
967	986	382.5	26	12.3	11.5	265	265	250	8					0.52	0.63	N	0		0.63	0.74	Y	7							
986	995	382.5	27	12.3	10	215	215	200	5					0.55	0.66	Y	4		0.66	0.77	Y	4							
1038	1039							50	4																				
1040	1046	382.5	30	5.5	4	125	120	50	13					0.52	0.53	N	0		0.53	0.54	N	0							
1046	1051	382.5	30	6.6	6.5	200	200	125	3					0.44	0.51	N	0		0.51	0.58	N	0							
1051	1056	382.5	30	15.9	15	Add Dur Constr		125	4					0.46	0.52	N	0		0.52	0.58	N	0							
1056	1073	382.5	30	17	18	Add Dur Constr		125	15					0.38	0.44	N	0		0.44	0.5	N	0							
1073	1078	382.5	30	15.5	12	Add Dur Constr		125	4					0.54	0.62	N	0		0.62	0.7	Y	3							
1079	1086	382.5	29	9.5	8.5	190	170	200	4					0.59	0.69	Y	3		0.69	0.79	Y	3							
1087	1090	382.5	29.5	14.9	10	Add Dur Constr		250	2					1	1.11	Y	1		1.11	1.22	Y	1							
1090	1100	382.5	29.5	9.2	4	Add Dur Constr		250	4					1.81	1.97	Y	3		1.97	2.13	Y	3							
1101	1107	382.5	29	8.4	6	135	130	100	7					0.57	0.66	Y	6		0.73	0.75	Y	6							
1107	1113	382.5	29	7.1	8.5	280	275	200	6					0.43	0.5	N	0		0.5	0.57	N	0							
1141	1157	382.5	22	8.8	10	245	245	250	9					0.51	0.61	N	0		0.61	0.71	Y	8							
1359	1367	382.5	22	9.2	7.5	210	190	100	6					0.39	0.49	N	0		0.49	0.59	N	0							
1490	1500	382.5	18	8.7	8	215	215	100	7					0.31	0.45	N	0		0.45	0.59	N	0							
							Total Existing Wells:		346		Hot Spot Wells:	62				Total New Wells:	92				Total New Wells:	172						

Table 4: Basic Data for 50-Yr Flood, Non-Well Reaches 1

Levee Reach		50-yr Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Need Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?
0.00	3.00	389.10						183	27	CL	0.32	27	0	376.00	376.00	22	1300	0.00064364	-	-	600	1554	783	13.1	8.71	0.32	15.1	10.04	0.37	N
3.00	15.00	389.40						223	28	CL	0.27	29	0	371.00	371.00	53	1300	0.00037293	-	-	600	2682	823	18.4	14.08	0.49	20.4	15.61	0.54	N
15.00	30.00	389.30						223	12	CL	2.10	15	0	371.00	371.00	83	1300	0.0012741	-	-	650	785	873	18.3	8.66	0.58	20.3	9.61	0.64	N
30.00	38.00	389.30						240	25	CL	0.45	30	0	368.80	368.80	80	1300	0.00041524	-	-	650	2408	890	20.5	14.97	0.50	22.5	16.43	0.55	N
38.00	45.00	389.30						240	27	CL	0.32	30	0	368.80	368.80	60	1300	0.00038974	-	-	650	2566	890	20.5	15.22	0.51	22.5	16.71	0.56	N
45.00	70.00	389.20						230	30	CL	0.19	35	0	370.00	370.00	55	1300	0.00029786	-	-	400	3357	630	19.2	16.17	0.46	21.2	17.85	0.51	N
70.00	80.00	389.20						223	25	CL	0.45	26	0	370.80	370.80	62	1300	0.00047168	-	-	300	2120	523	18.4	14.76	0.57	20.4	16.36	0.63	N
80.00	85.00	389.10						230	18	CL	1.16	20	0	370.00	370.00	62	1300	0.00089507	-	-	300	1117	530	19.1	12.95	0.65	21.1	14.31	0.72	Y
85.00	130.00	389.10						221	18	CL	1.16	20	0	371.00	371.00	75	1300	0.00092277	-	-	500	1229	721	18.1	11.41	0.57	20.1	12.67	0.63	N
130.00	145.00	388.90						213	14	CL	1.76	15	0	372.00	372.00	77	1300	0.00116135	-	-	400	894	613	16.9	10.02	0.67	18.9	11.21	0.75	Y
145.00	152.00	388.90						189	13	CL	1.92	14	0	375.00	375.00	80	1300	0.00114962	-	-	400	838	589	13.9	8.16	0.58	15.9	9.34	0.67	Y
152.00	167.00	388.90						218	14	CL	1.76	15	0	371.40	371.40	78	1300	0.00104009	-	-	400	899	618	17.5	10.37	0.69	19.5	11.56	0.77	Y
167.00	190.00	388.80						198	16	CL	1.44	17	0	373.80	373.80	80	1300	0.00099515	-	-	600	1074	798	15.0	8.61	0.51	17.0	9.75	0.57	N
190.00	200.00	388.70						177	14	CL	1.76	15	0	376.00	376.00	86	1300	0.00105893	-	-	600	944	777	12.7	6.97	0.46	14.7	8.06	0.54	N
200.00	205.00	388.70						177	11	CL	2.29	16	0	376.00	376.00	80	1300	0.00141418	-	-	800	707	977	12.7	5.33	0.33	14.7	6.17	0.39	N
205.00	215.00	388.60						177	12	CL	2.10	15	0	376.00	376.00	80	1300	0.00129777	-	-	1300	771	1477	12.6	4.32	0.29	14.6	5.01	0.33	N
215.00	220.00	388.50						177	21	CL	0.81	21	0	376.00	376.00	84	1300	0.00059282	-	-	800	1687	977	12.5	7.92	0.38	14.5	9.18	0.44	N
220.00	230.00	388.40						177	10	CL	2.48	15	0	376.00	376.00	80	1300	0.00154494	-	-	300	647	477	12.4	7.14	0.48	14.4	8.29	0.55	N
230.00	250.00	388.30						175	12	CL	2.10	20	0	375.00	375.00	70	1600	0.00125057	-	-	200	800	375	13.3	9.05	0.45	15.3	10.42	0.52	N
250.00	252.00	388.00						175	13	CL	1.92	20	0	375.00	375.00	95	1600	0.00098683	-	-	200	1013	375	13.0	9.49	0.47	15.0	10.95	0.55	N
252.00	255.00	388.00						175	15	CL	1.59	20	0	375.00	375.00	95	1600	0.00083621	-	-	600	1196	775	13.0	7.89	0.39	15.0	9.10	0.46	N
255.00	290.00	388.00						191	15	CL	1.59	20	0	372.60	372.60	100	1600	0.00081504	-	-	800	1227	991	15.4	8.52	0.43	17.4	9.63	0.48	N
294.00	300.00	387.75						191	17	CL	1.30	18	0	372.60	372.60	105	1600	0.00067413	-	-	1300	1483	1491	15.2	7.56	0.42	17.2	8.55	0.48	N
345.00	347.50	387.00						188	15	CL	1.59	15	0	371.00	371.00	102	1450	0.00084773	-	-	400	1180	588	16.0	10.68	0.71	18.0	12.01	0.80	Y
347.50	350.00	386.90						188	14	ML	2.75	14	0	371.00	371.00	102	1450	0.00115292	-	-	400	867	588	15.9	9.48	0.68	17.9	10.67	0.76	Y
350.00	353.00	386.90						188	15	CL	1.59	15	0	371.00	371.00	102	1450	0.00084773	-	-	400	1180	588	15.9	10.61	0.71	17.9	11.95	0.80	Y
372.00	393.00	386.70						192	15	CL	1.59	15	0	370.00	370.00	102	1200	0.00093186	-	-	400	1073	592	16.7	10.76	0.72	18.7	12.05	0.80	Y
413.00	420.00	386.50						208	10	CL	2.48	11	0	367.50	367.50	110	600	0.00193935	-	-	400	516	608	19.0	8.72	0.79	21.0	9.64	0.88	Y
420.00	423.00	386.50						208	12	ML	3.05	12	0	367.50	367.50	110	600	0.00196217	-	-	400	510	608	19.0	8.66	0.72	21.0	9.58	0.80	Y
442.00	450.00	386.20						236	17	CL	1.30	18	0	364.00	364.00	100	1350	0.00075202	-	-	400	1330	636	22.2	15.02	0.83	24.2	16.37	0.91	Y
450.00	460.00	386.20						236	28	CL	0.27	28	0	364.00	364.00	100	1350	0.00026642	-	-	400	3753	636	22.2	18.98	0.68	24.2	20.69	0.74	Y
460.00	465.00	386.20						236	13	ML	2.90	13	0	364.00	364.00	100	1350	0.00128451	-	-	400	779	636	22.2	12.22	0.94	24.2	13.32	1.02	Y

		50-yr																													Need
Levee Reach		Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?
465.00	467.00	386.00						236	12	CL	2.10	12	0	364.00	364.00	100	1350	0.00113907	-	-	400	878	636	22.0	12.76	1.06	24.0	13.92	1.16	Y
477.00	486.00	385.90						216	14	CL	1.76	17	0	366.00	366.00	100	600	0.00144548	-	-	400	692	616	19.9	10.53	0.62	21.9	11.58	0.68	Y
550.00	553.00	385.10						256	12	CL	2.10	14	0	360.00	360.00	92	1100	0.0013156	-	-	400	760	656	25.1	13.47	0.96	27.1	14.55	1.04	Y
553.00	555.00	385.10						256	12	ML	3.05	12	0	360.00	360.00	92	1100	0.0015846	-	-	400	631	656	25.1	12.31	1.03	27.1	13.29	1.11	Y
555.00	582.00	385.10						256	14	CL	1.76	18	0	360.00	360.00	92	1700	0.0008953	-	-	400	1117	656	25.1	15.81	0.88	27.1	17.07	0.95	Y
585.00	590.00	384.80						172	10.5	CL	2.38	16	0	362.00	362.00	95	1200	0.00141127	-	-	400	709	572	22.8	12.62	0.79	24.8	13.72	0.86	Y
590.00	597.00	384.80						172	15	CL	1.59	22	0	370.00	370.00	95	1200	0.00096558	-	-	400	1036	572	14.8	9.53	0.43	16.8	10.82	0.49	N
597.00	605.00	384.80						172	12	CL	2.10	15	0	370.00	370.00	95	1200	0.00123955	-	-	400	807	572	14.8	8.66	0.58	16.8	9.83	0.66	Y
613.00	631.00	384.50						204	14	CL	1.76	15	0	366.00	366.00	95	1200	0.00104866	-	-	400	954	604	18.5	11.33	0.76	20.5	12.55	0.84	Y
698.00	709.00	383.80						180	13	CL	1.92	15	0	368.00	368.00	94	600	0.00162004	-	-	300	617	480	15.8	8.89	0.59	17.8	10.01	0.67	Y
716.00	720.00	383.70						188	11	ML	3.21	11	0	367.00	367.00	100	1200	0.00156047	-	-	400	641	588	16.7	8.71	0.79	18.7	9.75	0.89	Y
720.00	721.00	383.60						188	19	CL	1.04	20	0	367.00	367.00	100	1200	0.00067379	-	-	400	1484	588	16.6	11.89	0.59	18.6	13.32	0.67	Y
724.00	738.00	383.60						196	12	CL	2.10	18	0	366.00	366.00	106	1200	0.00117347	-	-	400	852	596	17.6	10.36	0.58	19.6	11.53	0.64	N
738.00	739.00	383.40						196	13	ML	2.90	13	0	366.00	366.00	106	1200	0.00132331	-	-	400	756	596	17.4	9.73	0.75	19.4	10.85	0.83	Y
756.00	758.00	383.30						208	13	CL	1.92	16	0	364.00	364.00	95	600	0.00161149	-	-	400	621	608	19.3	9.75	0.61	21.3	10.76	0.67	Y
758.00	774.00	383.20						208	5	ML	4.51	5	0	364.00	364.00	95	600	0.00397841	-	-	400	251	608	19.2	5.62	1.12	21.2	6.20	1.24	Y
774.00	777.00	383.10						208	6	CL	3.34	6	0	364.00	364.00	95	1400	0.00204703	-	-	400	489	608	19.1	8.51	1.42	21.1	9.40	1.57	Y
777.00	807.00	383.10						208	14	ML	2.75	16	0	364.00	364.00	95	1400	0.00121579	-	-	400	823	608	19.1	10.98	0.69	21.1	12.13	0.76	Y
816.00	820.00	382.70						244	17	CL	1.30	17	0	359.00	359.00	112	1200	0.0007537	-	-	400	1327	644	23.7	15.96	0.94	25.7	17.30	1.02	Y
836.00	843.00	382.50						260	11	CL	2.29	13	0	357.00	357.00	125	1200	0.00117754	-	-	400	849	660	25.5	14.35	1.10	27.5	15.47	1.19	Y
942.00	950.00	380.80						222	5.3	CL	3.51	8.3	0	360.00	360.00	90	1000	0.00271207	-	-	1300	369	1522	20.8	4.06	0.49	22.8	4.45	0.54	N
950.00	956.00	380.70						286	9.5	CL	2.58	10	0	358.00	358.00	90	1000	0.001738	-	-	1300	575	1586	22.7	6.04	0.60	24.7	6.58	0.66	Y
996.00	1000.00	380.40						360	13	CL	1.92	15	0	350.00	354.00	82	1200	0.0012265	-	-	900	815	1260	26.4	10.37	0.69	28.4	11.16	0.74	Y
1000.00	1003.00	380.40						360	20	ML	2.04	20	0	345.00	354.00	82	1200	0.00101785	-	-	900	982	1260	26.4	11.57	0.58	28.4	12.44	0.62	N
1007.00	1016	380.4						360	7.5	CL	3.01	17	0	345.00	354.00	82	1200	0.00201789	-	-	250	496	610	26.4	11.83	0.70	28.4	12.73	0.75	Y
1016.00	1024	380.5						374	13	CL	1.92	13	0	345.00	354.00	82	1200	0.0012265	-	-	300	815	674	26.5	14.51	1.12	28.5	15.60	1.20	Y
1024.00	1031	380.5						374	19	CL	1.04	19	0	347.00	354.00	82	1200	0.00074408	-	-	300	1344	674	26.5	17.65	0.93	28.5	18.98	1.00	Y

		50-yr																													Need
Levee Reach		Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?
1035.00	1038	380.6						374	19	CL	1.04	19	0	347.00	354.00	82	1200	0.00074408	-	-	425	1344	799	26.6	16.68	0.88	28.6	17.94	0.94	Y
1120.00	1129	381						252	22	ML	1.83	22	0	358.00	358.00	70	1200	0.00099466	-	-	400	1005	652	23.0	13.95	0.63	25.0	15.17	0.69	Y
1129.00	1132	381						210	26	ML	1.39	26	0	366.00	366.00	60	1200	0.00086179	-	-	100	1160	310	15.0	11.84	0.46	17.0	13.42	0.52	N
1132.00	1137	381.1						210	23.5	CL	0.57	26.5	0	366.00	366.00	60	1200	0.00057871	-	-	100	1728	310	15.1	12.80	0.48	17.1	14.50	0.55	N
1158.00	1162	381.3						272	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	372	20.8	10.62	1.18	22.8	11.64	1.29	Y
1162.00	1169	381.3						290	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	390	20.8	10.38	1.15	22.8	11.37	1.26	Y
1169.00	1184	381.4						296	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	396	20.9	10.35	1.15	22.9	11.34	1.26	Y
1231.00	1250	381.9						332	14	CL	1.76	14	0	353.00	360.50	50	1200	0.00144548	-	-	100	692	432	21.4	13.17	0.94	23.4	14.40	1.03	Y
1446.00	1446		Add two wells for drainage structure																											Y

Table 5: Basic Data for 100-Yr Flood, Non-Well Reaches 1

		100-yr																												Need
Levee Reach		Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?
0.00	3.00	393.20						183	27	CL	0.32	27	0	376.00	376.00	22	1300	0.00064364	-	-	600	1554	783	17.2	11.44	0.42	19.2	12.77	0.47	N
3.00	15.00	393.20						223	28	CL	0.27	29	0	371.00	371.00	53	1300	0.00037293	-	-	600	2682	823	22.2	16.99	0.59	24.2	18.52	0.64	N
15.00	30.00	393.20						223	12	CL	2.10	15	0	371.00	371.00	83	1300	0.0012741	-	-	650	785	873	22.2	10.51	0.70	24.2	11.46	0.76	Y
30.00	38.00	393.20						240	25	CL	0.45	30	0	368.80	368.80	80	1300	0.00041524	-	-	650	2408	890	24.4	17.82	0.59	26.4	19.28	0.64	N
38.00	45.00	393.20						240	27	CL	0.32	30	0	368.80	368.80	60	1300	0.00038974	-	-	650	2566	890	24.4	18.12	0.60	26.4	19.60	0.65	N
45.00	70.00	393.20						230	30	CL	0.19	35	0	370.00	370.00	55	1300	0.00029786	-	-	400	3357	630	23.2	19.53	0.56	25.2	21.22	0.61	N
70.00	80.00	393.20						223	25	CL	0.45	26	0	370.80	370.80	62	1300	0.00047168	-	-	300	2120	523	22.4	17.97	0.69	24.4	19.57	0.75	Y
80.00	85.00	393.20						230	18	CL	1.16	20	0	370.00	370.00	62	1300	0.00089507	-	-	300	1117	530	23.2	15.74	0.79	25.2	17.09	0.85	Y
85.00	130.00	393.20						221	18	CL	1.16	20	0	371.00	371.00	75	1300	0.00092277	-	-	500	1229	721	22.2	13.99	0.70	24.2	15.25	0.76	Y
130.00	145.00	393.20						213	14	CL	1.76	15	0	372.00	372.00	77	1300	0.00116135	-	-	400	894	613	21.2	12.57	0.84	23.2	13.76	0.92	Y
145.00	152.00	393.20						189	13	CL	1.92	14	0	375.00	375.00	80	1300	0.00114962	-	-	400	838	589	18.2	10.69	0.76	20.2	11.86	0.85	Y
152.00	167.00	393.20						218	14	CL	1.76	15	0	371.40	371.40	78	1300	0.00104009	-	-	400	899	618	21.8	12.92	0.86	23.8	14.11	0.94	Y
167.00	190.00	393.20						198	16	CL	1.44	17	0	373.80	373.80	80	1300	0.00099515	-	-	600	1074	798	19.4	11.13	0.65	21.4	12.28	0.72	Y
190.00	200.00	393.20						177	14	CL	1.76	15	0	376.00	376.00	86	1300	0.00105893	-	-	600	944	777	17.2	9.44	0.63	19.2	10.53	0.70	Y
200.00	205.00	392.80						177	11	CL	2.29	16	0	376.00	376.00	80	1300	0.00141418	-	-	800	707	977	16.8	7.05	0.44	18.8	7.89	0.49	N
205.00	215.00	392.80						177	12	CL	2.10	15	0	376.00	376.00	80	1300	0.00129777	-	-	1300	771	1477	16.8	5.76	0.38	18.8	6.45	0.43	N
215.00	220.00	392.80						177	21	CL	0.81	21	0	376.00	376.00	84	1300	0.00059282	-	-	800	1687	977	16.8	10.64	0.51	18.8	11.90	0.57	N
220.00	230.00	392.40						177	10	CL	2.48	15	0	376.00	376.00	80	1300	0.00154494	-	-	300	647	477	16.4	9.44	0.63	18.4	10.59	0.71	Y
230.00	250.00	392.40						175	12	CL	2.10	20	0	375.00	375.00	70	1600	0.00125057	-	-	200	800	375	17.4	11.85	0.59	19.4	13.21	0.66	Y
250.00	252.00	390.70						175	13	CL	1.92	20	0	375.00	375.00	95	1600	0.00098683	-	-	200	1013	375	15.7	11.46	0.57	17.7	12.92	0.65	Y
252.00	255.00	390.70						175	15	CL	1.59	20	0	375.00	375.00	95	1600	0.00083621	-	-	600	1196	775	15.7	9.53	0.48	17.7	10.74	0.54	N
255.00	290.00	390.70						191	15	CL	1.59	20	0	372.60	372.60	100	1600	0.00081504	-	-	800	1227	991	18.1	10.01	0.50	20.1	11.12	0.56	N
294.00	300.00	389.60						191	17	CL	1.30	18	0	372.60	372.60	105	1600	0.00067413	-	-	1300	1483	1491	17.0	8.48	0.47	19.0	9.48	0.53	N
345.00	347.50	389.60						188	15	CL	1.59	15	0	371.00	371.00	102	1450	0.00084773	-	-	400	1180	588	18.6	12.41	0.83	20.6	13.75	0.92	Y
347.50	350.00	389.60						188	14	ML	2.75	14	0	371.00	371.00	102	1450	0.00115292	-	-	400	867	588	18.6	11.09	0.79	20.6	12.28	0.88	Y
350.00	353.00	389.60						188	15	CL	1.59	15	0	371.00	371.00	102	1450	0.00084773	-	-	400	1180	588	18.6	12.41	0.83	20.6	13.75	0.92	Y
372.00	393.00	388.50						192	15	CL	1.59	15	0	370.00	370.00	102	1200	0.00093186	-	-	400	1073	592	18.5	11.92	0.79	20.5	13.21	0.88	Y
413.00	420.00	388.20						208	10	CL	2.48	11	0	367.50	367.50	110	600	0.00193935	-	-	400	516	608	20.7	9.50	0.86	22.7	10.42	0.95	Y
420.00	423.00	388.20						208	12	ML	3.05	12	0	367.50	367.50	110	600	0.00196217	-	-	400	510	608	20.7	9.44	0.79	22.7	10.35	0.86	Y
442.00	450.00	388.20						236	17	CL	1.30	18	0	364.00	364.00	100	1350	0.00075202	-	-	400	1330	636	24.2	16.37	0.91	26.2	17.72	0.98	Y
450.00	460.00	388.20						236	28	CL	0.27	28	0	364.00	364.00	100	1350	0.00026642	-	-	400	3753	636	24.2	20.69	0.74	26.2	22.40	0.80	Y
460.00	465.00	388.20						236	13	ML	2.90	13	0	364.00	364.00	100	1350	0.00128451	-	-	400	779	636	24.2	13.32	1.02	26.2	14.42	1.11	Y
465.00	467.00	388.20						236	12	CL	2.10	12	0	364.00	364.00	100	1350	0.00113907	-	-	400	878	636	24.2	14.03	1.17	26.2	15.19	1.27	Y
477.00	486.00	387.70						216	14	CL	1.76	17	0	366.00	366.00	100	600	0.00144548	-	-	400	692	616	21.7	11.48	0.68	23.7	12.54	0.74	Y
550.00	553.00	386.90						256	12	CL	2.10	14	0	360.00	360.00	92	1100	0.0013156	-	-	400	760	656	26.9	14.44	1.03	28.9	15.51	1.11	Y
553.00	555.00	386.90						256	12	ML	3.05	12	0	360.00	360.00	92	1100	0.0015846	-	-	400	631	656	26.9	13.19	1.10	28.9	14.17	1.18	Y

		100-yr																													Need
Levee Reach		Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?
555.00	582.00	386.90						256	14	CL	1.76	18	0	360.00	360.00	92	1700	0.0008953	-	-	400	1117	656	26.9	16.95	0.94	28.9	18.21	1.01	Y
585.00	590.00	386.50						172	10.5	CL	2.38	16	0	362.00	362.00	95	1200	0.00141127	-	-	400	709	572	24.5	13.56	0.85	26.5	14.66	0.92	Y
590.00	597.00	386.50						172	15	CL	1.59	22	0	370.00	370.00	95	1200	0.00096558	-	-	400	1036	572	16.5	10.63	0.48	18.5	11.92	0.54	N
597.00	605.00	386.50						172	12	CL	2.10	15	0	370.00	370.00	95	1200	0.00123955	-	-	400	807	572	16.5	9.65	0.64	18.5	10.82	0.72	Y
613.00	631.00	386.50						204	14	CL	1.76	15	0	366.00	366.00	95	1200	0.00104866	-	-	400	954	604	20.5	12.55	0.84	22.5	13.78	0.92	Y
698.00	709.00	386.10						180	13	CL	1.92	15	0	368.00	368.00	94	600	0.00162004	-	-	300	617	480	18.1	10.18	0.68	20.1	11.31	0.75	Y
716.00	720.00	385.70						188	11	ML	3.21	11	0	367.00	367.00	100	1200	0.00156047	-	-	400	641	588	18.7	9.75	0.89	20.7	10.79	0.98	Y
720.00	721.00	385.70						188	19	CL	1.04	20	0	367.00	367.00	100	1200	0.00067379	-	-	400	1484	588	18.7	13.39	0.67	20.7	14.83	0.74	Y
724.00	738.00	385.70						196	12	CL	2.10	18	0	366.00	366.00	106	1200	0.00117347	-	-	400	852	596	19.7	11.59	0.64	21.7	12.77	0.71	Y
738.00	739.00	385.70						196	13	ML	2.90	13	0	366.00	366.00	106	1200	0.00132331	-	-	400	756	596	19.7	11.01	0.85	21.7	12.13	0.93	Y
756.00	758.00	385.30						208	13	CL	1.92	16	0	364.00	364.00	95	600	0.00161149	-	-	400	621	608	21.3	10.76	0.67	23.3	11.77	0.74	Y
758.00	774.00	385.30						208	5	ML	4.51	5	0	364.00	364.00	95	600	0.00397841	-	-	400	251	608	21.3	6.23	1.25	23.3	6.82	1.36	Y
774.00	777.00	385.30						208	6	CL	3.34	6	0	364.00	364.00	95	1400	0.00204703	-	-	400	489	608	21.3	9.49	1.58	23.3	10.38	1.73	Y
777.00	807.00	385.30						208	14	ML	2.75	16	0	364.00	364.00	95	1400	0.00121579	-	-	400	823	608	21.3	12.25	0.77	23.3	13.40	0.84	Y
816.00	820.00	385.30						244	17	CL	1.30	17	0	359.00	359.00	112	1200	0.0007537	-	-	400	1327	644	26.3	17.71	1.04	28.3	19.05	1.12	Y
836.00	843.00	384.90						260	11	CL	2.29	13	0	357.00	357.00	125	1200	0.00117754	-	-	400	849	660	27.9	15.70	1.21	29.9	16.82	1.29	Y
942.00	950.00	383.00						222	5.3	CL	3.51	8.3	0	360.00	360.00	90	1000	0.00271207	-	-	1300	369	1522	23.0	4.49	0.54	25.0	4.88	0.59	Y
950.00	956.00	383.00						286	9.5	CL	2.58	10	0	358.00	358.00	90	1000	0.001738	-	-	1300	575	1586	25.0	6.66	0.67	27.0	7.19	0.72	Y
996.00	1000.00	383.00						360	13	CL	1.92	15	0	350.00	354.00	82	1200	0.0012265	-	-	900	815	1260	29.0	11.39	0.76	31.0	12.18	0.81	Y
1000.00	1003.00	383.00						360	20	ML	2.04	20	0	345.00	354.00	82	1200	0.00101785	-	-	900	982	1260	29.0	12.71	0.64	31.0	13.58	0.68	Y
1007.00	1016	383						360	7.5	CL	3.01	17	0	345.00	354.00	82	1200	0.00201789	-	-	250	496	610	29.0	13.00	0.76	31.0	13.90	0.82	Y
1016.00	1024	383						374	13	CL	1.92	13	0	345.00	354.00	82	1200	0.0012265	-	-	300	815	674	29.0	15.88	1.22	31.0	16.97	1.31	Y
1024.00	1031	383						374	19	CL	1.04	19	0	347.00	354.00	82	1200	0.00074408	-	-	300	1344	674	29.0	19.31	1.02	31.0	20.65	1.09	Y
1035.00	1038	383						374	19	CL	1.04	19	0	347.00	354.00	82	1200	0.00074408	-	-	425	1344	799	29.0	18.19	0.96	31.0	19.44	1.02	Y
1120.00	1129	383						252	22	ML	1.83	22	0	358.00	358.00	70	1200	0.00099466	-	-	400	1005	652	25.0	15.17	0.69	27.0	16.38	0.74	Y
1129.00	1132	383						210	26	ML	1.39	26	0	366.00	366.00	60	1200	0.00086179	-	-	100	1160	310	17.0	13.42	0.52	19.0	14.99	0.58	N
1132.00	1137	383						210	23.5	CL	0.57	26.5	0	366.00	366.00	60	1200	0.00057871	-	-	100	1728	310	17.0	14.41	0.54	19.0	16.11	0.61	N
1158.00	1162	383						272	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	372	22.5	11.49	1.28	24.5	12.51	1.39	Y
1162.00	1169	383						290	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	390	22.5	11.22	1.25	24.5	12.22	1.36	Y
1169.00	1184	383						296	9	ML	3.58	9	0	352.00	360.50	50	1200	0.00257599	-	-	100	388	396	22.5	11.14	1.24	24.5	12.13	1.35	Y
1231.00	1250	383						332	14	CL	1.76	14	0	353.00	360.50	50	1200	0.00144548	-	-	100	692	432	22.5	13.85	0.99	24.5	15.08	1.08	Y
1446.00	1446		Add two wells for drainage structure																											Y

		100-yr																													Need
Levee Reach		Base	Riverside Conditions					Levee	Landside Conditions							Aquifer		Length Flowpath						Base Flood Results			Net Levee Results			Und-Seep
From	To	Flood Ele	z_{br}	USCS	$k_{br}*10^{-4}$ cm/s	RS GSE	L1	L2	z_{bl}	USCS	$k_{bl}*10^{-4}$ cm/s	z_t	L3	LS GSE	TW	D	$k_{br}*10^{-4}$ cm/s	c_l	c_r	comp x1 (Comp)	des x1 (Design)	x3	S	H_{tot}	h_0	i_o	H_{tot}	h_0	i_o	Control ?

Table 6: Well Analyses for 50-Yr Flood, Non-Well Reaches 1

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing				
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells	
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells
0	3	8.71	0.32	400	0.50	3.8774	156	0.42	4.30	5.06	5.87	0.22	400	300	1.72	1.00	400	1	300	Ext Top	1	0
3	15	14.08	0.49	400	0.50	5.7454	537	1.04	6.79	7.48	9.01	0.31	400	1200	1.00	1.00	400	3	400	Int	3	0
15	30	8.66	0.58	400	0.50	4.5034	640	1.28	5.78	6.27	7.01	0.47	400	1500	1.00	1.00	400	4	375	Int	4	0
30	38	14.97	0.50	325	0.50	5.2125	747	1.56	6.77	7.36	9.19	0.31	325	800	1.12	1.00	325	3	267	Int	3	0
38	45	15.22	0.51	400	0.50	6.0625	637	1.27	7.33	8.04	9.73	0.32	400	700	1.18	1.00	400	2	350	Int	2	0
45	70	16.17	0.46	400	0.50	7.2850	705	1.45	8.73	9.60	11.20	0.32	400	2500	1.00	1.00	400	6	417	Int	6	0
70	80	14.76	0.57	330	0.50	6.6750	755	1.58	8.26	9.04	10.50	0.40	330	1000	1.00	1.00	330	3	333	Int	3	0
80	85	12.95	0.65	350	0.50	6.5905	735	1.53	8.12	8.89	10.00	0.50	350	500	1.37	1.00	350	2	250	Ext End	3	3
85	130	11.41	0.57	400	0.50	5.6379	729	1.51	7.15	7.77	8.80	0.44	400	4500	1.00	1.00	400	11	409	Ext Top	11	0
130	145	10.02	0.67	300	0.50	4.6461	654	1.32	5.96	6.49	7.46	0.50	300	1500	1.00	1.00	300	5	300	Int	5	5
145	152	8.16	0.58	400	0.50	4.5983	631	1.26	5.86	6.36	6.97	0.50	400	700	1.18	1.00	400	2	350	Int	2	2
152	167	10.37	0.69	280	0.50	4.5778	661	1.33	5.91	6.44	7.49	0.50	280	1500	1.00	1.00	280	6	250	Int	6	6
167	190	8.61	0.51	400	0.50	4.2476	583	1.14	5.39	5.86	6.64	0.39	400	2300	1.00	1.00	400	6	383	Int	6	0
190	200	6.97	0.46	400	0.50	3.5727	524	1.01	4.58	4.97	5.57	0.37	400	1000	1.00	1.00	400	3	333	Int	3	0
200	205	5.33	0.33	400	0.50	2.7781	381	0.73	3.51	3.81	4.26	0.27	400	500	1.37	1.00	400	1	500	Int	1	0
205	215	4.32	0.29	400	0.50	2.0234	278	0.57	2.59	2.81	3.23	0.22	400	1000	1.00	1.00	400	3	333	Int	3	0
215	220	7.92	0.38	400	0.50	3.3237	477	0.91	4.24	4.60	5.44	0.26	400	500	1.37	1.00	400	1	500	Int	1	0
220	230	7.14	0.48	400	0.50	4.4190	607	1.20	5.62	6.10	6.55	0.44	400	1000	1.00	1.00	400	3	333	Ext End	4	0
230	250	9.05	0.45	400	0.50	5.7388	857	1.87	7.61	8.26	8.79	0.44	400	2000	1.00	1.00	400	5	400	Ext Top	5	0
250	252	9.49	0.47	400	0.50	5.9108	1170	2.92	8.83	9.46	10.05	0.50	400	200	1.00	1.00	400	1	200	Int	1	0
252	255	7.89	0.39	400	0.50	3.8668	766	1.61	5.48	5.89	6.61	0.33	400	300	1.00	1.00	400	1	300	Int	1	0
255	290	8.52	0.43	400	0.50	3.8596	801	1.71	5.57	5.98	6.83	0.34	400	3500	1.00	1.00	400	9	389	Int	9	0
294	300	7.56	0.42	400	0.50	2.8721	623	1.24	4.11	4.41	5.29	0.29	400	600	1.00	1.00	400	2	300	Ext End	3	0
345	348	10.68	0.71	230	0.50	4.0102	851	1.86	5.87	6.30	7.55	0.50	230	250	1.00	1.00	230	1	250	Int	1	1
348	350	9.48	0.68	230	0.50	3.8136	809	1.73	5.55	5.96	7.01	0.50	230	250	1.00	1.00	230	1	250	Int	1	1
350	353	10.61	0.71	230	0.50	3.9851	846	1.84	5.83	6.26	7.50	0.50	230	300	1.00	1.00	230	1	300	Int	1	1

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing				
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells	
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells
372	393	10.76	0.72	240	0.50	4.2413	739	1.54	5.78	6.24	7.45	0.50	240	2100	1.00	1.00	240	9	233	Int	9	9
413	420	8.72	0.79	190	0.50	3.5428	343	0.67	4.21	4.57	5.53	0.50	190	700	1.00	1.00	190	4	175	Int	4	4
420	423	8.66	0.72	230	0.50	4.0058	376	0.72	4.73	5.15	6.00	0.50	230	300	1.00	1.00	230	1	300	Int	1	1
442	450	15.02	0.83	185	0.50	4.4712	901	2.01	6.48	6.96	8.97	0.50	185	800	1.12	1.00	185	4	200	Int	4	4
450	460	18.98	0.68	320	0.50	7.4081	1354	3.63	11.04	11.85	14.00	0.50	320	1000	1.00	1.00	320	3	333	Int	3	3
460	465	12.22	0.94	130	0.50	3.1492	670	1.35	4.50	4.78	6.54	0.50	130	500	1.00	1.00	130	4	125	Int	4	4
465	467	12.76	1.06	105	0.50	2.6281	573	1.12	3.75	3.93	5.92	0.49	105	200	1.00	1.00	105	2	100	Int	2	2
477	486	10.53	0.62	400	0.50	6.1289	477	0.91	7.04	7.69	8.44	0.50	400	900	1.00	1.00	400	2	450	Int	2	2
550	553	13.47	0.96	140	0.50	3.6363	583	1.14	4.78	5.15	7.04	0.50	140	300	1.00	1.00	140	2	150	Int	2	2
553	555	12.31	1.03	115	0.50	3.0059	496	0.95	3.96	4.22	6.03	0.50	115	200	1.00	1.00	115	2	100	Int	2	2
555	582	15.81	0.88	150	0.50	4.0222	986	2.28	6.30	6.72	9.00	0.50	150	2700	1.00	1.00	150	18	150	Int	18	18
585	590	12.62	0.79	175	0.50	4.4014	762	1.60	6.00	6.48	8.03	0.50	175	500	1.00	1.00	175	3	167	Int	3	3
590	597	9.53	0.43	400	0.50	5.2533	780	1.65	6.90	7.46	8.21	0.37	400	700	1.00	1.00	400	2	350	Int	2	0
597	605	8.66	0.58	370	0.50	4.7777	720	1.49	6.26	6.78	7.45	0.50	370	800	1.00	1.00	370	2	400	Int	2	2
613	631	11.33	0.76	220	0.50	4.2475	707	1.45	5.70	6.17	7.49	0.50	220	1800	1.00	1.00	220	8	225	Int	8	8
698	709	8.89	0.59	400	0.50	5.5633	409	0.78	6.34	6.94	7.49	0.50	400	1100	1.00	1.00	400	3	367	Int	3	3
716	720	8.71	0.79	170	0.50	3.0507	554	1.08	4.13	4.45	5.51	0.50	170	400	1.00	1.00	170	3	133	Int	3	3
720	721	11.89	0.59	400	0.50	6.1686	960	2.20	8.36	9.02	10.03	0.50	400	100	1.00	1.00	400	0	#DIV/0!	Int	0	0
724	738	10.36	0.58	350	0.50	5.4490	917	2.06	7.51	8.09	8.95	0.50	350	1400	1.00	1.00	350	4	350	Int	4	0
738	739	9.73	0.75	195	0.50	3.5989	672	1.36	4.96	5.33	6.48	0.50	195	100	1.00	1.00	195	1	100	Int	1	1
756	758	9.75	0.61	400	0.50	5.8056	431	0.82	6.63	7.25	7.91	0.49	400	200	1.00	1.00	400	1	200	Int	1	1
758	774	5.62	1.12	60	0.50	1.2697	123	0.39	1.66	1.63	2.50	0.50	60	1600	1.00	1.00	60	27	59	Int	27	27
774	777	8.51	1.42	45	0.50	1.0663	242	0.52	1.59	1.48	2.99	0.50	45	300	1.00	1.00	45	7	43	Int	7	7
777	807	10.98	0.69	230	0.50	4.4018	848	1.85	6.25	6.74	7.96	0.50	230	3000	1.00	1.00	230	13	231	Int	13	13

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing				
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells	
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells
816	820	15.96	0.94	150	0.50	4.0230	817	1.76	5.78	6.13	8.45	0.50	150	400	1.00	1.00	150	3	133	Int	3	3
836	843	14.35	1.10	95	0.50	2.8253	651	1.31	4.13	4.17	6.47	0.50	95	700	1.00	1.00	95	8	88	Int	8	8
942	950	4.06	0.49	400	0.50	2.4447	288	0.58	3.03	3.29	3.56	0.43	400	800	1.12	1.00	400	2	400	Ext Top	2	0
950	956	6.04	0.60	400	0.50	3.1185	367	0.71	3.83	4.16	4.68	0.47	400	600	1.27	1.00	400	2	300	Ext End	3	3
996	1000	10.37	0.69	370	0.50	4.6790	617	1.22	5.90	6.42	7.45	0.50	370	400	1.51	1.18	314	1	400	Ext Top	1	1
1000	1003	11.57	0.58	400	0.50	5.1751	671	1.36	6.53	7.10	8.26	0.41	400	300	1.72	1.18	339	1	300	Ext End	2	0
1007	1016	11.83	0.70	210	0.50	5.0846	751	1.57	6.65	7.25	8.48	0.50	210	900	1.06	1.00	210	4	225	Ext Top	4	4
1016	1024	14.51	1.12	110	0.50	3.0051	497	0.95	3.96	4.25	6.49	0.50	110	800	1.12	1.00	110	7	114	Int	7	7
1024	1031	17.65	0.93	180	0.50	4.8780	742	1.55	6.42	6.99	9.43	0.50	180	700	1.18	1.00	180	4	175	Ext End	5	5
1035	1038	16.68	0.88	225	0.50	5.1488	750	1.57	6.72	7.32	9.50	0.50	225	300	1.72	1.72	131	2	150	Iso	3	3
1120	1129	13.95	0.63	390	0.50	7.2554	817	1.76	9.01	9.83	11.00	0.50	390	900	1.06	1.00	390	2	450	Int	2	2
1129	1132	11.84	0.46	400	0.50	7.5918	736	1.53	9.12	10.00	10.68	0.41	400	300	1.72	1.00	400	1	300	Int	1	0
1132	1137	12.80	0.48	400	0.50	7.9976	775	1.64	9.63	10.57	11.34	0.43	400	500	1.37	1.00	400	1	500	Int	1	0
1158	1162	10.62	1.18	65	0.50	2.0911	258	0.54	2.63	2.87	4.53	0.50	65	400	1.51	1.00	65	6	67	Int	6	6
1162	1169	10.38	1.15	65	0.50	2.0039	247	0.53	2.53	2.76	4.39	0.49	65	700	1.18	1.00	65	11	64	Int	11	11
1169	1184	10.35	1.15	70	0.50	2.1299	259	0.54	2.67	2.93	4.52	0.50	70	1500	1.00	1.00	70	22	68	Ext End	23	23
1231	1250	13.17	0.94	135	0.50	3.9220	415	0.79	4.71	5.26	7.00	0.50	135	1900	1.00	1.00	135	14	136	Iso	15	15
1446	1446																					
																					Total Wells:	231
																					Less Hot Spot Wells:	47
																					Total Wells:	184

Table 7: Well Analyses for 100-Yr Flood, Non-Well Reaches 1

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing					
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells		
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.	
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells	
0	3	11.44	0.42	400	0.50	5.0910	205	0.47	5.56	6.56	7.63	0.28	400	300	1.72	1.00	400	1	300	Ext Top	1	0	
3	15	16.99	0.59	400	0.50	6.9320	648	1.30	8.23	9.07	10.91	0.38	400	1200	1.00	1.00	400	3	400	Int	3	0	
15	30	10.51	0.70	300	0.50	4.5568	687	1.40	5.95	6.47	7.56	0.50	300	1500	1.00	1.00	300	5	300	Int	5	5	
30	38	17.82	0.59	225	0.50	4.5523	703	1.44	5.99	6.53	9.07	0.30	225	800	1.12	1.00	225	4	200	Int	4	0	
38	45	18.12	0.60	400	0.50	7.2159	758	1.59	8.80	9.64	11.66	0.39	400	700	1.18	1.00	400	2	350	Int	2	0	
45	70	19.53	0.56	400	0.50	8.8027	852	1.86	10.66	11.71	13.65	0.39	400	2500	1.00	1.00	400	6	417	Int	6	0	
70	80	17.97	0.69	330	0.50	8.1261	919	2.06	10.19	11.14	12.92	0.50	330	1000	1.00	1.00	330	3	333	Int	3	3	
80	85	15.74	0.79	225	0.50	5.9192	729	1.51	7.43	8.16	9.98	0.50	225	500	1.37	1.00	225	2	250	Ext End	3	3	
85	130	13.99	0.70	330	0.50	6.1044	822	1.77	7.88	8.57	10.01	0.50	330	4500	1.00	1.00	330	14	321	Ext Top	14	14	
130	145	12.57	0.84	190	0.50	4.1834	646	1.30	5.48	5.98	7.56	0.50	190	1500	1.00	1.00	190	8	188	Int	8	8	
145	152	10.69	0.76	210	0.50	3.9816	624	1.24	5.22	5.69	6.94	0.50	210	700	1.18	1.00	210	4	175	Int	4	4	
152	167	12.92	0.86	180	0.50	4.0997	647	1.30	5.40	5.89	7.55	0.50	180	1500	1.00	1.00	180	9	167	Int	9	9	
167	190	11.13	0.65	380	0.50	5.3212	738	1.54	6.86	7.44	8.49	0.50	380	2300	1.00	1.00	380	6	383	Int	6	6	
190	200	9.44	0.63	390	0.50	4.7667	703	1.44	6.21	6.73	7.56	0.50	390	1000	1.00	1.00	390	3	333	Int	3	3	
200	205	7.05	0.44	600	0.50	4.5121	569	1.11	5.62	6.11	6.52	0.41	600	500	1.37	1.00	600	1	500	Int	1	0	
205	215	5.76	0.38	600	0.50	3.3973	429	0.82	4.22	4.58	4.98	0.33	600	1000	1.00	1.00	600	2	500	Int	2	0	
215	220	10.64	0.51	600	0.50	5.7586	761	1.60	7.36	7.97	8.82	0.42	600	500	1.37	1.00	600	1	500	Int	1	0	
220	230	9.44	0.63	270	0.50	4.7470	707	1.45	6.20	6.75	7.57	0.50	270	1000	1.00	1.00	270	4	250	Ext End	5	5	
230	250	11.85	0.59	260	0.50	5.9964	982	2.27	8.26	8.98	10.00	0.50	260	2000	1.00	1.00	260	8	250	Ext Top	8	8	
250	252	11.46	0.57	240	0.50	5.4234	1185	2.98	8.40	9.00	10.09	0.50	240	200	1.00	1.00	240	1	200	Int	1	1	
252	255	9.53	0.48	600	0.50	5.8099	1061	2.53	8.34	8.94	9.56	0.48	600	300	1.00	1.00	600	1	300	Int	1	0	
255	290	10.01	0.50	600	0.50	5.7430	1101	2.67	8.42	9.00	9.74	0.49	600	3500	1.00	1.00	600	6	583	Int	6	0	
294	300	8.48	0.47	600	0.50	4.2277	848	1.85	6.08	6.50	7.27	0.40	600	600	1.00	1.00	600	1	600	Ext End	2	0	
345	348	12.41	0.83	170	0.50	3.6881	823	1.77	5.46	5.84	7.51	0.50	170	250	1.00	1.00	170	2	125	Int	2	2	
348	350	11.09	0.79	170	0.50	3.5613	795	1.69	5.25	5.62	7.05	0.50	170	250	1.00	1.00	170	2	125	Int	2	2	
350	353	12.41	0.83	170	0.50	3.6881	823	1.77	5.46	5.84	7.51	0.50	170	300	1.00	1.00	170	2	150	Int	2	2	
372	393	11.92	0.79	200	0.50	4.1053	739	1.54	5.64	6.08	7.56	0.50	200	2100	1.00	1.00	200	11	191	Int	11	11	
413	420	9.50	0.86	160	0.50	3.4172	339	0.66	4.08	4.40	5.55	0.50	160	700	1.00	1.00	160	5	140	Int	5	5	
420	423	9.44	0.79	190	0.50	3.8498	372	0.72	4.57	4.95	6.00	0.50	190	300	1.00	1.00	190	2	150	Int	2	2	
442	450	16.37	0.91	160	0.50	4.3180	891	1.98	6.30	6.73	9.06	0.50	160	800	1.12	1.00	160	5	160	Int	5	5	
450	460	20.69	0.74	270	0.50	7.1071	1341	3.58	10.69	11.47	14.03	0.50	270	1000	1.00	1.00	270	4	250	Int	4	4	
460	465	13.32	1.02	110	0.50	2.9769	646	1.30	4.27	4.49	6.51	0.50	110	500	1.00	1.00	110	5	100	Int	5	5	
465	467	14.03	1.17	90	0.50	2.5230	558	1.09	3.61	3.72	6.00	0.50	90	200	1.00	1.00	90	2	100	Int	2	2	

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing					
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells		
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.	
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells	
477	486	11.48	0.68	320	0.50	5.9286	482	0.92	6.85	7.49	8.48	0.50	320	900	1.00	1.00	320	3	300	Int	3	3	
550	553	14.44	1.03	120	0.50	3.4153	560	1.09	4.51	4.82	6.96	0.50	120	300	1.00	1.00	120	3	100	Int	3	3	
553	555	13.19	1.10	100	0.50	2.8547	479	0.92	3.77	3.98	6.01	0.50	100	200	1.00	1.00	100	2	100	Int	2	2	
555	582	16.95	0.94	130	0.50	3.8019	952	2.17	5.97	6.34	8.90	0.49	130	2700	1.00	1.00	130	21	129	Int	21	21	
585	590	13.56	0.85	150	0.50	4.1941	745	1.55	5.75	6.18	7.96	0.50	150	500	1.00	1.00	150	4	125	Int	4	4	
590	597	10.63	0.48	300	0.50	4.9457	777	1.64	6.59	7.13	8.16	0.37	300	700	1.00	1.00	300	3	233	Int	3	0	
597	605	9.65	0.64	280	0.50	4.5258	720	1.49	6.01	6.51	7.44	0.50	280	800	1.00	1.00	280	3	267	Int	3	3	
613	631	12.55	0.84	180	0.50	4.0357	696	1.42	5.46	5.90	7.51	0.50	180	1800	1.00	1.00	180	10	180	Int	10	10	
698	709	10.18	0.68	280	0.50	5.3161	419	0.80	6.12	6.71	7.56	0.50	280	1100	1.00	1.00	280	4	275	Int	4	4	
716	720	9.75	0.89	135	0.50	2.8540	537	1.04	3.89	4.15	5.48	0.50	135	400	1.00	1.00	135	3	133	Int	3	3	
720	721	13.39	0.67	300	0.50	5.8070	955	2.18	7.99	8.62	10.01	0.50	300	100	1.00	1.00	300	1	100	Int	1	1	
24	738	11.59	0.64	270	0.50	5.2114	920	2.07	7.28	7.84	9.01	0.50	270	1400	1.00	1.00	270	5	280	Int	5	5	
738	739	11.01	0.85	155	0.50	3.4216	661	1.33	4.76	5.08	6.53	0.50	155	100	1.00	1.00	155	1	100	Int	1	1	
756	758	10.76	0.67	310	0.50	5.6004	437	0.83	6.43	7.05	7.96	0.50	310	200	1.00	1.00	310	1	200	Int	1	1	
758	774	6.23	1.25	50	0.50	1.2173	118	0.39	1.60	1.51	2.53	0.51	50	1600	1.00	1.00	50	32	50	Int	32	32	
774	777	9.49	1.58	35	0.50	0.9305	217	0.49	1.42	1.27	3.01	0.50	35	300	1.00	1.00	35	9	33	Int	9	9	
777	807	12.25	0.77	185	0.50	4.1774	836	1.81	5.99	6.45	7.97	0.50	185	3000	1.00	1.00	185	16	188	Int	16	16	
816	820	17.71	1.04	125	0.50	3.8169	792	1.69	5.50	5.77	8.50	0.50	125	400	1.00	1.00	125	3	133	Int	3	3	
836	843	15.70	1.21	80	0.50	2.6733	620	1.23	3.90	3.85	6.46	0.50	80	700	1.00	1.00	80	9	78	Int	9	9	
942	950	4.49	0.54	470	0.50	2.9066	331	0.65	3.55	3.86	4.12	0.50	470	800	1.12	1.00	470	2	400	Ext Top	2	2	
950	956	6.66	0.67	380	0.50	3.3320	396	0.76	4.09	4.45	5.04	0.50	380	600	1.27	1.00	380	2	300	Ext End	3	3	
996	1000	11.39	0.76	300	0.50	4.4391	611	1.21	5.65	6.15	7.44	0.50	300	400	1.51	1.18	254	2	200	Ext Top	2	2	
1000	1003	12.71	0.64	500	0.50	6.5377	809	1.73	8.27	8.97	10.07	0.50	500	300	1.72	1.18	424	1	300	Ext End	2	2	
1007	1016	13.00	0.76	170	0.50	4.8028	738	1.54	6.34	6.89	8.42	0.50	170	900	1.06	1.00	170	5	180	Ext Top	5	5	
1016	1024	15.88	1.22	90	0.50	2.7347	464	0.89	3.62	3.83	6.42	0.49	90	800	1.12	1.00	90	9	89	Int	9	9	
1024	1031	19.31	1.02	155	0.50	4.6828	732	1.52	6.20	6.74	9.55	0.50	155	700	1.18	1.00	155	5	140	Ext End	6	6	

							Well Radius	1.00	Well Efficiency =		0.80				Well Spacing Adjus			Adjust Spacing					
		Head w/o	Gradient										Trial	Reach	for Reach Length			to fit reach length		Type Well	No. Wells		
Levee Reach		Wells	w/o Wells	Trial	Percent	H2	Well Flow	Head Loss	100% eff	100% eff	<100% eff	Grad	Well	Length	SubReach	Global	Adj Well	No. Well	Adj. Well	Reach	in Reach	Final No.	
From	To	ho	io	Spacing	Penetr		(GPM)	(Ft)	$H_{(avg)}$	$H_{(max)}$	$H_{(eff-max)}$	for TWS	Spacing		Adjust	Adjust	Spacing	Intervals	Spacing			Wells	
1035	1038	18.19	0.96	190	0.50	4.8619	732	1.52	6.38	6.95	9.50	0.50	190	300	1.72	1.72	110	3	100	Iso	4	4	
1120	1129	15.17	0.69	320	0.50	6.9754	820	1.76	8.74	9.54	11.02	0.50	320	900	1.06	1.00	320	3	300	Int	3	3	
1129	1132	13.42	0.52	430	0.50	8.8738	846	1.84	10.72	11.75	12.45	0.48	430	300	1.72	1.00	430	1	300	Int	1	0	
1132	1137	14.41	0.54	350	0.50	8.4405	843	1.83	10.27	11.26	12.26	0.46	350	500	1.37	1.00	350	2	250	Int	2	0	
1158	1162	11.49	1.28	55	0.50	1.9302	245	0.52	2.45	2.64	4.51	0.50	55	400	1.51	1.00	55	7	57	Int	7	7	
1162	1169	11.22	1.25	60	0.50	2.0088	251	0.53	2.54	2.75	4.55	0.51	60	700	1.18	1.00	60	12	58	Int	12	12	
1169	1184	11.14	1.24	60	0.50	1.9811	248	0.53	2.51	2.72	4.51	0.50	60	1500	1.00	1.00	60	25	60	Ext End	26	26	
1231	1250	13.85	0.99	120	0.50	3.7166	404	0.77	4.49	5.01	6.93	0.50	120	1900	1.00	1.00	120	16	119	Iso	17	17	
1446	1446																					2	
																					Total Wells:	339	
																					Less Hot Spot Wells:	47	
																					Total Wells:	292	

Table 8: Berm Analyses for 50-yr Flood 1

																			Final Berm Dimensions				
Station			LS				50-yr flood												(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	TW	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
0.00	3.00		376.00	783.00	1553.67	27.00	389.10	376.00	13.10	8.71	0.32	No Berm	-	-	-	-	-	-	N				
3.00	15.00		371.00	823.00	2681.50	29.00	389.40	371.00	18.40	14.08	0.49	No Berm	-	-	-	-	-	-	N				
15.00	30.00		371.00	873.00	784.87	15.00	389.30	371.00	18.30	8.66	0.58	Min Berm	-	150.00	-	5.00	150.00	29166.67	N				
30.00	38.00		368.80	890.00	2408.25	30.00	389.30	368.80	20.50	14.97	0.50	No Berm	-	-	-	-	-	-	N				
38.00	45.00		368.80	890.00	2565.80	30.00	389.30	368.80	20.50	15.22	0.51	Min Berm	-	150.00	-	5.00	150.00	13611.11	N				
45.00	70.00		370.00	630.00	3357.33	35.00	389.20	370.00	19.20	16.17	0.46	No Berm	-	-	-	-	-	-	N				
70.00	80.00		370.80	523.00	2120.08	26.00	389.20	370.80	18.40	14.76	0.57	Min Berm	-	150.00	-	5.00	150.00	19444.44	N				
80.00	85.00		370.00	530.00	1117.24	20.00	389.10	370.00	19.10	12.95	0.65	Min Berm	-	150.00	-	5.00	150.00	9722.22	Y	5.00	150.00	9722.22	
85.00	130.00		371.00	721.00	1228.80	20.00	389.10	371.00	18.10	11.41	0.57	Min Berm	-	150.00	-	5.00	150.00	87500.00	N				
130.00	145.00		372.00	613.00	893.57	15.00	388.90	372.00	16.90	10.02	0.67	Min Berm	-	150.00	-	5.00	150.00	29166.67	Y	5.00	150.00	29166.67	
145.00	152.00		375.00	589.00	838.21	14.00	388.90	375.00	13.90	8.16	0.58	Min Berm	-	150.00	-	5.00	150.00	13611.11	Y	5.00	150.00	13611.11	
152.00	167.00		371.40	618.00	899.36	15.00	388.90	371.40	17.50	10.37	0.69	Min Berm	-	150.00	-	5.00	150.00	29166.67	Y	5.00	150.00	29166.67	
167.00	190.00		373.80	798.00	1074.26	17.00	388.80	373.80	15.00	8.61	0.51	Min Berm	-	150.00	-	5.00	150.00	44722.22	N				
190.00	200.00		376.00	777.00	944.35	15.00	388.70	376.00	12.70	6.97	0.46	No Berm	-	-	-	-	-	-	N				
200.00	205.00		376.00	977.00	707.12	16.00	388.70	376.00	12.70	5.33	0.33	No Berm	-	-	-	-	-	-	N				
205.00	215.00		376.00	1477.00	770.55	15.00	388.60	376.00	12.60	4.32	0.29	No Berm	-	-	-	-	-	-	N				
215.00	220.00		376.00	977.00	1686.87	21.00	388.50	376.00	12.50	7.92	0.38	No Berm	-	-	-	-	-	-	N				
220.00	230.00		376.00	477.00	647.28	15.00	388.40	376.00	12.40	7.14	0.48	No Berm	-	-	-	-	-	-	N				
230.00	250.00		375.00	375.00	799.64	20.00	388.30	375.00	13.30	9.05	0.45	No Berm	-	-	-	-	-	-	N				
250.00	252.00		375.00	375.00	1013.34	20.00	388.00	375.00	13.00	9.49	0.47	No Berm	-	-	-	-	-	-	N				
252.00	255.00		375.00	775.00	1195.87	20.00	388.00	375.00	13.00	7.89	0.39	No Berm	-	-	-	-	-	-	N				
255.00	290.00		372.60	991.00	1226.93	20.00	388.00	372.60	15.40	8.52	0.43	No Berm	-	-	-	-	-	-	N				
294.00	300.00		372.60	1491.00	1483.40	18.00	387.75	372.60	15.15	7.56	0.42	No Berm	-	-	-	-	-	-	N				
345.00	347.50		371.00	588.00	1179.63	15.00	387.00	371.00	16.00	10.68	0.71	Min Berm	-	150.00	-	5.00	150.00	4861.11	Y	5.00	150.00	4861.11	
347.50	350.00		371.00	588.00	867.36	14.00	386.90	371.00	15.90	9.48	0.68	Min Berm	-	150.00	-	5.00	150.00	4861.11	Y	5.00	150.00	4861.11	
350.00	353.00		371.00	588.00	1179.63	15.00	386.90	371.00	15.90	10.61	0.71	Min Berm	-	150.00	-	5.00	150.00	5833.33	Y	5.00	150.00	5833.33	
372.00	393.00		370.00	592.00	1073.13	15.00	386.70	370.00	16.70	10.76	0.72	Min Berm	-	150.00	-	5.00	150.00	40833.33	Y	5.00	150.00	40833.33	
413.00	420.00		367.50	608.00	515.64	11.00	386.50	367.50	19.00	8.72	0.79	Min Berm	-	150.00	-	5.00	150.00	13611.11	Y	5.00	150.00	13611.11	
420.00	423.00		367.50	608.00	509.64	12.00	386.50	367.50	19.00	8.66	0.72	Min Berm	-	150.00	-	5.00	150.00	5833.33	Y	5.00	150.00	5833.33	
442.00	450.00		364.00	636.00	1329.75	18.00	386.20	364.00	22.20	15.02	0.83	Design Berm	7.97	62.55	15.09	9.32	150.00	25151.68	Y	9.32	150.00	25151.68	
450.00	460.00		364.00	636.00	3753.49	28.00	386.20	364.00	22.20	18.98	0.68	Min Berm	-	150.00	-	5.00	150.00	19444.44	Y	5.00	150.00	19444.44	
460.00	465.00		364.00	636.00	778.51	13.00	386.20	364.00	22.20	12.22	0.94	Design Berm	9.37	150.94	12.57	8.34	150.94	14449.00	Y	8.34	150.94	14449.00	
465.00	467.00		364.00	636.00	877.91	12.00	386.00	364.00	22.00	12.76	1.06	Design Berm	8.99	304.50	13.39	9.41	300.00	12678.87	Y	9.41	300.00	12678.87	
477.00	486.00		366.00	616.00	691.81	17.00	385.90	366.00	19.90	10.53	0.62	Min Berm	-	150.00	-	5.00	150.00	17500.00	Y	5.00	150.00	17500.00	

																			Final Berm Dimensions				
Station			LS				50-yr flood												(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	TW	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
550.00	553.00		360.00	656.00	760.11	14.00	385.10	360.00	25.10	13.47	0.96	Design Berm	9.56	170.81	13.94	9.37	170.81	10786.21	Y	9.37	170.81	10786.21	
553.00	555.00		360.00	656.00	631.07	12.00	385.10	360.00	25.10	12.31	1.03	Design Berm	10.29	197.40	12.97	9.01	197.40	8053.16	Y	9.01	197.40	8053.16	
555.00	582.00		360.00	656.00	1116.94	18.00	385.10	360.00	25.10	15.81	0.88	Design Berm	8.42	120.27	16.02	10.21	150.00	91568.89	Y	10.21	150.00	91568.89	
585.00	590.00		362.00	572.00	708.58	16.00	384.80	362.00	22.80	12.62	0.79	Min Berm	-	150.00	-	5.00	150.00	9722.22	Y	5.00	150.00	9722.22	
590.00	597.00		370.00	572.00	1035.65	22.00	384.80	370.00	14.80	9.53	0.43	No Berm	-	-	-	-	-	-	N				
597.00	605.00		370.00	572.00	806.75	15.00	384.80	370.00	14.80	8.66	0.58	Min Berm	-	150.00	-	5.00	150.00	15555.56	Y	5.00	150.00	15555.56	
613.00	631.00		366.00	604.00	953.60	15.00	384.50	366.00	18.50	11.33	0.76	Min Berm	-	150.00	-	5.00	150.00	35000.00	Y	5.00	150.00	35000.00	
698.00	709.00		368.00	480.00	617.27	15.00	383.80	368.00	15.80	8.89	0.59	Min Berm	-	150.00	-	5.00	150.00	21388.89	Y	5.00	150.00	21388.89	
716.00	720.00		367.00	588.00	640.83	11.00	383.70	367.00	16.70	8.71	0.79	Min Berm	-	150.00	-	5.00	150.00	7777.78	Y	5.00	150.00	7777.78	
720.00	721.00		367.00	588.00	1484.14	20.00	383.60	367.00	16.60	11.89	0.59	Min Berm	-	150.00	-	5.00	150.00	1944.44	Y	5.00	150.00	1944.44	
724.00	738.00		366.00	596.00	852.17	18.00	383.60	366.00	17.60	10.36	0.58	Min Berm	-	150.00	-	5.00	150.00	27222.22	N				
738.00	739.00		366.00	596.00	755.68	13.00	383.40	366.00	17.40	9.73	0.75	Min Berm	-	150.00	-	5.00	150.00	1944.44	Y	5.00	150.00	1944.44	
756.00	758.00		364.00	608.00	620.54	16.00	383.30	364.00	19.30	9.75	0.61	Min Berm	-	150.00	-	5.00	150.00	3888.89	Y	5.00	150.00	3888.89	
758.00	774.00		364.00	608.00	251.36	5.00	383.20	364.00	19.20	5.62	1.12	Design Berm	15.98	121.62	6.31	4.62	150.00	29428.23	Y	4.62	150.00	29428.23	
774.00	777.00		364.00	608.00	488.51	6.00	383.10	364.00	19.10	8.51	1.42	Design Berm	11.13	390.16	9.85	7.74	300.00	16227.04	Y	7.74	300.00	16227.04	
777.00	807.00		364.00	608.00	822.51	16.00	383.10	364.00	19.10	10.98	0.69	Min Berm	-	150.00	-	5.00	150.00	58333.33	Y	5.00	150.00	58333.33	
816.00	820.00		359.00	644.00	1326.79	17.00	382.70	359.00	23.70	15.96	0.94	Design Berm	8.00	242.75	16.27	10.74	242.75	22908.22	Y	10.74	242.75	22908.22	
836.00	843.00		357.00	660.00	849.23	13.00	382.50	357.00	25.50	14.35	1.10	Design Berm	9.21	338.63	15.20	10.87	300.00	50039.79	Y	10.87	300.00	50039.79	
942.00	950.00		360.00	1522.00	368.72	8.30	380.80	360.00	20.80	4.06	0.49	No Berm	-	-	-	-	-	-	N				
950.00	956.00		358.00	1586.00	575.37	10.00	380.70	358.00	22.70	6.04	0.60	Min Berm	-	150.00	-	5.00	150.00	11666.67	Y	5.00	150.00	11666.67	
996.00	1000.00		350.00	1260.00	815.33	15.00	380.40	354.00	26.40	10.37	0.69	Min Berm	-	150.00	-	5.00	150.00	7777.78	Y	5.00	150.00	7777.78	
1000.00	1003.00		345.00	1260.00	982.46	20.00	380.40	354.00	26.40	11.57	0.58	Min Berm	-	150.00	-	5.00	150.00	5833.33	N				
1007.00	1016.00		345.00	610.00	495.57	17.00	380.40	354.00	26.40	11.83	0.70	Min Berm	-	150.00	-	5.00	150.00	17500.00	Y	5.00	150.00	17500.00	
1016.00	1024.00		345.00	674.00	815.33	13.00	380.50	354.00	26.50	14.51	1.12	Design Berm	9.41	339.39	15.44	11.10	300.00	58217.43	Y	11.10	300.00	58217.43	
1024.00	1031.00		347.00	674.00	1343.95	19.00	380.50	354.00	26.50	17.65	0.93	Design Berm	8.07	230.16	17.98	11.81	230.16	41197.94	Y	11.81	230.16	41197.94	
1035.00	1038.00		347.00	799.00	1343.95	19.00	380.60	354.00	26.60	16.68	0.88	Design Berm	8.45	144.00	16.90	10.77	150.00	10640.00	Y	10.77	150.00	10640.00	
1087.00	1090.00		348.00	589.00	602.14	10.00	380.80	353.50	27.30	13.80	1.38	Design Berm	10.04	440.21	15.54	12.06	300.00	23431.71	Y	12.06	300.00	23431.71	
1120.00	1129.00		358.00	652.00	1005.37	22.00	381.00	358.00	23.00	13.95	0.63	Min Berm	-	150.00	-	5.00	150.00	17500.00	Y	5.00	150.00	17500.00	
1129.00	1132.00		366.00	310.00	1160.38	26.00	381.00	366.00	15.00	11.84	0.46	No Berm	-	-	-	-	-	-	N				

																			Final Berm Dimensions				
Station			LS				50-yr flood												(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	TW	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
1132.00	1137.00		366.00	310.00	1728.00	26.50	381.10	366.00	15.10	12.80	0.48	No Berm	-	-	-	-	-	-	N				
1158.00	1162.00		352.00	372.00	388.20	9.00	381.30	360.50	20.80	10.62	1.18	Design Berm	9.95	194.53	11.52	8.48	194.53	15107.39	Y	8.48	194.53	15107.39	
1162.00	1169.00		352.00	390.00	388.20	9.00	381.30	360.50	20.80	10.38	1.15	Design Berm	10.14	182.87	11.22	8.20	182.87	24170.60	Y	8.20	182.87	24170.60	
1169.00	1184.00		352.00	396.00	388.20	9.00	381.40	360.50	20.90	10.35	1.15	Design Berm	10.21	181.63	11.19	8.17	181.63	51293.63	Y	8.17	181.63	51293.63	
1231.00	1250.00		353.00	432.00	691.81	14.00	381.90	360.50	21.40	13.17	0.94	Design Berm	8.58	131.62	13.49	8.93	150.00	57710.96	Y	8.93	150.00	57710.96	

Table 9: Berm Analyses for 100-Yr Flood 1

																			Final Berm Dimensions				
Station			LS				100yr flood												(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
0.00	3.00		376.00	783.00	1553.67	27.00	393.20	17.20	11.44	0.42	No Berm	-	-	-	-	-	-	N					
3.00	15.00		371.00	823.00	2681.50	29.00	393.20	22.20	16.99	0.59	Min Berm	-	150.00	-	5.00	150.00	23333.33	N					
15.00	30.00		371.00	873.00	784.87	15.00	393.20	22.20	10.51	0.70	Min Berm	-	150.00	-	5.00	150.00	29166.67	Y	5.00	150.00	29166.67		
30.00	38.00		368.80	890.00	2408.25	30.00	393.20	24.40	17.82	0.59	Min Berm	-	150.00	-	5.00	150.00	15555.56	N					
38.00	45.00		368.80	890.00	2565.80	30.00	393.20	24.40	18.12	0.60	Min Berm	-	150.00	-	5.00	150.00	13611.11	N					
45.00	70.00		370.00	630.00	3357.33	35.00	393.20	23.20	19.53	0.56	Min Berm	-	150.00	-	5.00	150.00	48611.11	N					
70.00	80.00		370.80	523.00	2120.08	26.00	393.20	22.40	17.97	0.69	Min Berm	-	150.00	-	5.00	150.00	19444.44	Y	5.00	150.00	19444.44		
80.00	85.00		370.00	530.00	1117.24	20.00	393.20	23.20	15.74	0.79	Min Berm	-	150.00	-	5.00	150.00	9722.22	Y	5.00	150.00	9722.22		
85.00	130.00		371.00	721.00	1228.80	20.00	393.20	22.20	13.99	0.70	Min Berm	-	150.00	-	5.00	150.00	87500.00	Y	5.00	150.00	87500.00		
130.00	145.00		372.00	613.00	893.57	15.00	393.20	21.20	12.57	0.84	Design Berm	8.83	48.27	12.66	7.85	150.00	41037.57	Y	7.85	150.00	41037.57		
145.00	152.00		375.00	589.00	838.21	14.00	393.20	18.20	10.69	0.76	Min Berm	-	150.00	-	5.00	150.00	13611.11	Y	5.00	150.00	13611.11		
152.00	167.00		371.40	618.00	899.36	15.00	393.20	21.80	12.92	0.86	Design Berm	8.83	77.32	13.07	8.24	150.00	42658.52	Y	8.24	150.00	42658.52		
167.00	190.00		373.80	798.00	1074.26	17.00	393.20	19.40	11.13	0.65	Min Berm	-	150.00	-	5.00	150.00	44722.22	Y	5.00	150.00	44722.22		
190.00	200.00		376.00	777.00	944.35	15.00	393.20	17.20	9.44	0.63	Min Berm	-	150.00	-	5.00	150.00	19444.44	Y	5.00	150.00	19444.44		
200.00	205.00		376.00	977.00	707.12	16.00	392.80	16.80	7.05	0.44	No Berm	-	-	-	-	-	-	N					
205.00	215.00		376.00	1477.00	770.55	15.00	392.80	16.80	5.76	0.38	No Berm	-	-	-	-	-	-	N					
215.00	220.00		376.00	977.00	1686.87	21.00	392.80	16.80	10.64	0.51	Min Berm	-	150.00	-	5.00	150.00	9722.22	N					
220.00	230.00		376.00	477.00	647.28	15.00	392.40	16.40	9.44	0.63	Min Berm	-	150.00	-	5.00	150.00	19444.44	Y	5.00	150.00	19444.44		
230.00	250.00		375.00	375.00	799.64	20.00	392.40	17.40	11.85	0.59	Min Berm	-	150.00	-	5.00	150.00	38888.89	Y	5.00	150.00	38888.89		
250.00	252.00		375.00	375.00	1013.34	20.00	390.70	15.70	11.46	0.57	Min Berm	-	150.00	-	5.00	150.00	3888.89	Y	5.00	150.00	3888.89		
252.00	255.00		375.00	775.00	1195.87	20.00	390.70	15.70	9.53	0.48	No Berm	-	-	-	-	-	-	N					
255.00	290.00		372.60	991.00	1226.93	20.00	390.70	18.10	10.01	0.50	Min Berm	-	150.00	-	5.00	150.00	68055.56	N					
294.00	300.00		372.60	1491.00	1483.40	18.00	389.60	17.00	8.48	0.47	No Berm	-	-	-	-	-	-	N					
345.00	347.50		371.00	588.00	1179.63	15.00	389.60	18.60	12.41	0.83	Design Berm	8.06	44.78	12.46	7.66	150.00	6706.20	Y	7.66	150.00	6706.20		
347.50	350.00		371.00	588.00	867.36	14.00	389.60	18.60	11.09	0.79	Min Berm	-	150.00	-	5.00	150.00	4861.11	Y	5.00	150.00	4861.11		
350.00	353.00		371.00	588.00	1179.63	15.00	389.60	18.60	12.41	0.83	Design Berm	8.06	44.78	12.46	7.66	150.00	8047.44	Y	7.66	150.00	8047.44		
372.00	393.00		370.00	592.00	1073.13	15.00	388.50	18.50	11.92	0.79	Min Berm	-	150.00	-	5.00	150.00	40833.33	Y	5.00	150.00	40833.33		
413.00	420.00		367.50	608.00	515.64	11.00	388.20	20.70	9.50	0.86	Design Berm	10.86	48.32	9.66	6.11	150.00	15772.12	Y	6.11	150.00	15772.12		
420.00	423.00		367.50	608.00	509.64	12.00	388.20	20.70	9.44	0.79	Min Berm	-	150.00	-	5.00	150.00	5833.33	Y	5.00	150.00	5833.33		
442.00	450.00		364.00	636.00	1329.75	18.00	388.20	24.20	16.37	0.91	Design Berm	7.97	193.98	16.62	10.79	193.98	36759.84	Y	10.79	193.98	36759.84		
450.00	460.00		364.00	636.00	3753.49	28.00	388.20	24.20	20.69	0.74	Min Berm	-	150.00	-	5.00	150.00	19444.44	Y	5.00	150.00	19444.44		
460.00	465.00		364.00	636.00	778.51	13.00	388.20	24.20	13.32	1.02	Design Berm	9.37	236.08	13.93	9.65	236.08	25459.89	Y	9.65	236.08	25459.89		

																			Final Berm Dimensions				
Station			LS				100yr flood												(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
465.00	467.00		364.00	636.00	877.91	12.00	388.20	24.20	14.03	1.17	Design Berm	8.99	414.90	14.99	10.95	300.00	14386.84	Y	10.95	300.00	14386.84	
477.00	486.00		366.00	616.00	691.81	17.00	387.70	21.70	11.48	0.68	Min Berm	-	150.00	-	5.00	150.00	17500.00	Y	5.00	150.00	17500.00	
550.00	553.00		360.00	656.00	760.11	14.00	386.90	26.90	14.44	1.03	Design Berm	9.56	238.43	15.15	10.53	238.43	16596.08	Y	10.53	238.43	16596.08	
553.00	555.00		360.00	656.00	631.07	12.00	386.90	26.90	13.19	1.10	Design Berm	10.29	256.59	14.13	10.13	256.59	11524.26	Y	10.13	256.59	11524.26	
555.00	582.00		360.00	656.00	1116.94	18.00	386.90	26.90	16.95	0.94	Design Berm	8.42	212.03	17.34	11.48	212.03	142911.79	Y	11.48	212.03	142911.79	
585.00	590.00		362.00	572.00	708.58	16.00	386.50	24.50	13.56	0.85	Design Berm	9.33	47.85	13.69	8.55	150.00	14647.97	Y	8.55	150.00	14647.97	
590.00	597.00		370.00	572.00	1035.65	22.00	386.50	16.50	10.63	0.48	No Berm	-	-	-	-	-	-	N				
597.00	605.00		370.00	572.00	806.75	15.00	386.50	16.50	9.65	0.64	Min Berm	-	150.00	-	5.00	150.00	15555.56	Y	5.00	150.00	15555.56	
613.00	631.00		366.00	604.00	953.60	15.00	386.50	20.50	12.55	0.84	Design Berm	8.61	49.09	12.63	7.82	150.00	49092.14	Y	7.82	150.00	49092.14	
698.00	709.00		368.00	480.00	617.27	15.00	386.10	18.10	10.18	0.68	Min Berm	-	150.00	-	5.00	150.00	21388.89	Y	5.00	150.00	21388.89	
716.00	720.00		367.00	588.00	640.83	11.00	385.70	18.70	9.75	0.89	Design Berm	9.78	79.14	9.94	6.39	150.00	9316.78	Y	6.39	150.00	9316.78	
720.00	721.00		367.00	588.00	1484.14	20.00	385.70	18.70	13.39	0.67	Min Berm	-	150.00	-	5.00	150.00	1944.44	Y	5.00	150.00	1944.44	
724.00	738.00		366.00	596.00	852.17	18.00	385.70	19.70	11.59	0.64	Min Berm	-	150.00	-	5.00	150.00	27222.22	Y	5.00	150.00	27222.22	
738.00	739.00		366.00	596.00	755.68	13.00	385.70	19.70	11.01	0.85	Design Berm	9.25	50.84	11.12	6.94	150.00	2483.70	Y	6.94	150.00	2483.70	
756.00	758.00		364.00	608.00	620.54	16.00	385.30	21.30	10.76	0.67	Min Berm	-	150.00	-	5.00	150.00	3888.89	Y	5.00	150.00	3888.89	
758.00	774.00		364.00	608.00	251.36	5.00	385.30	21.30	6.23	1.25	Design Berm	15.98	164.01	7.28	5.56	164.01	36747.07	Y	5.56	164.01	36747.07	
774.00	777.00		364.00	608.00	488.51	6.00	385.30	21.30	9.49	1.58	Design Berm	11.13	477.66	11.31	9.14	300.00	18573.56	Y	9.14	300.00	18573.56	
777.00	807.00		364.00	608.00	822.51	16.00	385.30	21.30	12.25	0.77	Min Berm	-	150.00	-	5.00	150.00	58333.33	Y	5.00	150.00	58333.33	
816.00	820.00		359.00	644.00	1326.79	17.00	385.30	26.30	17.71	1.04	Design Berm	8.00	408.75	18.30	12.69	300.00	32652.68	Y	12.69	300.00	32652.68	
836.00	843.00		357.00	660.00	849.23	13.00	384.90	27.90	15.70	1.21	Design Berm	9.21	441.88	16.93	12.53	300.00	56487.51	Y	12.53	300.00	56487.51	
942.00	950.00		360.00	1522.00	368.72	8.30	383.00	23.00	4.49	0.54	Min Berm	-	150.00	-	5.00	150.00	15555.56	Y	5.00	150.00	15555.56	
950.00	956.00		358.00	1586.00	575.37	10.00	383.00	25.00	6.66	0.67	Min Berm	-	150.00	-	5.00	150.00	11666.67	Y	5.00	150.00	11666.67	
996.00	1000.00		350.00	1260.00	815.33	15.00	383.00	33.00	12.96	0.86	Design Berm	12.37	79.40	13.21	8.38	150.00	11532.60	Y	8.38	150.00	11532.60	
1000.00	1003.00		345.00	1260.00	982.46	20.00	383.00	38.00	16.65	0.83	Design Berm	11.29	47.81	16.79	10.38	150.00	10316.27	Y	10.38	150.00	10316.27	
1007.00	1016.00		345.00	610.00	495.57	17.00	383.00	38.00	17.03	1.00	Design Berm	11.08	142.40	17.95	12.36	150.00	35897.19	Y	12.36	150.00	35897.19	
1016.00	1024.00		345.00	674.00	815.33	13.00	383.00	38.00	20.80	1.60	Design Berm	9.41	767.54	23.84	19.17	300.00	94096.09	Y	19.17	300.00	94096.09	
1024.00	1031.00		347.00	674.00	1343.95	19.00	383.00	36.00	23.98	1.26	Design Berm	8.07	744.86	25.47	19.01	300.00	81715.43	Y	19.01	300.00	81715.43	

																		Final Berm Dimensions				
Station			LS				100yr flood											(based on this sheet and col AE In basic data)				
From	To		GSE	S	X3	z	Elev	Delta H	ho	io	LS Berm?	A	Xsp	h0prime	t	Xdes	Volumn	Need?	t	Xdes	Volumn	
1035.00	1038.00		347.00	799.00	1343.95	19.00	383.00	36.00	22.58	1.19	Design Berm	8.45	649.99	23.96	17.56	300.00	32595.01	Y	17.56	300.00	32595.01	
1087.00	1090.00		348.00	589.00	602.14	10.00	383.00	35.00	17.69	1.77	Design Berm	10.04	680.75	21.09	17.40	300.00	32326.57	Y	17.40	300.00	32326.57	
1120.00	1129.00		358.00	652.00	1005.37	22.00	383.00	25.00	15.17	0.69	Min Berm	-	150.00	-	5.00	150.00	17500.00	Y	5.00	150.00	17500.00	
1129.00	1132.00		366.00	310.00	1160.38	26.00	383.00	17.00	13.42	0.52	Min Berm	-	150.00	-	5.00	150.00	5833.33	N				
1132.00	1137.00		366.00	310.00	1728.00	26.50	383.00	17.00	14.41	0.54	Min Berm	-	150.00	-	5.00	150.00	9722.22	N				
1158.00	1162.00		352.00	372.00	388.20	9.00	383.00	31.00	15.83	1.76	Design Berm	9.95	433.70	18.80	15.48	300.00	38847.94	Y	15.48	300.00	38847.94	
1162.00	1169.00		352.00	390.00	388.20	9.00	383.00	31.00	15.46	1.72	Design Berm	10.14	421.28	18.37	15.07	300.00	66371.75	Y	15.07	300.00	66371.75	
1169.00	1184.00		352.00	396.00	388.20	9.00	383.00	31.00	15.35	1.71	Design Berm	10.21	417.18	18.23	14.93	300.00	141095.45	Y	14.93	300.00	141095.45	
1231.00	1250.00		353.00	432.00	691.81	14.00	383.00	30.00	18.47	1.32	Design Berm	8.58	434.61	19.99	15.18	300.00	181331.45	Y	15.18	300.00	181331.45	

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX C

DESIGN

APPENDIX C - DESIGN

TABLE OF CONTENTS

SECTION	PAGE
Civil Engineering	C- 1
Structural Analysis and Design	C- 3
Mechanical Analysis and Design	C-14

CIVIL ENGINEERING

Existing Conditions

The profile of the existing levee varies from several feet above the 100-year profile to areas along the back levee that are below the 50-year profile.

Existing levee side slopes vary from 1 on 3 to 1 on 4.

A network of ditches that lead to gravity drains and the four pump stations drains the interior of the levee district

The levee district owns everything inside a line 16’ from the toe of the levee and stability berms. The Real Estate portion of this report addresses the estimate of additional property landside of the levee to be acquired for construction of the 100 year levee raise and stability berms, installation of relief wells/seepage berms, construction of the north railroad closure, pump station construction, and construction of ditches. Where possible, relief well installation will be performed with equipment setup on existing stability berms to minimize construction easement requirements.

Civil Engineering Aspects of the Design Deficiency Repairs and 100-Year Raise

Design Deficiency Repairs - Approximately 3.3 miles of levee (along the back levee) must be repaired to restore the levee to the 50-year protection level (see Drawing 3 in the main report). The existing levee slopes will be maintained.

100 Year Raise - Approximately 19.9 miles of the levee must be raised to achieve 100-year flood protection (see drawing 4). The MVD ITR recommended performing crown raises in areas where the levee raise is 2’ or less. A variation of this recommendation will be used. A 1 on 3-side slope will be used for all raises regardless of the existing slope of the levee and depth of levee raise. The point of intersection of the new 1on 3 slope with the existing slope will vary from near the crown to the levee toe. In some cases, the new 1 on 3 slope will have to parallel the existing slope, making the levee footprint wider. This is also the sponsors preferred method for raising the levee. The existing crown width of the levee will be maintained. Since no permanent construction will be allowed beyond the riverside levee toe, the existing levee alignment will be shifted landward where necessary. See Drawing 12 in the main report.

50’ wide stability berms will be constructed anywhere the difference between the levee profile elevation and the existing ground elevation exceeds 22’. Stability berms will only be constructed landside of the levee since no construction beyond the riverside levee toe is allowed. Drawing 4 shows the approximate location of new stability berms to be constructed on existing ROW and new ROW. Drawing 12 shows a typical section of stability berm construction.

Attendant to the design deficiency repairs is construction of a new north railroad closure (see Drawing 6). The best way to construct the new closure and still maintain the line protection was considered by Corps personnel and the sponsor. Although the sponsor preferred construction in the current location to minimize land acquisition, the preferred location is

offset from the current location to maintain the existing line of flood protection during construction. Offset locations inside and outside the existing levee were considered. The interior location is the more cost effective alternative.

Existing access ramps will be modified to maintain current levee access.

For Both Projects – Some existing ditches will be extended and modified to capture flow from the new relief wells (see Drawing 10). The ditching shown on Drawing 10 is the current estimate. For purposes of developing quantities for this report, ditches with 1 on 3 side slopes have been assumed. The final ditch layout and cross sections will depend on the completed interior drainage analysis and coordination with environmental interests, the sponsor, and the landowners, to arrive at a plan that meets the needs of all concerned to the fullest extent possible.

Potential borrow areas (see drawing 9) have been identified along the existing levee, some riverside, some landside, and at the Martin Marietta quarry. Almost all of the borrow areas are on private property and will require acquisition by the levee district. The borrow areas will be excavated to produce a net maximum finished depth of 4'. This means unsuitable material at the surface will be removed and stockpiled, borrow excavation will then be no more than 4' deeper. The stockpiled material will be returned to the borrow area and finish graded. The amount of material removed from each borrow area and the final depth and shape of the borrow areas will be coordinated with environmental interests, the sponsor, and the land owners, to arrive at a plan that meets the needs of all concerned to the fullest extent possible. Soil borings have been obtained for all borrow areas and will be used to define the borrow excavation plan. The sponsor prefers obtaining as much borrow from the Martin Marietta quarry as possible. This will be a major consideration in development of the final borrow plan.

<u>Other Considerations</u>

Existing SAST topographic data is being adapted for use with this project. It will be available for development of plans and specifications and interior drainage analysis. Ground surveys are also being obtained to verify and supplement the SAST data.

Detailed ROW information will be obtained from the sponsor and incorporated into the final drawings.

Structural Analysis and Design

Introduction

Several structural features are required to bring the Bois Brule Project level of protection up to the 100-year level. The features include demolition of the existing north railroad closure structure and replacement with a new closure structure, as well as new pump stations located adjacent to each of the existing four pump station locations.

The protected area currently has three closure structures: the Highway 51 closure and the north and south railroad closure structures. The original designs of the three existing closures are not deficient, although not compliant with current standards. None of the existing closures will require modification for the 50-year level of protection. No modification will be required on the south railroad closure for the 100-year level of protection. No modification is described for the existing Highway 51 closure as it is assumed that the road will be raised by others to a 100-year level of protection. The new north railroad closure and adjacent T-walls will be pile founded. I-walls will be placed adjacent to the T-walls. A continuous sheet pile cut-off will be provided under the structure and will support the concrete I-walls.

All four of the existing pump stations (Missouri Chute, Jones Cutoff, Cinque Hommes, Bois Brule) require additional capacity for the 100-year level of protection. For the design deficiency project, only three of the four existing pump station locations will require additional capacity (the Bois Brule pump station will not require additional capacity). None of these additions can be made with the existing pump station structure. For both the 50-year plan and the 100-year plan, new pump stations will be constructed next to the existing pump stations to provide the additional capacity. These new stations will be similar to the existing stations with cast-in-place concrete sumps and prefabricated steel buildings.

Design Criteria

The structures for the Bois Brule Project shall be designed in accordance with the criteria in the following references:

Corps of Engineers References

EM 1110-2-2104, “Strength Design for Reinforced Concrete Hydraulic Structures,” 30 Apr 92
EM 1110-2-2105, “Design of Hydraulic Steel Structures,” 31 March 93
EM 1110-2-2502, “Retaining and Flood Walls,” 29 Sep 89
EM 1110-2-2504, “ Design of Sheet Pile Walls,” 31 March 1994
EM 1110-2-2705, “ Structural Design of Closure Structures For Local Flood Protection Projects,” 31 March 1994
EM 1110-2-2906, “ Design of Pile Foundations,” 15 January 1991
EM 1110-2-3102, “General Principles of Pumping Station Design and Layout,” 28 February 1995
ER 1110-2-1806, “Earthquake Design and Evaluation for Civil Works Projects,” 31 Jul 95
Computer Program, WESLIB/CORPS/X0031, “Design/Analysis of Sheet-Pile Walls by Classical Method” (CWALSHT)
Computer Program, WESLIB/CORPS/X0080, “Pile Group Analysis Program – Rigid Base Method” (CPGA)

Industry and State Standards

American Concrete Institute (ACI), Publication 318-99, Building Code Requirements for Structural Concrete
American Institute of Steel Construction (AISC), Manual of Steel Construction – Allowable Stress Design, 9th Edition
American Society for Testing and Materials, ASTM Standards, 2000
American Welding Society, Structural Welding Code, ANSI/AWS D1.1-94, 1994

<u>Design Loads and Strengths</u>

Concrete and Reinforcing Steel

The concrete structures shall be designed using the strength design method in accordance with the requirements of ACI 318-95/318R-95 modified by the hydraulic structural factor, H_f, for hydraulic structures contained in EM 1110-2-2104. Service live and dead loads shall be calculated at the critical loaded sections by standard accepted analysis procedures using properties obtained from the gross concrete dimensions. The single load factor method presented in EM 1110-2-2104 shall be used for concrete design. The format of the equation is:

$$U_h = H_f \ (1.7 \ [D+L])$$

where H_f = Hydraulic Structural Factor, equal to 1.3
D = Dead Load
L = Live Load
U_h = Required Strength

Where resistance to a specific earthquake load is applicable, the following combination shall apply:

$$U_h = H_f \ (1.7 \ [D+L] + 1.9 \ E)$$

where H_f = Hydraulic Structural Factor, equal to 1.3
D = Dead Load
L = Live Load
E = Earthquake Load
U_h = Required Strength

In short duration overload conditions, a factor of 0.75 shall be applied in calculating U_h (equivalent to a 1/3 increase in allowable stress). For additional guidance, see EM 1110-2-2104.

Twenty-eight day compressive strength of the concrete for the structural elements shall be 4000 psi. Concrete design shall be based on the use of ASTM Grade 60 reinforcing bars, F_y = 60 ksi. All splice and embedment lengths shall be based on the use of Grade 60 reinforcement.

Temperature and Shrinkage Reinforcement

In concrete slabs and walls where the main reinforcement extends in one direction only, reinforcement in the direction normal to the main reinforcement shall be provided to minimize the effect of cracking due to temperature and shrinkage change. The minimum main reinforcement provided

shall be at least the amount required for temperature and shrinkage control. This amount shall be determined in accordance with EM 1110-2-2104.

Structural Steel

The basic working stresses used for hydraulic steel structural shall be in accordance with AISC Code modified by EM 1110-2-2105. All sheet pile shall be ASTM A690, F_y = 50 ksi. All other structural steel used shall be ASTM A36.

Material Weights

The assumed average values for weights of materials are as follows:

Water	62.4 lb/ft^3
Concrete	150 lb/ft^3
Steel	490 lb/ft^3

Soil Properties

Soil parameters for the new pump stations and north railroad closure structure will be developed and incorporated during the PED phase.

A stability analysis of the existing north railroad closure for the 100-year flood elevation was performed using the following soil parameters:

<u>Soil</u>

γ = 0.12 kcf
Drained ϕ= 27°
Drained c = 0 ksf
Undrained ϕ= 0
Undrained c = 0.50 ksf
Ultimate Bearing Capacity = 3.16 ksf

<u>Ballast</u>

γ = 0.125 kcf
ϕ= 35°
c = 0 ksf

Uplift

Uplift pressures beneath the structures will be based on the line of creep method.

Earthquake Loads

Earthquake loads shall be in accordance with ER 1110-2-1806 and EM 1110-2-2502. The earthquake forces to be considered acting on the structures will be the dynamic action of the mass of the structure, the water adjacent to the structure, and the earth against the structure. Earthquake loads shall not be combined with temporary loading conditions. Earthquake loadings shall not be considered in combination with a flood event. Loading conditions involving earthquake loads shall be designed for overload conditions.

Westergaard's Formula. The dynamic water pressure shall be computed by use of Westergaard's formula. This force shall be applied at a point two-fifths of the height of the water above the base of the structure. Water on both sides of the structure shall be considered.

Earth Forces. Forces exerted on the structure by the acceleration of earth backfill shall be calculated in accordance with EM 1110-2-2502.

Usual, Unusual and Extreme Loading Defined

Usual. These conditions include normal operating and frequent flood conditions. Basic allowable stresses and safety factors shall be used for this type of loading condition.

Unusual. Higher allowable stresses and lower safety factors may be used for unusual loading conditions such as maintenance, infrequent floods, or construction. For these conditions allowable stresses for service load based design shall be increased by 33 percent. Lower safety factors for foundation and sheet pile stability shall be used.

Extreme. High allowable stresses and low safety factors are used for extreme loading conditions associated with natural disasters. Allowable stresses shall be increased up to 75 percent. Low safety factors for foundation and sheet pile stability shall be used.

Pump Stations

50-Year Flood Event - Design Deficiency Project

The existing relief wells have been determined to be inadequate for a 50-year flood event. The additional relief wells required to correct this design deficiency will generate additional required pumping capacity. Based on a preliminary interior drainage analysis additional pumping capacity is required at Missouri Chute Pump Station, Jones Cutoff Pump Station and Cinque Hommes Pump Station (see Appendix A – Hydrology & Hydraulics for the additional capacities).

It has been determined that these additional capacities cannot be developed with the existing pump station structures. To meet these needs new pump stations will be constructed adjacent to, but separate from, the existing structures. The new stations will be soil founded reinforced concrete structures with prefabricated steel buildings, similar to the existing structures. At this stage of the design, estimates of the costs of the new pump stations were based on the lump sum cost of the existing Bois Brule pump station and by considering the difference between the new capacities and the old capacity. During the PED phase of the project, a detailed interior drainage analysis will verify the required additional pumping capacities. After the completion of the detailed drainage analysis, a detailed design of the pump stations will be performed.

100-Year Flood Event

Additional relief wells are required for the levee system to perform during a 100-year flood event. These additional wells will generate additional required pumping capacity. Based on a preliminary interior drainage analysis additional pumping capacity is required at Missouri Chute

Pump Station, Jones Cutoff Pump Station, Cinque Hommes Pump Station and Boise Brule Pump Station (see Appendix A – Hydrology & Hydraulics for the additional capacities).

It has been determined that these additional capacities cannot be developed with the existing pump station structures. To meet these needs new pump stations will be constructed adjacent to, but separate from, the existing structures. The new stations will be soil founded reinforced concrete structures with prefabricated steel buildings, similar to the existing structures. At this stage of the design, estimates of the costs of the new pump stations were based on the lump sum cost of the existing Bois Brule pump station and by considering the difference between the new capacities and the old capacity. During the PED phase of the project, a detailed interior drainage analysis will verify the required additional pumping capacities. After the completion of the detailed drainage analysis, a detailed design of the pump stations will be performed.

Closure Structures For 50-Year Flood Event - Design Deficiency Project

The existing flood protection has three closure structures: Highway 51 closure, north railroad closure and south railroad closure. Stability analyses of the north and south railroad closures has been performed (see Tables 1 and 2 for the results of these analyses). Some of the factors of safety are below values required by current criteria. It is our opinion that these structures, as designed, are safe. No modifications to the existing three closure structures are required for them to perform adequately during a 50-year flood event.

Bois Brule North Railroad Closure Stability Analysis Summary		
Case I1 - Water to 2' Below Existing Top		
	Result	Requirement
Overturning - % Base in Compression	97%	100%
Bearing Pressure	FS = 2.78	FS = 3.0
Sliding	FS = 1.66	FS = 1.5
Case I2 - Water to Top		
	Result	Requirement
Overturning - % Base in Compression	64%	75%
Bearing Pressure	FS = 1.82	FS = 2.0
Sliding	FS = 1.27	FS = 1.33

Table 1: North Railroad Closure Stability Analysis Summary

Bois Brule South Railroad Closure Stability Analysis Summary		
Case I1 - Water to 2' Below Existing Top		
	Result	Requirement
Overturning - % Base in Compression	100%	100%
Bearing Pressure	FS = 2.53	FS = 3.0
Sliding	FS = 1.41	FS = 1.5
Case I2 - Water to Top		
	Result	Requirement
Overturning - % Base in Compression	82%	75%
Bearing Pressure	FS = 2.04	FS = 2.0
Sliding	FS = 1.18	FS = 1.33

Table 2: South Railroad Closure Stability Analysis Summary

100-Year Flood Event – Highway 51 Closure

For this project it has been assumed that the Highway 51 closure will be demolished and the road near the Highway 51 closure will be raised to go over the levee. An estimate of the demolition quantities has been prepared. The remainder of this work is not considered within the scope of work for the project. It is assumed that this work will be performed by others.

100-Year Flood Event – South Railroad Closure

The existing top of the south railroad closure structure is at elevation 388.3. The design water surface at this location has an elevation of 386.3 and the net levee grade along this part of the flood protection provides 2’ of freeboard. As such, the top of existing structure is already at the required 100-year elevation, including the 2’ of freeboard. Since the height of the existing structure is sufficient, no modifications to the structure are proposed. (See also the discussion above regarding the stability of the existing structure).

100-Year Flood Event – North Railroad Closure

Existing North Railroad Closure

The 100-year flood elevation for the north railroad closure is 393.2. With the required three feet of freeboard, the top of the closure is set at elevation 396.2. A stability analysis of the existing structure for this loading has been performed (see results in Table 3 below). The existing structure fails the stability criteria for overturning, bearing pressure and sliding when subjected to the 100-year flood loading. Consideration was

given to the design of modifications to the existing structure that would safely allow application of the increased loading. Cost analyses have determined that such modifications are not economically feasible. It is our recommendation that a new North railroad closure will have to be constructed.

Bois Brule North Railroad Closure Stability Analysis Summary For 100 Year Flood Event Loadings		
Case I1 - Water to 3' Below New Top Elevation		
	Result	Requirement
Overturning - % Base in Compression	53%	100%
Bearing Pressure	FS = 1.50	FS = 3.0
Sliding	FS = 1.19	FS = 1.5
Case I2 - Water to New Top Elevation		
	Result	Requirement
Overturning - % Base in Compression	0% (Resultant outside base)	75%
Bearing Pressure	FS = 0 (Resultant outside base)	FS = 2.0
Sliding	FS = 0.86	FS = 1.33

Table 2: North Railroad Closure Stability Analysis Summary For 100 Year Flood Event Loadings

Demolition of Existing North Railroad Closure

The I-wall and portions of the T-wall on the east side of the existing north railroad closure will be demolished to facilitate future agricultural activities (see Drawing S-1). The key of the T-wall will remain in place. The existing swing gate will be removed for salvage value. The center 25’ section of the closure will remain in place so as not to disturb the railroad by it’s demolition. The T-wall and I-wall on the west side will also remain in place since it is near high ground and will not interfere with future activities.

New North Railroad Closure

Description. Two methods of constructing the replacement closure structure were considered. Railroad traffic at the site cannot be stopped for any significant length of time. In one method, construction of the new closure is accomplished with rail traffic passing over the site on a temporary trestle. This scheme requires various time windows with rail traffic stopped. In the other method, construction of the new closure is accomplished with rail traffic on a temporary bypass around the construction

site. A cost comparison between these alternatives was made for the Sainte Genevieve north and middle closure structures, another Corps project recently completed. The same rail line, Burlington Northern Sante Fe, which runs through the Sainte Genevieve closure structures also runs through the north closure of this project. Therefore the traffic assumptions on available construction windows are applicable. This study showed the bypass to be the preferred alternative. Savings from simplification in the construction sequence, elimination of interference from rail traffic, and elimination of multiple charges from the railroad associated with the use of flagmen are contributing factors. Based on our experience at Sainte Genevieve we had the opinion that the railroad would not accept the trestle method of construction because this method presents a much greater potential to disrupt their operations and schedules. This opinion was confirmed when we coordinated with Burlington Northern Sante Fe regarding the potential closure structure replacement for the Bois Brule project. The railroad strongly indicated they want a bypass if the closure structure is constructed.

Three possible locations were considered for the new north railroad closure: at the existing closure, north of the existing closure, and south of the existing closure. The south and north locations require construction of a section of levee to tie in the new closure with the existing levee. Use of the existing location was ruled out due to the need to provide flood protection during the construction phase. The location south of the existing closure was selected over the north location due to reduced earthwork quantities.

The recommended plan consists of a swing gate closure with pile founded cast-in-place concrete slab, abutments, walls and sill (see drawing S-2). The structure will have a sheet pile cutoff and cast-in-place concrete I-walls to transition into the levee. The swing gate will be structural steel with rubber J-seals on the bottom and sides. The sill elevation is assumed to be at the same elevation of the existing sill, 382.10. The top of the walls shall be at elevation 396.20 and the clear opening width shall be 18'-6".

<u>Design Criteria and Loading Condition</u>. The north railroad closure shall be designed in accordance with the pertinent criteria, loads and strengths listed above. The applicable load cases are as follows:

Case I1 – Design Flood (Usual Condition)
- **a. Structure Complete**
- **b. Backfill in place**
- **c. Gate closed**
- **d. Water at elevation 393.2**

Case I2 – Water To Top Of Wall (Unusual Condition)
- **a. Structure Complete**
- **b. Backfill in place**
- **c. Gate closed**
- **d. Water at elevation 396.2**

Case I3 – Earthquake Loading (OBE–Unusual Condition and MDE–Extreme Condition)
- **a. Structure Complete**
- **b. Backfill in place**
- **c. Gate opened**
- **d. OBE or MDE applied in worst direction**

Case I4 – Construction (Unusual Condition)

a. Structure Complete
b. Backfill not in place
c. Gate in any position
d. Wind load

Case I5 – Gate Swinging (Usual Condition)

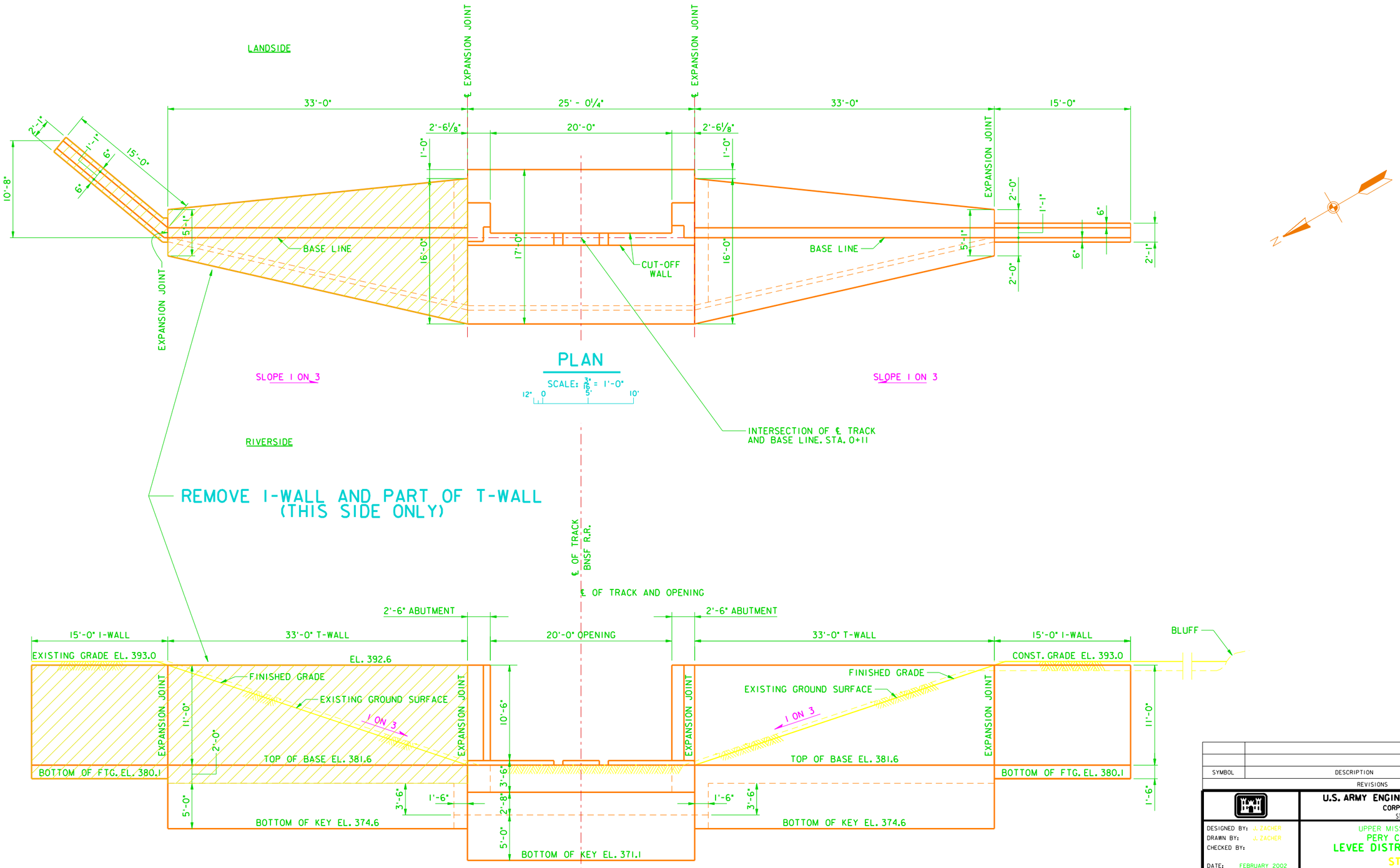
a. Structure Complete
b. Backfill not in place
c. Gate in any position

Preliminary Design. Drawing S-2 shows a preliminary plan and elevation of the new north railroad closure. This preliminary design is based on the middle railroad closure structure recently constructed for the flood control project at Saint Genevieve, Missouri. The Saint Genevieve middle closure structure is of similar height and width. Final design will be made during the PED phase of the project. Except for the height of the wall, the concrete dimensions were taken from the Saint Genevieve middle closure plans. The pile type and pile layout were also from the Saint Genevieve plans. The assumed H-pile and sheet pile length was provided by the Foundation Engineering Section.

Functional Operation and Maintenance of Recommended Project

With the proper operation and maintenance the pump stations and the new closure structure will function as intended. The closure structure gate will be kept open but can be closed quickly and easily during high water events. The new pump station designs will be similar to the existing designs and will consider ease of operation. A thorough, workable and accepted operation plan will be developed during the PED phase.

Periodic inspection of the structures should be performed to assure early detection and correction of any deficiencies critical to the project. Required maintenance provisions for each structure will be developed and included in the agreement with the local sponsors in the PED phase.



PLAN

SCALE: 3/16" = 1'-0"

ELEVATION

SCALE: 3/16" = 1'-0"

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

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

DESIGNED BY: J. ZACHER
DRAWN BY: J. ZACHER
CHECKED BY:
DATE: FEBRUARY 2002

SUBMITTED:
DESIGN ENGINEER

SUBMITTED: THOMAS J. QUIGLEY, P.E.
CHIEF, STRUCTURAL/ARCH. SECTION

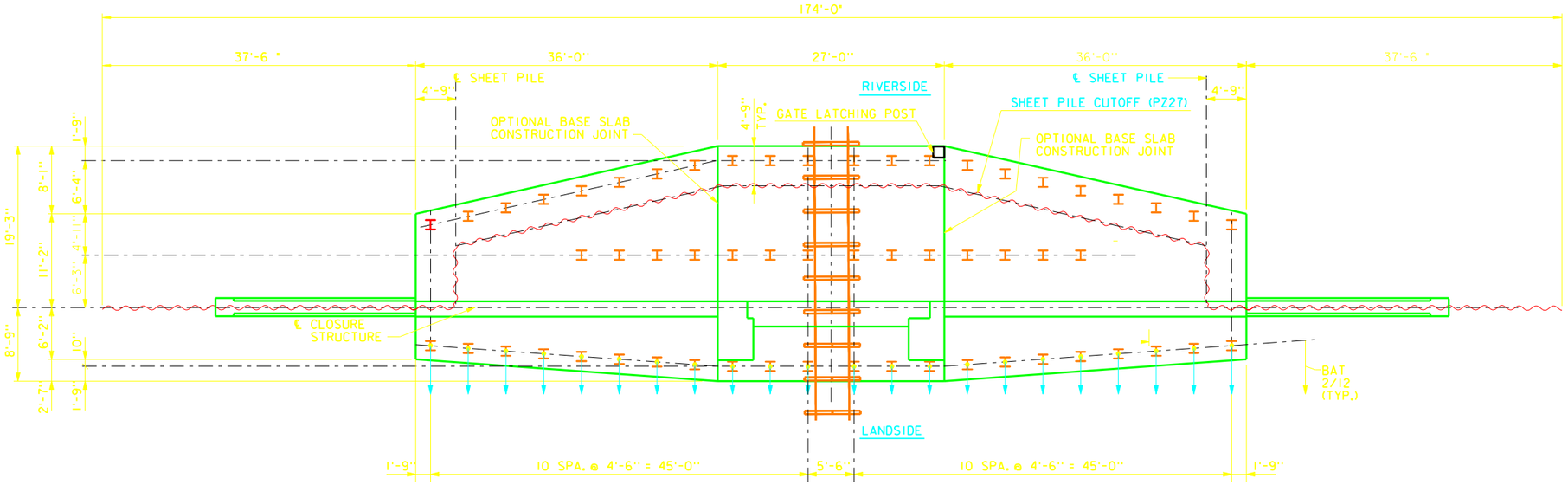
APPROVED: BOBBY R. HUGHEY, P.E.
CHIEF, DESIGN BRANCH

UPPER MISSISSIPPI RIVER BASIN
PERY COUNTY, MISSOURI
LEVEE DISTRICTS NO.S 1, 2 & 3
STRUCTURAL

BOIS BRULE EXISTING NORTH RR CLOSURE CONCRETE DEMOLITION PLAN AND ELEVATION

SIZE	DWG. CODE	DRAWING NO.
D	DACW 43	S-1

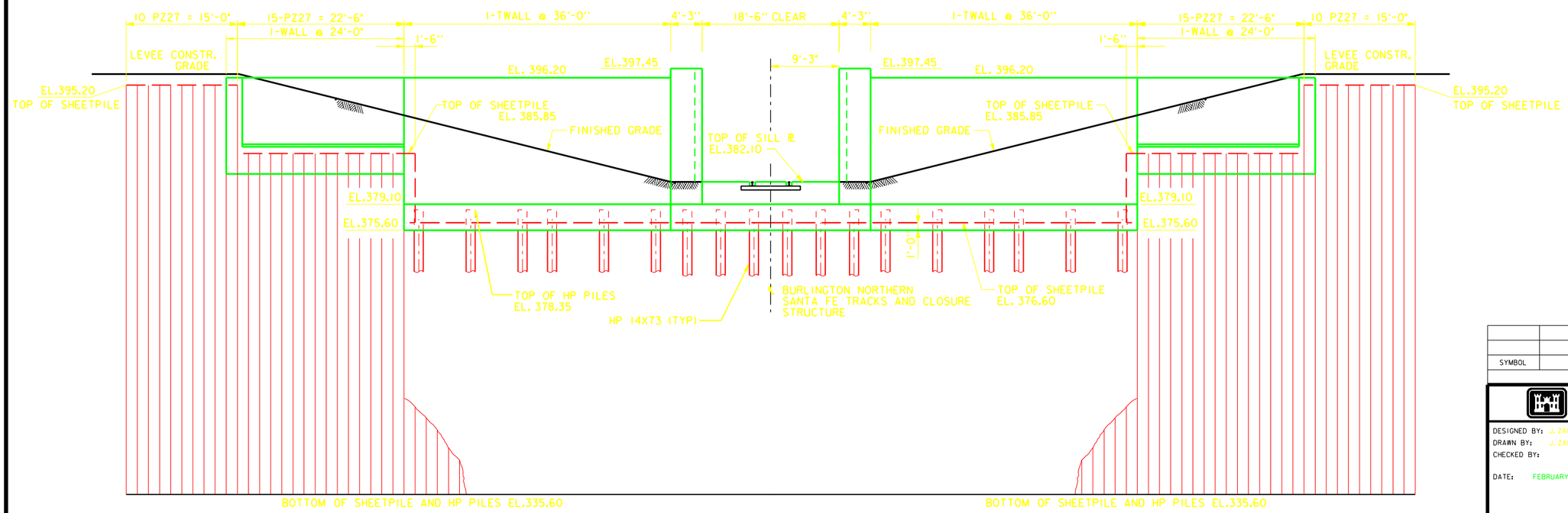
DESIGN FILE: $$$DESIGN$FILE$SPECIFICATION$$$ PLOT DATE: $$$$DATE-TIME$$$$
PLOT SCALE: SOL. NO. DACW43-XX-X-XXXX



PLAN VIEW

SCALE: $\frac{1}{8}$" = 1'-0"

12"0 5' 10' 15'



LANDSIDE ELEVATION

SCALE: $\frac{1}{8}$" = 1'-0"

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

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

DESIGNED BY: J. ZACHER
DRAWN BY: J. ZACHER
CHECKED BY:
DATE: FEBRUARY 2002

SUBMITTED:
DESIGN ENGINEER

SUBMITTED:
THOMAS J. QUIGLEY, P.E.
CHIEF, STRUCTURAL/ARCH. SECTION

APPROVED:
BOBBY R. HUGHEY, P.E.
CHIEF, DESIGN BRANCH

UPPER MISSISSIPPI RIVER BASIN
PERY COUNTY, MISSOURI
LEVEE DISTRICTS NO.S 1, 2 & 3
STRUCTURAL

BOIS BRULE NEW NORTH RR CLOSURE PLAN AND ELEVATION

SIZE	DWG. CODE	DRAWING NO.
D	DACW 43	S-2

DESIGN FILE: $$$DESIGN$FILE$SPECIFICATION$$$ | PLOT DATE: $$$$DATE-TIME$$$$

PLOT SCALE: | SOL. NO. DACW43-XX-X-XXXX

Bois Brule DDR/DPR
Mechanical Analysis and Design

Existing Pumping Stations

There are four pumping stations located in the Bois Brule Levee and Drainage District. The pumps are operated by diesel engines. The normal mode of pumping is with siphon assist. The diesel engines and related equipment are enclosed in prefabricated metal buildings. The stations have steel discharge pipes over the levee, with siphon breakers. The discharge pipes terminate with saxophone discharge. A minimum of two feet of cover is provided over the discharge pipes. Vehicular traffic is permitted on the levee. Access ramps are provided at the pump stations.

Bois Brule Pump Station (see Chart D-1) is located at levee station 1466+56.28 and has a nominal capacity of 150 cfs provided by three pumps. The pumps have right angle gear reducers with a 3:1 gear ratio. The vertical, submerged, propeller type, pumps are driven by 300 hp diesel engines. The pumps discharge through 36-inch discharge pipes over the levee, with siphon breakers, to an outlet structure with saxophone discharge. Two 66-inch gravity drains are located adjacent to the pump station.

Jones Cutoff Pump Station (see Chart D-2) is located at levee station 1001+52.2 and has a nominal capacity of 125 cfs provided by two pumps. The pumps have right angle gear reducers with a 3:1 gear ratio. The vertical, submerged, propeller type pumps are driven by 300 hp diesel engines. The pumps discharge through 36-inch diameter discharge pipes over the levee, with siphon breakers, to an outlet structure with saxophone discharge. Two 30-inch gravity drains are located adjacent to the pump station.

Cinque Hommes Pump Station (see Chart D-3) is located at levee station 1131+60.22 and has a nominal capacity of 125 cfs provided by two pumps. The pumps have right angle gear reducers with a 3:1 gear ratio. The vertical, submerged, propeller type pumps are driven by 300 hp diesel engines. The pumps discharge through 36-inch diameter discharge pipes over the levee, with siphon breakers, to an outlet structure with saxophone discharge. Two 60-inch gravity drains are located adjacent to the pump station.

Missouri Chute Pump Station (see Chart D-4) is located at levee station 580+93.51 and has a nominal capacity of 50 cfs provided by one pump. The pump has a right angle gear reducer with a 3:1 gear ratio. The vertical, submerged, propeller type pump is driven by a 300 hp diesel engine. The pump discharges through a 36-inch discharge pipe over the levee, with a siphon breaker, to an outlet structure with saxophone discharge. A 48-inch gravity drain is located adjacent to the pump station.

Authorized Project

Pump Discharge Pipes

50 Year – Design Deficiency Project

Modification of pump discharge pipes is not required for the design deficiency project.

100-Year Project

Bois Brule Pumping Station: The proposed 100 year net levee grade at Bois Brule Pump Station is the same as the existing net levee grade so no modification to the pump discharge pipes is required.

Missouri Chute Pumping Station: The invert of the discharge pipe at Missouri Chute Pump Station is 0.9 feet above the proposed 100-year net levee grade, so no modification to the discharge pipe is required.

Cinque Hommes Pumping Station: The invert of the discharge pipes at Cinque Hommes Pump Station is 1.8 feet below the proposed 100-year net levee grade so the discharge pipes should be raised.

Jones Cutoff Pumping Station: The invert of the discharge pipes at Jones Cutoff Pump Station is 2 feet below the proposed 100-year net levee grade so the discharge pipes should be raised if the pumps have adequate priming capacity (see below).

Pump Priming Capacity

Cinque Hommes Pumping Station: The Cinque Hommes pumps have adequate priming capacity with the invert of the discharge pipes raised to 0.9 feet above the proposed net levee grade.

Jones Cutoff Pumping Station: The Jones Cutoff pumps do not have adequate priming capacity to allow the discharge pipes to be raised. The invert of the discharge pipes is at EL 383.3, the same elevation as the proposed 100-year design water surface. The discharge pipes should be left at EL 383.3 and a valve installed in the discharge pipes to prevent water from flowing back into the pumps.

New Pumping Stations

50 Year – Design Deficiency Project

Additional relief wells required for the 50-year net levee grade will generate additional required pumping capacity. The additional pumping capacity required for each pump station is listed in Table 2 in Appendix A. A new pump station will be required adjacent to the existing station to provide this additional pumping capacity. At this stage of the design, estimates of the costs of the new pump stations were based on the cost of the Missouri Chute Pump Station, considering the difference in pumping capacity and adjusting the cost to 2002 price level. During the PED phase of the project, a detailed interior drainage analysis will verify the required additional pumping capacities. After completion of the detailed drainage analysis, a detailed design of the pump stations will be performed.

100-Year Project

Additional relief wells required for the 100-year net levee grade will generate additional required pumping capacity. The additional pumping capacity required for each pump station is listed in Table 2 in Appendix A. A new pump station will be required adjacent to each existing station to provide this additional pumping capacity. At this stage of the design, estimates of the costs of the new pump stations were based on the cost of the Missouri Chute Pump Station, considering the difference in pumping capacity

and adjusting the cost to 2002 price level. During the PED phase of the project, a detailed interior drainage analysis will verify the required additional pumping capacities. After completion of the detailed drainage analysis, a detailed design of the pump stations will be performed.

New Pump Station Location

The new pump stations will be located adjacent to the existing pump stations. The exact locations have not been determined at this time. The new pump stations located adjacent to Bois Brule Pump Station, Jones Cutoff Pump Station, and Missouri Chute Pump Station will be located on the side of the station away from the gravity drain shown on Charts D-1, D-2 and D-4. The new pump station located adjacent to Cinque Hommes Pump Station may be located between the existing pump station and the gravity drain shown on Chart D-3 because there is a road adjacent to the pump station on the side away from the gravity drain.

Pump Station Layout

The layout will be similar to the Missouri Chute Pump Station. A drawing of Missouri Chute Pump Station is shown on Chart D-4. The station will have one vertical, submerged, axial flow, propeller type, single stage pump driven by a diesel engine. The normal mode of pumping will be with siphon assist. The pump will discharge through a discharge pipe over the levee, to an ungated outlet structure. The discharge pipe will terminate with a saxophone discharge. An air operated siphon breaker valve will be provided. A manual valve will also be provided for emergency breaking of the siphon.

Design Criteria

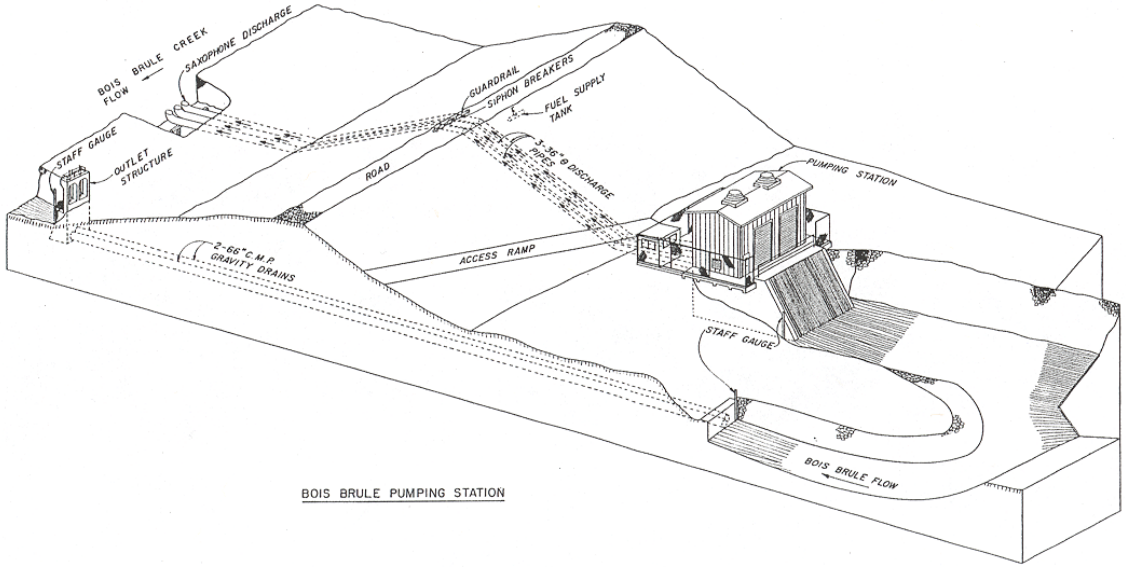
EM 1110-2-3105, Mechanical and Electrical Design of Pumping Stations
EM 1110-2-3102, General Principles of Pumping Station Design and Layout

Pump Control

The pump will be started and stopped manually. A low water cutoff switch will be incorporated into the control of the diesel engine to automatically shut-off the pumping system in case the pump is not stopped manually at the minimum pumping elevation.

Trash Removal

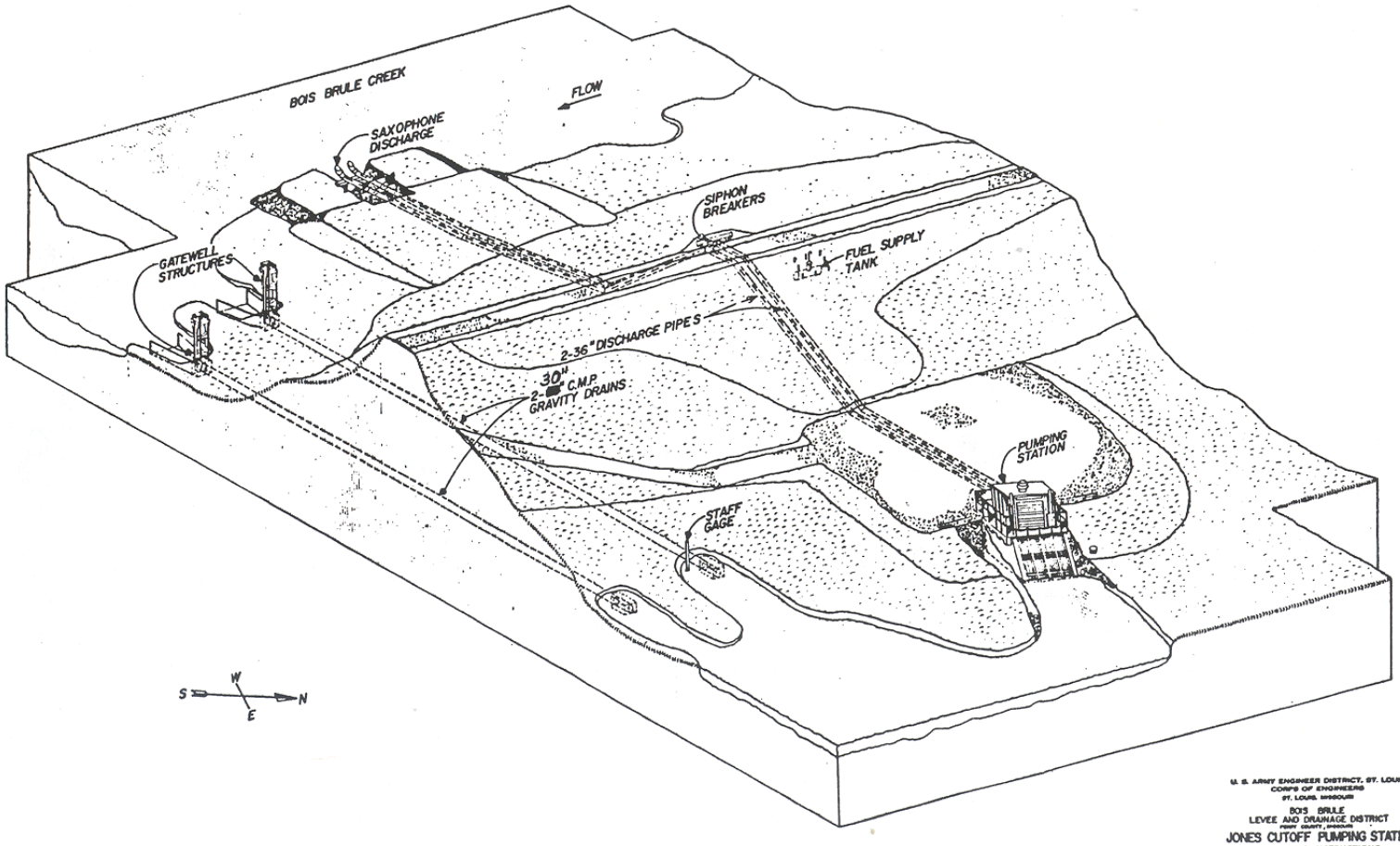
Each of the pumps will be protected from large debris by metal forebay trash racks. Trash will be removed using a hand trash rake.



BOIS BRULE PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS MISSOURI
BOIS BRULE
LEVEE AND DRAINAGE DISTRICT
PERRY COUNTY, MISSOURI
BOIS BRULE PUMPING STATION
OPERATING INSTRUCTIONS
NOT TO SCALE
OPERATION AND MAINTENANCE MANUAL

Chart D-1



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

BOIS BRULE
LEVEE AND DRAINAGE DISTRICT
PERRY COUNTY, MISSOURI

JONES CUTOFF PUMPING STATION
OPERATING INSTRUCTIONS

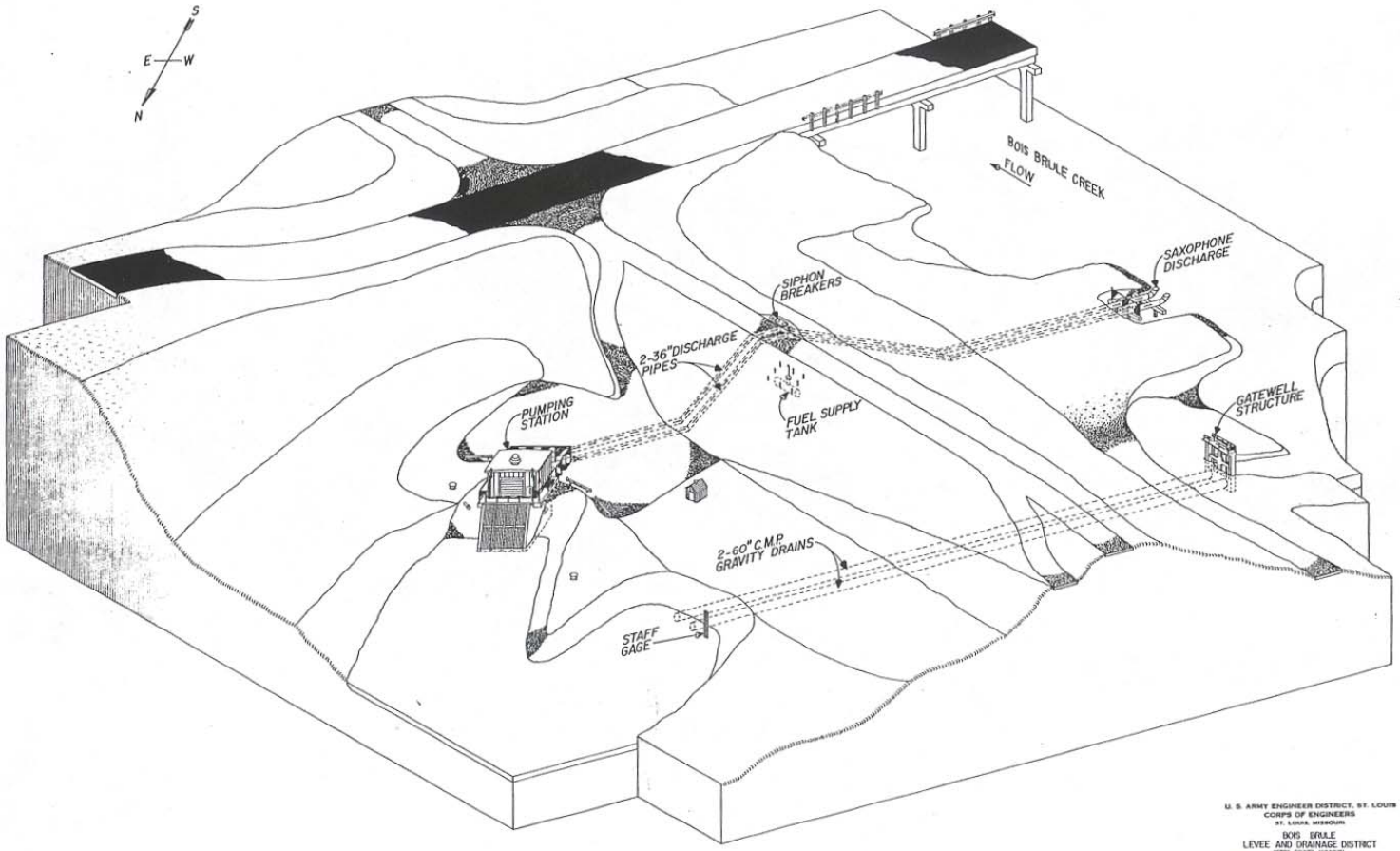
NOT TO SCALE

OPERATION AND MAINTENANCE MANUAL

Robert A. Bilbrough

PLATE NO. 3

Chart D-2



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

BOIS BRULE
LEVEE AND DRAINAGE DISTRICT
PEMIS COUNTY, MISSOURI

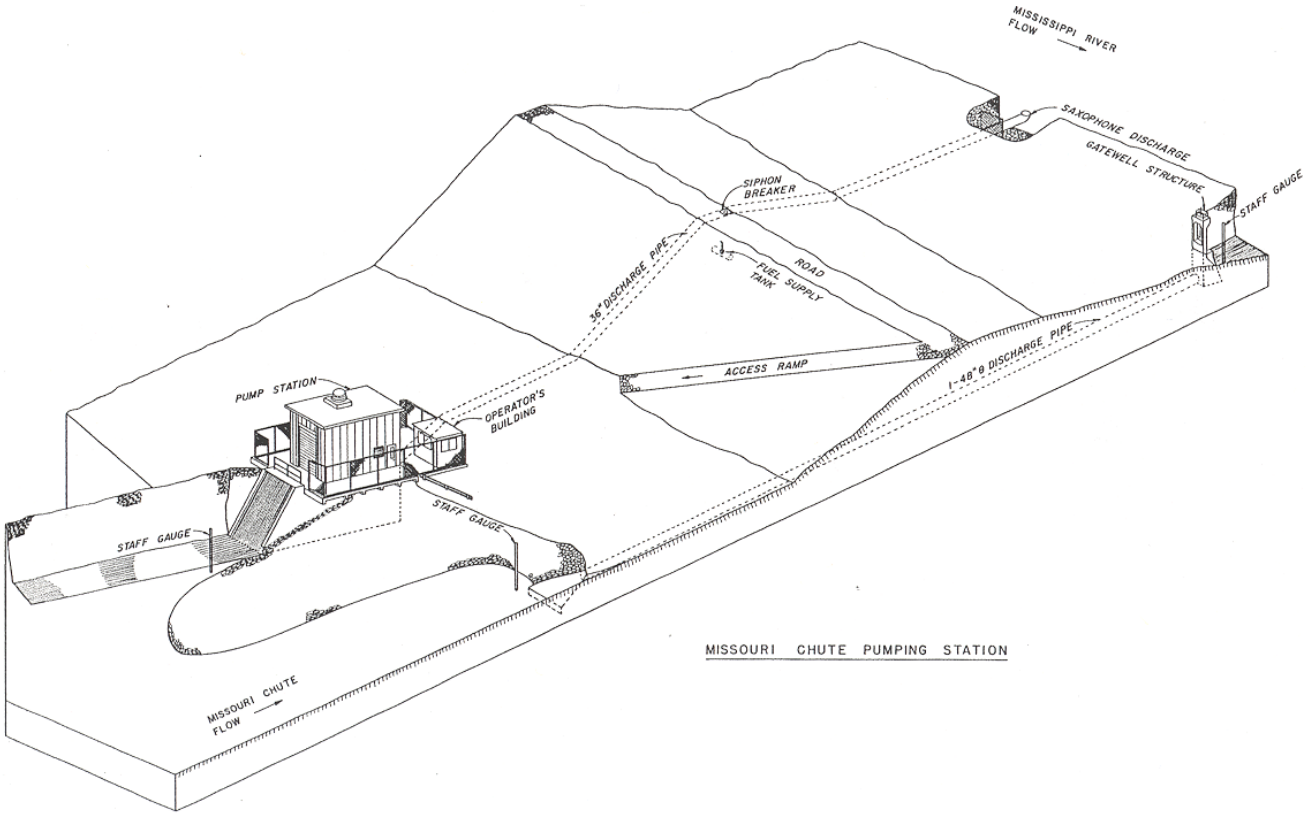
CINQUE HOMMES PUMPING STATION
OPERATING INSTRUCTIONS

NOT TO SCALE

OPERATION AND MAINTENANCE MANUAL

PLATE NO. 3

Chart D-3



MISSOURI CHUTE PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, ST LOUIS
CORPS OF ENGINEERS
ST LOUIS MISSOURI
BOIS BRULE
LEVEE AND DRAINAGE DISTRICT
PERRY COUNTY, MISSOURI
MISSOURI CHUTE PUMPING STATION
OPERATING INSTRUCTIONS
NOT TO SCALE
OPERATION AND MAINTENANCE MANUAL

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX D

REAL ESTATE

REAL ESTATE PLAN
BOIS BRULE DESIGN DEFICIENCY PROJECT
AND
COMBINED DESIGN DEFICIENCY AND SECTION 205 FLOOD CONTROL PROJECT

The Bois Brule levee system is located is located predominately in Perry County, Missouri, with a small section extending into Randolph County, Illinois. Perry County is approximately 90 miles south of St. Louis, Missouri, along US Highway 55 and between river miles 94 and 111 along the right bank of the Mississippi River. The levee system is 33.1 miles long, owned by the Bois Brule Levee and Drainage District, the project sponsor, and provides flood protection to approximately 26,060 acres of primarily agricultural land.

1. Purpose

The Real Estate Plan is in support of the Combined Design Deficiency and Detailed Project Report, which will be the basis for signing a Project Cooperation Agreement. The report comprises a study of the following two projects; the design deficiency project to restore the existing flood control system to its authorized 50- year level of protection, and a combined design deficiency and Section 205 flood control project to raise the level of protection to 100-year. The Energy and Water Development Appropriations Act, 2002 (PL 107-66) directs the Secretary of the Army to construct these projects, and to construct them concurrently.

2. Lands, Easements, and Right-of-Way Required for Construction

Under the Design Deficiency Project the sponsor will be responsible for all the acquisition of all lands, easements, right-of-ways, relocations and borrow and disposal areas (LERRDs) but is not required to provide cash contributions.

The Section 205 Flood Control Project portion of the combined project will be cost shared consistent with Section 103(a) of the Water Resources Development Act of 1986, notwithstanding section 202(a) of the Water Resources Development Act of 1996.

The design deficiency project will require acquisitions from approximately 12 tracts of land for construction. The combined project will require acquisitions from approximately 102 tracts of land for construction. These requirements are further identified as follows.

Permanent Easements, Design Deficiency Project

This portion of the project will require the placement of 13,100 linear feet of landside seepage berms for a total volume of 305,600 cubic yards. This will require the acquisition of a total of 48.96 acres of permanent easement.

Approximately 34.2 acres of Drainage Ditch easements will be required to take flow from new relief wells to existing drainage ditches where necessary, and ditches into and out of three new pump stations.

4 acres of permanent easement will be required for the installation of 3 new pump stations.

Temporary Easements, Design Deficiency Project

Approximately 5.7 acres of temporary borrow easement will be required. The area identified is located on high ground and is under one ownership.

Temporary construction easements total 48.41 acres and include; 1.6 acres for the seepage berm, 4.0 acres for the pump stations, 11.0 acres for the relief wells and 31.81 acres for the drainage ditches.

Severance Damage, Design Deficiency Project

There will be no severance damage as a result of the Design Deficiency Project construction.

Permanent Easements, Combined Project

14.11 acres of additional permanent easement will be required for the placement of an additional 1,300 feet of landside seepage berms.

18.07 acres of additional permanent easement will be required for the addition of 12.5 miles of landside stability berms and the installation of new relief wells.

Approximately 34.2 acres of Drainage Ditch easements will be required to take flow from new relief wells to existing drainage ditches where necessary, and ditches into and out of four new pump stations.

4 acres of permanent easement will be required for the installation of 4 new pump stations

9.6 acres of permanent easement for the new railroad closure structure for the Burlington Northern Santa Fe railroad track.

A permanent conservation easement of 419 acres is required for environmental mitigation.

Permanent flowage easements may be required for induced flooding as discussed later in this report.

Temporary Easements, Combined Project

Approximately 446.70 acres of temporary borrow easements will be required for the removal of material. There are 13 borrow sites identified.

A total of 206.81 acres of temporary construction easements will be required during the construction phase of the improvement. This total consist of 40.7 acres for the construction of the railroad closure, 2.5 acres for seepage berm construction, 72.3 acres for stability berm construction, 38.5 acres for haul roads, 4 acres for pump stations, 17 acres for relief wells and 31.81 acres for drainage ditch construction.

Severance Damages, Combined Project

Under the Combined Project, as a result of the acquisition of the above easements, several tracts of agricultural land will suffer a loss in utility as a result of severance.

The Army Corps of Engineers approved estates are depicted in Exhibit A.

3. Land Required Owned by the Sponsor

The Bois Brule Levee and Drainage District owns permanent levee easement under the footprint of the existing levee. Their ownership generally extends 16 feet from the toe of the levee. Since both the design deficiency and the combined projects involve modifying the existing levee, the sponsor for the construction of the original levee acquired most of the realty interests currently required for this project. CEMVS-RE will consult with the Bois Brule Levee and Drainage District attorney, Mr. Francois Toohey, to make a determination as to the levee district's sufficiency of interest in realty rights owned.

4. Proposed Non-Standard Estates

A permanent conservation easement is required for the environmental mitigation area of 419 acres. The restrictive easement used for the Ste. Genevieve Levee Project and approved and June of 1999 is presented in the attached Exhibit "A". Since the Bois Brule requirements are similar, the Ste. Genevieve restrictive easement will serve as the basis for the Bois Brule restrictive easement.

5. Existing Federal Project within the Lands, Easements, and Right-of-Way Required for the Project

The present levee system lies within the Bois Brule Levee and Drainage District and is in the Army Corps of Engineers Public Law 84-99 program. When the levee failed during the 1993 flood it was repaired. The Energy and Water Development Appropriations Act of 2002 directs the Secretary of the Army to initiate design and construction of deficiency correction work to restore the Bois Brule Drainage and Levee District project to its authorized level of protection.

6. Federally Owned Land Required for the Project

There is no federally owned land in the required lands, easements, and right-of-way.

7. Navigational Servitude

Navigational Servitude does not affect the project.

8. Map Depicting the Area

See the Map of the project area in the main report.

9. Possibility of Induced Flooding Due to Project

The preliminary assessment of induced flooding accomplished to date indicates that induced flooding impacts properties adjacent to, and upstream

from the existing Bois Brule levee. The areas impacted include lands along the Mississippi River, at the downstream end of the Kaskaskia River, and along the Old Channel of the Mississippi River, including parts of the town of St. Marys.

10. Baseline Cost Estimate

A cost estimate is attached as Exhibit C.

11. Relocation Assistance Benefits

Relocation Assistance under Public Law 91-646 is not required.

12. Mineral Activity in Project Area

No mineral activity is known to exist in the area of the project.

13. Sponsors Legal and Professional Capability to Acquire Lands, Easements, and Right-of-Way

The Bois Brule levee is a Federally authorized levee and the Bois Brule Levee and Drainage District does have the legal authority to acquire and hold title to real property for project purposes. The District also has the power of eminent domain within the project area. The levee district is very familiar with real estate issues and acquiring interests for levee improvements. Exhibit B provides a more detailed analysis of the sponsor's capabilities.

The Bois Brule Levee and Drainage District does not have the power of eminent domain outside of their jurisdiction. They could not, therefore, condemn the flowage easements required as a result of the induced flooding. Engineering Regulation 405-1-12, section 12-34 allows the Government to acquire those tracts in which they, the non-Federal sponsor, lack the legal authority to acquire. This ER further states that the decision to acquire on behalf of the non-Federal sponsor lies within the sole discretion of the Government. CEMVS-RE and CEMVS-OC have determined that should acquisition through eminent domain be necessary as a result of induced flooding, the Government will acquire those lands. Therefore, all lands, easement and rights-of-way (LER) required by this project, including the induced flooding easements can, if necessary, be acquired through eminent domain.

14. Zoning Ordinances Proposed

No new zoning ordinances are proposed.

15. Schedule of Land Acquisition Milestones

Certification of right-of-way (ROW) is scheduled after final ROW requirements are provided to the sponsor and the ROW is acquired. A detailed schedule will be developed when final ROW is determined. A minimum of one-year will be required to acquire ROW. This does not include parcels that may require condemnation.

16. Facility or Utility Relocations

The north Burlington Northern Santa Fe Railroad structure will be affected by Combined Project and must be replaced. The new closure structure

is a cost-shared feature, but the temporary relocation of the tracks during construction is classified as relocation.

There is an Exxon Mobil oil pipeline that crosses under the levee in 3 places, 2 of which are in areas that will be raised. The pipelines that are in areas that will be raised may have to have their casings extended and/or reinforced.

The Missouri Department of Transportation has committed to construct a new section of Highway 51 over the top of the levee. A Highway 51 facility relocation will, therefore not be required where the existing Highway 51 crosses the existing levee.

Overhead electric lines also cross the levee in 12 locations. These lines will have to be relocated during the construction phase.

17. Impacts of Suspected or Known Contaminants

No identified contaminants would be affected by the levee raise. Once the required right-of-way is determined, a Phase 1 survey will be conducted on all affected properties.

18. Landowner Support or Opposition to the Project

Landowners fully support the project for the additional flood protection it can provide. Many of them remember the 1993 flood and the extensive losses to crops, buildings, and jobs.

19. Notification to the Non-Federal Sponsor Regarding Risks Associated with Acquiring Land before Execution of the Project Cooperation Agreement

A letter will be sent to the Sponsor regarding the risks associated with acquiring land before execution of the Project Cooperation Agreement.

20. Other Real Estate Issues Relevant to the Project

None are known to exist.

Thomas R. Hewlett
Chief, Real Estate Division
USACE, St. Louis District

Real Estate Plan-Steele Beller
Cost Estimate-Tim Nelson
7 May 2002

EXHIBT A
Army Corps of Engineers 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.

2. Flowage Easement (Occasional Flooding). The perpetual right, power, privilege and easement occasionally to overflow, flood, and submerge (the land described in Schedule A)(Tracts Nos.____, ____ and ____)(and to maintain mosquito control) in connection with the operation and maintenance of the _____ project as authorized by-the Act of Congress approved _____, together with all right, title and interest in and to the structure; and improvements now situate on the land, except fencing (and also excepting _____ (here identify those structures not designed for human habitation which the District Engineer determines may remain on the land); provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of land-fill; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

3. Flood Protection Levee Easement. A perpetual and assignable right and easement in (the land described in Schedule A) (Tracts Nos.____, ____ and ____) to construct, maintain, repair, operate, patrol and replace a flood protection levee, including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land 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.

4. Drainage Ditch Easement. A perpetual and assignable easement and right-of-way in, over and across (the land described in Schedule A) (Tracts Nos.___, ___ and ____) to construct, maintain, repair, operate, patrol and replace a drainage ditch, reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land 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.

5. Borrow Easement. A perpetual and assignable right and easement to clear, borrow, excavate and remove soil, dirt, and other materials from (the land described in Schedule A) (Tracts Nos. ____, ____ and ____); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges in said land as may be used without interfering with or abridging the rights and easement hereby acquired.

6. 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 there from 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.

7. Right of Entry For Survey and Exploration. An assignable easement, in, over and across the land described in Exhibit "A" for a period of ( ) months beginning with the date possession of the land is granted to the United States, consisting of the right of the United States, its representative, agents, contractors and assigns to enter upon said land to survey, stake out, appraise, make borings; and conduct tests and other exploratory work necessary to the design of a public works project; together with the right to trim, cut, fell, and remove there from all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles as required in connection with said work; subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowner(s), their heirs, executors, administrators, successors and assigns, all such right, title, interest and privilege as may be used and enjoyed without interfering with or abridging the rights and easement hereby acquired.

Non Standard Estate
Restrictive Easement

DECLARATION OF COVENANTS AND RESTRICTIONS

The Declarant, the _____, a municipal corporation is the owner in fee simple of certain real property, hereinafter called "Restricted Property," lying, being, and situate in the County of _____, State of _____, and described as follows; to wit:

The "Restricted Property" herein is, or will become, a jurisdictional waters of the United States under the regulatory jurisdiction of the St. Louis District U.S. Army Corps of Engineers (hereinafter referred to as the U.S. Army Corps of Engineers), pursuant to Section 404 of the Clean Water Act (33 USC 1344).

The Declarant is the applicant for U.S. Army Corps of Engineers permit number _____, to conduct certain activities described therein which includes the placement of fill in waters of the United States in accordance with plans which form a part of the _____ Flood Control Project; the U.S.

Army Corps of Engineers has regulatory jurisdiction of said waters of the United States pursuant to Section 404 of the Clean Water Act (33 USC 1344).

The Declarant and the U.S. Army Corps of Engineers have reached an agreement whereby the Declarant will be permitted to conduct certain activities, including the placement of fill material in waters of the United States, in accordance with the terms and conditions of U.S. Army Corps of Engineers permit number _____ and; that in consideration for the permittee to conduct such activities and place fill material in waters of the United States, the Declarant will mitigate the adverse environmental effects resulting from the said activities and placement of fill material which will adversely impact approximately _____ acres of wetlands and other waters of the United States, _____ acres environmental mitigation area which will include open water scrub-shrub and emergent wetlands and _____ acres of trees planted on three sides, which when completed, will be what is described herein as the "Restricted Property" and dedicating the realty described as the "Restricted Property" for the perpetual use as a conservancy area in accordance with the terms and conditions of this document and the above mentioned permit.

WHEREAS, a permit to place fill in waters of the United States would not have been granted but for the performance of the mitigation measures contained in the said permit, including the dedication of the "Restricted Property" for this use as environmental mitigation, and; that, a certified copy of this document, as recorded in the Office of the Recorder of Deeds for Ste. Genevieve County, Missouri, must be submitted to the U.S. Army Corps of Engineers as least 7 days prior to the start of any work in either the mitigation site, or in the existing jurisdictional portions of the _____ acres which will be adversely impacted, and; the said permit is issued in consideration for the performance of the mitigation measures contained in the said permit, including the execution and recording of this Declaration of Covenants and Restrictions.

NOW THEREFORE, the Declarant for and in consideration of the facts herein recited and the mutual covenants, terms conditions and restrictions herein contained, does hereby make the following covenants and creates the following restrictions on the "Restricted Property", for the purpose set forth herein:

COVENANTS OF DECLARANT:

The Declarant shall not obstruct the view of "Restricted Property" in its natural, scenic, and open condition; the "Restricted Property" shall be reserved for wetland protection and wildlife purposes exclusively.

The Declarant does hereby insure the right of the U.S. Army Corps of Engineers, in a reasonable manner and at reasonable times, to enforce by proceedings at law or in equity the covenants hereinafter set forth. The U.S. Army Corps of Engineers does not waive or forfeit the right to take action as may be necessary to insure compliance with the covenants and purposes of this declaration by any prior failure to act;

The Declarant does hereby agree to allow the U.S. Army Corps of Engineers the right to enter "Restricted Property" at all reasonable times for the purpose of inspecting "Restricted Property" to determine if the Declarant, or its heirs or assigns, is complying with the covenants and purposes of this declaration.

Without the prior express written consent from the U.S. Army Corps of Engineers under the terms of the aforesaid U.S. Army Corps of Engineers permit number _____, the Declarant shall abide by the following covenants:

There shall be no dredged or fill material placed on "Restricted Property" except as necessary for completion of the approved mitigation plan as provided pursuant to the U.S. Army Corps of Engineers permit number _____, or for public safety or essential utility services. However, any public safety or essential utility services project must be approved by the U.S. Army Corps of Engineers, and effects upon the "Restricted Property" must be avoided and minimized to the maximum extent possible. The Declarant shall create a _____ acre environmental mitigation area within the Clay borrow area which shall include open water, scrub-shrub, emergent wetlands, as well as _____ acres of trees planted on three sides. This shall be performed in accordance with the mitigation methods described in George Butler & Associates, Inc., March, 1999, *Mitigation and Monitoring Plan for the Impacts to Jurisdictional Waters of the United States at the T.R. Hughes Stadium Parking Lots Project.* The excavation activities will be conducted to create a functional emergent wetland area that shall establish a dominant hydrophytic plant community and maintain a hydrological source. The dominant hydrophytic plant community shall contain a minimum stand of 85% hydrophytic vegetation, determined by both total stem density and ground cover. In the event that the dominant hydrophytic plant community is not established after the first two (2) years, then physical plantings and/or hydrological manipulations will be required. Vegetation monitoring will occur for a minimum of five (5) years. After the first year of establishment of the _____ acre wetland mitigation area, if the necessary hydrology is not adequate (ponding, inundation, or saturation for a minimum of 15 consecutive days during the growing season), corrective measures must be designed and implemented to restore the required wetland hydrology. During design preparation, creating the detention basins/mitigation areas to pond six to eight inches of water, under average and natural climatic conditions, would meet the hydrological criteria requirement. Hydrological monitoring will occur for a minimum of five (5) years. The Declarants shall conduct project monitoring, maintenance, and management for five (5) consecutive years within the preservation and creation areas. Monitoring is to include yearly site visits with members of the St. Louis District Regulatory Staff. The monitoring, at the discretion of the U.S. Army Corps of Engineers, shall include an on-site review prior to construction, during construction, and long-term monitoring not to exceed five (5) years. The long-term monitoring on the mitigation site shall be required for five (5) years after all criteria are met. If at the end of the monitoring period, the mitigation sites are providing adequate functions and values, then no additional monitoring will be required. If however, the mitigation sites are not functioning in the manner envisioned after the monitoring period, and then corrective measures shall be implemented. Any borrow activities or mitigation establishment activities altering surrounding wetlands must be corrected to return surrounding wetlands to their pre-project conditions. Stand management and maintenance of the mitigation sites shall be the responsibility of the Declarants. All mitigation construction of the detention basins, totaling _____ acres shall be implemented concurrently with project construction and completed no later than six months after borrow and grading activities are finalized. There shall be no commercial, industrial, agricultural, residential or recreational developments, buildings, or structures including signs, billboards, other advertising material, or other structures built or placed on "Restricted Property" except

as necessary to the U.S. Army Corps of Engineers permit number _____, or for educational or interpretive purposes. However, any projects for educational or interpretive purposes must be approved by the U.S. Army Corps of Engineers, and effects upon the "Restricted Property" must be avoided and minimized to the maximum extent possible. There shall be no removal or destruction of trees and plants, mowing, draining, plowing, mining, removal of topsoil, sand, rock, grave, minerals, or other materials on "Restricted Property" except as necessary for completion of the mitigation plan as provided pursuant to the U.S. Army Corps of Engineers permit number _____. Pursuant to the mitigation plan, any forest management plan must be approved by the U.S. Army Corps of Engineers, Missouri Department of Conservation, and U.S. Fish and Wildlife Services. There shall be no grazing or keeping of cattle, sheep, horses, or other livestock on "Restricted Property". There shall be no operation of snowmobiles, dunebuggies, motorcycles, all-terrain vehicles or any other types of motorized vehicles on "Restricted Property", except as necessary for completion of the mitigation plan as provided pursuant to the U.S. Army Crops of Engineers permit number _____.

This Declaration of Covenants and Restrictions may be changed, modified or revoked only upon written approval of the U.S. Army Corps of Engineers. To be effective, such approval must be witnessed, authenticated, and recorded pursuant to the law of the State of Missouri.

Except as expressly limited herein, the Declarant reserves for itself, its heirs and assigns, all rights as owner of "Restricted Property", including the right to use the property for all purposes not inconsistent with this grant.

This Declaration of Covenants and Restrictions is created in consideration for the Declarant being allowed to place fill in waters of the United States in accordance with the terms and conditions of the U.S. Army Crops of Engineers permit number _____.

The terms and conditions of this Declaration of Covenants and Restrictions shall, as of the date of execution of this document, bind the Declarant to the extent of its legal and/or equitable interest in "Restricted Property", and; this Declaration, and the covenants and restrictions contained herein, shall run with the land both as to benefit and to burden and shall be binding on the Declarant and its heirs, successors, and assigns forever.

The terms and conditions of this Declaration of Covenants and Restrictions shall be both implicitly and explicitly included in any transfer, conveyance, or encumbrance of "Restricted Property" or any part thereof, and; any instrument of transfer, conveyance, or encumbrance affecting all or any part of "Restricted Property" shall set forth the terms and conditions of this document either by reference to this document or set forth in full text.

EXHIBIT B

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE CAPABILITY

Legal Authority:

Does the sponsor have legal authority to acquire and hold title to real property for project purposes?

Yes the sponsor's legal representative, Mr. Francis Toohey of the law firm Toohey and Moore, has so stated to Mr. William Levins, Office of Counsel that they have legal authority to acquire and hold title to property. Mr. Toohey later reaffirmed this to Mr. Steele Beller, of the Real Estate Division. The sponsor is a legally authorized levee and drainage district in the State of Missouri and under Section 245 of the Missouri Statues does have legal authority to acquire and hold title to real property.

Does the sponsor have the power of eminent domain for this project?

Yes, as a legally authorized levee and drainage district the sponsor does have the power of eminent domain under Missouri statue.

Does the sponsor have "quick-take" authority for this project?

The sponsor has stated there is an untested provision that grants them "quick take" authority. Sponsor feels this provision could be challenged and would use it only as an absolute last resort.

Are any of the lands/interests in land required for the project located outside the sponsor's political boundary?

Yes. Induced damages could occur outside the sponsor's political boundary, however the sponsor does have the legal right to acquire and hold real estate outside their political boundary.

Human Resource Requirements:

Will the sponsor's in-house staff require training to become familiar with the real estate requirements of the Federal project including P.L. 91-646, as amended?

No. The sponsor is using the law firm of to acquire necessary rights of way. They are very experienced in real estate acquisition, and additional training would not be required.

If the answer to I.e. is "yes" has a reasonable plan been developed to provide such training? N.A.

Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

Yes. Toohey and Moore have successfully acquired over 500 properties for drainage and levee districts within the States of Missouri and Illinois.

Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?

Yes. Toohey and Moore are experienced in real estate acquisition and eminent domain and represent several levee districts.

Can the sponsor obtain contractor support, if required in a timely fashion?

Yes. There are a number of local contractors that could provide support, however it is very unlikely that it would be required.

Will the sponsor likely request USACE assistance in acquiring real estate?

The sponsor is planning on acquiring all real estate for the project. The sponsor has indicated they may contract with the St. Louis District to condemn certain properties if they cannot be acquired through negotiations.

Other Project Variables

Will the sponsor's staff be located within reasonable proximity to the project site?

Yes. They have offices in Perryville, which is the county seat of Perry County and is easily accessible to the project area.

Has the sponsor approved project/real estate schedule/milestones?

No milestones have been developed for the project at this time.

Overall Assessment

Has the sponsor performed satisfactorily on other USACE projects?

The sponsor has performed satisfactorily on PL99 emergency repair projects and their law firm; Toohey and Moore have competently represented other drainage and levee districts within the St. Louis District. With regard to this project, the sponsor is anticipated to be fully capable.

EXHIBIT C

BOIS BRULE DESIGN DEFICIENCY/LEVEE RAISE PROJECT

SUMMARY/ESTIMATE OF COSTS/LANDS AND DAMAGES

	Design Deficiency	Combined Design Deficiency and 100-Yr Levee Raise
Permanent Easements		
Berms		
(Stability) 18.7ac @ $1750/ac	$ 0	$ 32,725
(Seepage) 14.11ac @ $1750/ac	$ 15,680	$ 24,693
Seepage Berm @ North Area		
(Design Deficiency only)		
40.0 ac @ $1750/ac	$ 70,000	$ 0
Pump Station		
4.0 ac @ $1750/ac	$ 7,000	$ 7,000
Railroad Closure		
9.6 ac @ $1750/ac	$ 0	$ 16,800
Drainage Ditch		
34.2 ac @ $1750/ac	$ 59,850	$ 59,850
Temporary Easements		
Berms		
(Stability)		
72.3 ac @ $1750/ac X .10	$ 0	$ 12,653
(Seepage)		
2.5 ac @ $1750/ac X .10	$ 280	$ 438
Pump Station		
4.0 ac @ $1750/ac X .10	$ 700	$ 700
Railroad Closure		
40.7 ac @ $1750/ac X .10	$ 0	$ 7,123
Borrow Area		
186.4 ac @ $1750/ac X .90	$ 8,978	$ 293,580
260.3 ac @ $1000/ac X .90	$ 0	$ 234,270
Relief Wells		
17.0 ac @ $1750/ac X .10	$ 1,925	$ 2,975
Drainage Ditch		
31.81 ac @ $1750/ac X .10	$ 5,567	$ 5,567
Roads		
38.5 ac @ $1750/ac X .10	$ 0	$ 6,738
Subtotal Project Acquisitions	$ 169,980	$ 705,112

SUMMARY/ESTIMATE OF COSTS/LANDS AND DAMAGES (cont)

	Design Deficiency	Combined Design Deficiency and 100-Yr Levee Raise
Subtotal Project Acquisitions	$ 169,980	$ 705,112
Severance Damages (10%)		
Design Deficiency		
$ 169,980 X .10	$ 16,998	
Combined D.D. and 100-Yr		
$ 705,112 X .10		$ 70,511
Subtotal	$ 186,978	$ 775,623
Contingency (25%)		
Design Deficiency		
$ 186,978 X .25	$ 46,745	
Combined D.D. and 100-Yr		
$ 775,623 X .25		$ 193,906
Subtotal	$ 233,723	$ 969,529
Relocation Assistance PL 91-646		
-Title III Payments		
102 Tracts @ $500 per ownership	$ 6,000	$ 51,000
12 Tracts @ $500 per ownership (seepage berm @ north area)	$ 6,000	
Acquisition Cost per Ownership		
Planning $1,500		
Acquisition $5,500		
Appraisal $1,000		
Total $8,000		
102 Tracts @ $8,000 per ownership	$ 96,000	$ 816,000
12 Tracts @ $8,000 per ownership (seepage berm @ north area)	$ 96,000	
Subtotal	$ 437,723	$1,836,529

SUMMARY/ESTIMATE OF COSTS/LANDS AND DAMAGES (cont)

	Design Deficiency	Combined Design Deficiency and 100-Yr Levee Raise
Subtotal	$ 437,723	$1,836,529
Utility Relocations/Alterations	$ 2,000	$ 94,600
Environnemental Mitigation Lands*	$ 0	$ 538,000
Induced Flooding (see attached cost estimate)	$ 0	$1,989,000
	==========	==========
TOTAL PROJECT COSTS (ROUND)	$ 440,000	$4,458,000

*Note: Although the unit amounts (value per acre) for Environmental Mitigation Lands were provided by RE-E, the estimate does NOT include Damages, Relocation, and Administrative Acquisition Costs. However, we believe the Total Project Cost contingencies are sufficient to cover the additional cost.

INDUCED FLOODING ESTIMATED REAL ESTATE COSTS

	Design Deficiency	Combined Design Deficiency and 100-Yr Levee Raise
Permanent Easements		
Flowage		
436 ac @ $1000/ac X .25	$ 0	$ 109,000
4.0 ac @ $2500/ac X .25	$ 0	$ 2,500
Subtotal Project Acquisitions	$ 0	$ 111,500
Severance Damages (10%)		
Design Deficiency		
$ 0 X .10	$ 0	
Combined D.D. and 100-Yr		
$ 111,500 X .10		$ 11,150
Subtotal	$ 0	$ 122,650
Contingency (25%)		
Design Deficiency		
$ 0 X .25	$ 0	
Combined D.D. and 100-Yr		
$ 122,650 X .25		$ 30,663
Subtotal	$ 0	$ 153,313
Relocation Assistance PL 91-646		
-Title III Payments		
216 Tracts @ $500 per ownership	$ 0	$ 108,000
Acquisition Cost per Ownership		
Planning $1,500		
Acquisition $5,500		
Appraisal $1,000		
Total $8,000		
216 Tracts @ $8,000 per ownership	$ 0	$1,728,000
TOTAL INDUCED FLOODING PROJECT COSTS	$ 0	$1,989,000

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX E

RELOCATIONS

Appendix E - Relocations

Utility Relocations

Design Deficiency Project

No utility relocations will be required for the design deficiency project.

Section 205 Project

Aerial Electric

Aerial electrical power lines crossing the levee in twelve locations may need to be modified for the Section 205 levee raise project. See Drawing 11 in the main report for the location of the crossings. The estimated cost for these modifications is $27,600.

Aerial electric power lines run along the levee between station 20+00 and 40+00 and between station 1500+00 and 1540+00. A stability berm is required in these areas for the Section 205 project. This may require a relocation of the power lines at an estimated cost of $2,000 and $23,000 respectively.

Exxon Mobil Transmission Line

A 20-inch diameter crude transmission line crosses under the levee in three locations. At station 250+00, the levee footprint will be widened by about 25 feet on the landside. This will require the pipeline casing to be extended at an estimated cost of $42,255.

Road Relocations

Design Deficiency Project

No road relocations will be required for the design deficiency project.

Section 205 Project

No road relocations will be required for the Section 205 levee raise project.

Railroad Relocations

Design Deficiency Project

No railroad relocations will be required for the design deficiency project.

Section 205 Project

Railroad relocations are associated with replacing the north closure structure at the Burlington Northern Sante Fe Railroad tracks for the Section

205 levee raise project. The railroad relocations include a temporary railroad bypass at the north railroad closure structure and the cost of Burlington Northern Sante Fe work associated with the closure structure, such as removing and reinstalling track, maintaining signaling while the railroad bypass is being used, installing temporary and permanent track crossings, providing flagmen, and railroad engineering and administrative costs.

The incremental cost estimate for the railroad relocations based on similar work at the Ste. Genevieve Middle Closure Structure is $360,000 at October 2002 price levels. The temporary railroad bypass at the Ste. Genevieve project was constructed by a Corps contractor in accordance with plans reviewed and approved by the railroad. A separate set of bid items for the railroad relocations work was included in the closure structure contract. This facilitated having the sponsor directly pay for the relocations costs. In addition to the railroad bypass costs in the Corps construction contract, the railroad relocations costs also included all Corps construction management, engineering during construction, and administrative costs associated with the railroad bypass and the work done by the railroad.

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX F

COST ESTIMATES

Appendix F - Cost Estimates

The cost estimates in this appendix are at 1 October 2002 price levels. The estimates include:

- A Micro-Computer Aided Cost Estimate (MCACES) estimate for the Design Deficiency project.
- An MCACES estimate for the combined Design Deficiency and Section 205 Flood Control project.
- An estimate of the Operation, Maintenance and Replacement costs for the Design Deficiency (50-year) project.
- An estimate of the Operation, Maintenance and Replacement costs for the combined Design Deficiency and Section 205 (100-year) project.

The MCACES cost estimates are incremental estimates that reflect the cost if the entire project was constructed on 1 October 2002. Cost tables presented in the main report show the estimated fully funded cost, which accounts for expected price level increases in construction, real estate and engineering and administrative labor over the project schedule.

The cost estimates for new pumping stations were based on the cost for the existing Missouri Chute Pumping Station, because the new pumping stations will be similar to this facility. The cost was factored up to current price levels and adjusted for the differences in pumping capacity.

BOIS BRULE-50 YEAR
DESIGN DEFICIENCY

Designed By: ST. LOUIS DISTRICT, COE
Estimated By: ST. LOUIS DISTRICT, COE

Prepared By: DAWAYNE SANDERS, P.E.

Preparation Date: 04/30/02
Effective Date of Pricing: 04/30/02

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

M C A C E S f o r W i n d o w s
Software Copyright (c) 1985-1997
by Building Systems Design, Inc.
Release 1.2

** CONTRACTOR SETTINGS **

	AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
PM Prime Contractor										
Field Office Overhead	P	5.50								
Home Office Overhead	P	5.00								
Profit	P	7.80								
Bond	C		(Class: A)							
EL Electrical										
Field Office Overhead	P	3.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							
ME Mechanical										
Field Office Overhead	P	3.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							
DW Dewatering										
Field Office Overhead	P	5.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							

SUMMARY REPORTS SUMMARY PAGE

PROJECT OWNER SUMMARY - Level 1.....1
PROJECT OWNER SUMMARY - Level 2.....2
PROJECT OWNER SUMMARY - Level 6.....3
PROJECT INDIRECT SUMMARY - Level 1.....16
PROJECT INDIRECT SUMMARY - Level 2.....17
PROJECT INDIRECT SUMMARY - Level 6.....19
PROJECT DIRECT SUMMARY - Level 1.....32
PROJECT DIRECT SUMMARY - Level 2.....33
PROJECT DIRECT SUMMARY - Level 6.....35

DETAILED ESTIMATE DETAIL PAGE

A. RELIEF WELLS # 1 Contract
11. Levees
01. Relief Wells-74 each
02. Mob, Demob & Preparatory Work
1. Mobilization and Demobilization.....1
99. Associated Levee Items
1. Relief Wells, Welled Reaches-74.....1
2. Seeding.....2
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....2
2. Engineering During Construction.....2
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....2
2. Engineering During Construction.....2
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....2
2. Engineering During Construction.....2
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....3
2. Engineering During Construction.....3
05. Project Management
1. Plans & Specifications.....3
2. Engineering During Construction.....3
06. CT-Contracts
1. Plans & Specifications.....3
2. Engineering During Construction.....3
07. CO-C, AND CO-F
1. Plans & Specifications.....3
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....3
B. RELIEF WELLS # 2 Contract
11. Levees
01. Relief Wells-210
02. Mob, Demob & Preparatory Work

DETAILED ESTIMATE DETAIL PAGE

1. Mobilization and Demobilization.....4
99. Associated Levee Items
1. Relief Wells for hot spot areas.....4
2. Relief Wells, Welled Reaches.....5
3. Relief Wells, Non-Welled Reaches.....5
5. Seeding.....6
02. Piezometers
01. Piezometers
1. Piezometers.....6
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....6
2. Engineering During Construction.....6
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....7
2. Engineering During Construction.....7
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....7
2. Engineering During Construction.....7
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....7
2. Engineering During Construction.....7
05. Project Management
1. Plans & Specifications.....7
2. Engineering During Construction.....7
06. CT-Contracts
1. Plans & Specifications.....7
2. Engineering During Construction.....7
07. CO-C, AND CO-F
1. Plans & Specifications.....7
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....8
C. EMBANKMENT & DITCHING Contract
11. Levees
01. Levee Raise and Seepage Berms
02. Mob, Demob & Preparatory Work
1. Mobilization and Demobilization.....9
04. Permanent Access Road
1. Road on Levee Crown.....9
99. Associated Levee Items
1. Embankment In Place.....9
2. Seepage Berms-Bois Brule Pump.....10
3. Landside Seepage Berms-Pervious.....10
5. Establishment of Turf.....10
02. Drainage Ditching
01. Jones Cutoff Drainage Area
1. Ditch Excavation.....10
2. Establishment of Turf.....11

DETAILED ESTIMATE DETAIL PAGE

3. 36" Dia. Corrugated Metal Pipe.....11
02. Cinque Holmes Drainage Area
1. Ditch Excavation.....11
2. Establishment of Turf.....11
3. 36" Dia. Corrugated Metal Pipe.....11
03. Highway 51 Closure Structure
02. Demolish High. 51 Closure Struct
1. Remove Reinforced Concrete Struc.....12
2. Excavation.....12
3. Backfill to Grade.....12
4. Disposal of Steel Panels.....12
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....12
2. Engineering During Construction.....12
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....12
2. Engineering During Construction.....12
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....13
2. Engineering During Construction.....13
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....13
2. Engineering During Construction.....13
05. Project Management
1. Plans & Specifications.....13
2. Engineering During Construction.....13
06. CT-Contracts
1. Plans & Specifications.....13
2. Engineering During Construction.....13
07. CO-C, AND CO-F
1. Plans & Specifications.....13
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....14
D. PUMP STATIONS Contract
13. Pumping Plant
01. Missouri Chute Pump Station
01. Pump Station
1. Pump Station - 25 cfs.....15
04. Mob . Demob & Preparatory
01. Mob . Demob & Preparatory.....15
02. Jones Cutoff Pump Station
01. Pump Station
1. Pump Station - 30 cfs.....15
04. Mob. Demob. & Preparatory cost
1. Mob. Demob. & Preparatory cost.....15
03. Cinque Hommes Pump Station
01. Pump Station

DETAILED ESTIMATE DETAIL PAGE

1. Pump Station - 10 cfs.....15
04. Mob. Demob. & Preparatory cost
1. Mob. Demob. & Preparatory cost.....15
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....16
2. Engineering During Construction.....16
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....16
2. Engineering During Construction.....16
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....16
2. Engineering During Construction.....16
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....16
2. Engineering During Construction.....16
05. Engineering - ED-DA Structures
1. Plans & Specifications,Drawings.....16
4. Engineering During Construction.....16
06. Engineering - ED-DM Mechanical
1. Modifiy Pump Discharge Pipes.....17
2. Engineering During Const.-Pipes.....17
3. Pump Station Design-4 each.....17
4. Eng during Const-4 Pump Stations.....17
07. Engineering - ED-DM Electrical
1. Plans & Specification-4 Stations.....17
08. Value Engineering
1. Value Engineering-Pump Stations.....17
09. Project Management
1. Plans & Specifications.....17
2. Engineering During Construction.....17
10. CT-Contracts
1. Plans & Specifications.....17
2. Engineering During Construction.....17
11. CO-C, AND CO-F
1. Plans & Specifications.....17
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....18
F. NON FEDERAL COSTS
01. Lands and Damages
02. Acquisition Costs
02. Acquisition Costs
02. Permanent Easements
A. Berms-Seepage.....19
B. Pump Station.....19
D. Drainage Ditch.....19
E. Seepage Berm-North area,.....19
03. Temporary Easements

DETAILED ESTIMATE DETAIL PAGE

A. Berms-Seepage.....19
B. Pump Station.....19
D. Borrow Area - "A".....19
F. Relief Wells.....19
G. Drainage Ditch.....19
04. Severance Damages
A. Severance Damages - 10%.....19
05. Acquisition Costs-Ownerships-24
A. Planning.....19
B. Acquisition.....20
C. Appraisal.....20
07. PL 91-646 Relocation Assistance
A. Title III Payments-Basic Project.....20
G. FEDERAL COSTS-PART OF 30 ACCOUNT
30. Planning, Engineering & Design
01. Planning, Engineering & Design
01. Design Deficiency Project.....21

BACKUP REPORTS BACKUP PAGE

CREW BACKUP.....1
LABOR BACKUP.....3
EQUIPMENT BACKUP.....4

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Level 1 **

		QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A	RELIEF WELLS # 1 Contract		2,418,123	481,281	2,899,403	
B	RELIEF WELLS # 2 Contract		6,593,974	1,398,493	7,992,467	
C	EMBANKMENT & DITCHING Contract		2,495,000	514,500	3,009,499	
D	PUMP STATIONS Contract		1,834,807	309,202	2,144,009	
F	NON FEDERAL COSTS		390,979	46,745	437,724	
G	FEDERAL COSTS-PART OF 30 ACCOUNT		1,372,000	0	1,372,000	
TOTAL	BOIS BRULE-50 YEAR	1.00 EA	15,104,882	2,750,221	17,855,10317855103	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract						
A11 Levees			1,925,123	481,281	2,406,403	
A30 Planning, Engineering and Design			252,000	0	252,000	
A31 Supervision and Administration			241,000	0	241,000	
TOTAL RELIEF WELLS # 1 Contract			2,418,123	481,281	2,899,403	
B RELIEF WELLS # 2 Contract						
B11 Levees			5,593,974	1,398,493	6,992,467	
B30 Planning, Engineering and Design			301,000	0	301,000	
B31 Supervision and Administration			699,000	0	699,000	
TOTAL RELIEF WELLS # 2 Contract			6,593,974	1,398,493	7,992,467	
C EMBANKMENT & DITCHING Contract						
C11 Levees			2,058,000	514,500	2,572,499	
C30 Planning, Engineering and Design			180,000	0	180,000	
C31 Supervision and Administration			257,000	0	257,000	
TOTAL EMBANKMENT & DITCHING Contract			2,495,000	514,500	3,009,499	
D PUMP STATIONS Contract						
D13 Pumping Plant			1,236,807	309,202	1,546,009	
D30 Planning, Engineering and Design			443,000	0	443,000	
D31 Supervision and Administration			155,000	0	155,000	
TOTAL PUMP STATIONS Contract			1,834,807	309,202	2,144,009	
F NON FEDERAL COSTS						
F01 Lands and Damages			390,979	46,745	437,724	
TOTAL NON FEDERAL COSTS			390,979	46,745	437,724	
G FEDERAL COSTS-PART OF 30 ACCOUNT						
G30 Planning, Engineering & Design			1,372,000	0	1,372,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			1,372,000	0	1,372,000	
TOTAL BOIS BRULE-50 YEAR	1.00	EA	15,104,882	2,750,221	17,855,10317855103	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract						
A11 Levees						
A1101 Relief Wells-74 each						
A1101_02 Mob, Demob & Preparatory Work						
A1101_02 1 Mobilization and Demobilization			91,337	22,834	114,172	
TOTAL Mob, Demob & Preparatory Work			91,337	22,834	114,172	
A1101_99 Associated Levee Items						
A1101_99 1 Relief Wells, Welled Reaches-74	74.00	EA	1,813,548	453,387	2,266,935	30634
A1101_99 2 Seeding	14.80	ACR	20,237	5,059	25,296	1709.19
TOTAL Associated Levee Items			1,833,785	458,446	2,292,231	
TOTAL Relief Wells-74 each	74.00	EA	1,925,123	481,281	2,406,403	32519
TOTAL Levees			1,925,123	481,281	2,406,403	
A30 Planning, Engineering and Design						
A3001 Planning, Engineering and Design						
A3001_01 Engineering - ED-DC Civil Design						
A3001_01 1 Plans/Specification&Gen.Drawings			60,000	0	60,000	
A3001_01 2 Engineering During Construction			39,000	0	39,000	
TOTAL Engineering - ED-DC Civil Design			99,000	0	99,000	
A3001_02 Engineering - ED-GF Geotech						
A3001_02 1 Plans & Specifications			65,000	0	65,000	
A3001_02 2 Engineering During Construction			40,000	0	40,000	
TOTAL Engineering - ED-GF Geotech			105,000	0	105,000	
A3001_03 Engineering - ED-HE Hydrologic						
A3001_03 1 Plans & Specifications			5,000	0	5,000	
A3001_03 2 Engineering During Construction			3,500	0	3,500	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrologic		8,500	0	8,500	
A3001_04 Engineering - ED-C Cost Estimate					
A3001_04 1 Plans & Specs. Bid Opening		11,000	0	11,000	
A3001_04 2 Engineering During Construction		500	0	500	
TOTAL Engineering - ED-C Cost Estimate		11,500	0	11,500	
A3001_05 Project Management					
A3001_05 1 Plans & Specifications		6,000	0	6,000	
A3001_05 2 Engineering During Construction		5,000	0	5,000	
TOTAL Project Management		11,000	0	11,000	
A3001_06 CT-Contracts					
A3001_06 1 Plans & Specifications		5,000	0	5,000	
A3001_06 2 Engineering During Construction		2,000	0	2,000	
TOTAL CT-Contracts		7,000	0	7,000	
A3001_07 CO-C, AND CO-F					
A3001_07 1 Plans & Specifications		10,000	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	10,000	
TOTAL Planning, Engineering and Design		252,000	0	252,000	
TOTAL Planning, Engineering and Design		252,000	0	252,000	
A31 Supervision and Administration					
A3123 Construction Contracts					
A3123_11 Supervision and Administration					
A3123_1101 Supervision and Administration		241,000	0	241,000	
TOTAL Supervision and Administration		241,000	0	241,000	
TOTAL Construction Contracts		241,000	0	241,000	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Supervision and Administration			241,000	0	241,000	
TOTAL RELIEF WELLS # 1 Contract			2,418,123	481,281	2,899,403	
B RELIEF WELLS # 2 Contract						
B11 Levees						
B1101 Relief Wells-210						
B1101_02 Mob, Demob & Preparatory Work						
B1101_02 1 Mobilization and Demobilization			326,634	81,659	408,293	
TOTAL Mob, Demob & Preparatory Work			326,634	81,659	408,293	
B1101_99 Associated Levee Items						
B1101_99 1 Relief Wells for hot spot areas	62.00	EA	1,519,459	379,865	1,899,324	30634
B1101_99 2 Relief Wells, Welled Reaches	18.00	EA	441,133	110,283	551,417	30634
B1101_99 3 Relief Wells, Non-Welled Reaches	130.00	EA	3,181,280	795,320	3,976,600	30589
B1101_99 5 Seeding	42.00	ACR	57,429	14,357	71,786	1709.19
TOTAL Associated Levee Items			5,199,302	1,299,825	6,499,127	
TOTAL Relief Wells-210	210.00	EA	5,525,936	1,381,484	6,907,420	32892
B1102 Piezometers						
B1102_01 Piezometers						
B1102_01 1 Piezometers	68.00	EA	68,038	17,009	85,047	1250.70
TOTAL Piezometers	68.00	EA	68,038	17,009	85,047	1250.70
TOTAL Piezometers	68.00	EA	68,038	17,009	85,047	1250.70
TOTAL Levees			5,593,974	1,398,493	6,992,467	
B30 Planning, Engineering and Design						
B3001 Planning, Engineering and Design						
B3001_01 Engineering - ED-DC Civil Design						
B3001_01 1 Plans/Specification&Gen.Drawings			52,000	0	52,000	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
B3001_01 2 Engineering During Construction		43,000	0	43,000	
TOTAL Engineering - ED-DC Civil Design		95,000	0	95,000	
B3001_02 Engineering - ED-GF Geotech					
B3001_02 1 Plans & Specifications		67,000	0	67,000	
B3001_02 2 Engineering During Construction		58,000	0	58,000	
TOTAL Engineering - ED-GF Geotech		125,000	0	125,000	
B3001_03 Engineering - ED-HE Hydrologic					
B3001_03 1 Plans & Specifications		5,000	0	5,000	
B3001_03 2 Engineering During Construction		7,000	0	7,000	
TOTAL Engineering - ED-HE Hydrologic		12,000	0	12,000	
B3001_04 Engineering - ED-C Cost Estimate					
B3001_04 1 Plans & Specs. Bid Opening		14,000	0	14,000	
B3001_04 2 Engineering During Construction		6,000	0	6,000	
TOTAL Engineering - ED-C Cost Estimate		20,000	0	20,000	
B3001_05 Project Management					
B3001_05 1 Plans & Specifications		7,000	0	7,000	
B3001_05 2 Engineering During Construction		16,000	0	16,000	
TOTAL Project Management		23,000	0	23,000	
B3001_06 CT-Contracts					
B3001_06 1 Plans & Specifications		6,000	0	6,000	
B3001_06 2 Engineering During Construction		10,000	0	10,000	
TOTAL CT-Contracts		16,000	0	16,000	
B3001_07 CO-C, AND CO-F					
B3001_07 1 Plans & Specifications		10,000	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	10,000	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Planning, Engineering and Design			301,000	0	301,000	
TOTAL Planning, Engineering and Design			301,000	0	301,000	
B31 Supervision and Administration						
B3123 Construction Contracts						
B3123_11 Supervision and Administration						
B3123_1101 Supervision and Administration			699,000	0	699,000	
TOTAL Supervision and Administration			699,000	0	699,000	
TOTAL Construction Contracts			699,000	0	699,000	
TOTAL Supervision and Administration			699,000	0	699,000	
TOTAL RELIEF WELLS # 2 Contract			6,593,974	1,398,493	7,992,467	
C EMBANKMENT & DITCHING Contract						
C11 Levees						
C1101 Levee Raise and Seepage Berms						
C1101_02 Mob, Demob & Preparatory Work						
C1101_02 1 Mobilization and Demobilization			59,202	14,801	74,003	
TOTAL Mob, Demob & Preparatory Work			59,202	14,801	74,003	
C1101_04 Permanent Access Road						
C1101_04 1 Road on Levee Crown			150,716	37,679	188,395	
TOTAL Permanent Access Road			150,716	37,679	188,395	
C1101_99 Associated Levee Items						
C1101_99 1 Embankment In Place	62000	CY	261,756	65,439	327,195	5.28
C1101_99 2 Seepage Berms-Bois Brule Pump	223600	CY	944,009	236,002	1,180,012	5.28
C1101_99 3 Landside Seepage Berms-Pervious	82000	CY	346,193	86,548	432,741	5.28
C1101_99 5 Establishment of Turf	50.00	ACR	61,682	15,420	77,102	1542.04
TOTAL Associated Levee Items			1,613,640	403,410	2,017,049	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Levee Raise and Seepage Berms			1,823,558	455,890	2,279,448	
C1102 Drainage Ditching						
C1102_01 Jones Cutoff Drainage Area						
C1102_01 1 Ditch Excavation	16644	CY	71,536	17,884	89,420	5.37
C1102_01 2 Establishment of Turf	20.00	ACR	24,673	6,168	30,841	1542.04
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	6,097	1,524	7,622	90.74
TOTAL Jones Cutoff Drainage Area			102,306	25,577	127,883	
C1102_02 Cinque Holmes Drainage Area						
C1102_02 1 Ditch Excavation	16528	CY	71,037	17,759	88,797	5.37
C1102_02 2 Establishment of Turf	20.00	ACR	24,673	6,168	30,841	1542.04
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	6,097	1,524	7,622	90.74
TOTAL Cinque Holmes Drainage Area			101,807	25,452	127,259	
TOTAL Drainage Ditching			204,113	51,028	255,142	
C1103 Highway 51 Closure Structure						
C1103_02 Demolish High. 51 Closure Struct						
C1103_02 1 Remove Reinforced Concrete Struc	105.00	CY	26,479	6,620	33,099	315.23
C1103_02 2 Excavation	50.00	CY	240	60	300	6.00
C1103_02 3 Backfill to Grade	150.00	CY	1,207	302	1,509	10.06
C1103_02 4 Disposal of Steel Panels			2,402	600	3,002	
TOTAL Demolish High. 51 Closure Struct			30,328	7,582	37,910	
TOTAL Highway 51 Closure Structure			30,328	7,582	37,910	
TOTAL Levees			2,058,000	514,500	2,572,499	
C30 Planning, Engineering and Design						
C3001 Planning, Engineering and Design						
C3001_01 Engineering - ED-DC Civil Design						
C3001_01 1 Plans/Specification&Gen.Drawings			60,000	0	60,000	
C3001_01 2 Engineering During Construction			40,000	0	40,000	
TOTAL Engineering - ED-DC Civil Design			100,000	0	100,000	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
C3001_02 Engineering - ED-GF Geotech					
C3001_02 1 Plans & Specifications		23,000	0	23,000	
C3001_02 2 Engineering During Construction		20,000	0	20,000	
TOTAL Engineering - ED-GF Geotech		43,000	0	43,000	
C3001_03 Engineering - ED-HE Hydrologic					
C3001_03 1 Plans & Specifications		3,000	0	3,000	
C3001_03 2 Engineering During Construction		3,000	0	3,000	
TOTAL Engineering - ED-HE Hydrologic		6,000	0	6,000	
C3001_04 Engineering - ED-C Cost Estimate					
C3001_04 1 Plans & Specs. Bid Opening		12,000	0	12,000	
C3001_04 2 Engineering During Construction		2,000	0	2,000	
TOTAL Engineering - ED-C Cost Estimate		14,000	0	14,000	
C3001_05 Project Management					
C3001_05 1 Plans & Specifications		2,000	0	2,000	
C3001_05 2 Engineering During Construction		5,000	0	5,000	
TOTAL Project Management		7,000	0	7,000	
C3001_06 CT-Contracts					
C3001_06 1 Plans & Specifications		3,000	0	3,000	
C3001_06 2 Engineering During Construction		3,000	0	3,000	
TOTAL CT-Contracts		6,000	0	6,000	
C3001_07 CO-C, AND CO-F					
C3001_07 1 Plans & Specifications		4,000	0	4,000	
TOTAL CO-C, AND CO-F		4,000	0	4,000	
TOTAL Planning, Engineering and Design		180,000	0	180,000	
TOTAL Planning, Engineering and Design		180,000	0	180,000	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
C31 Supervision and Administration					
C3123 Construction Contracts					
C3123_11 Supervision and Administration					
C3123_1101 Supervision and Administration		257,000	0	257,000	
TOTAL Supervision and Administration		257,000	0	257,000	
TOTAL Construction Contracts		257,000	0	257,000	
TOTAL Supervision and Administration		257,000	0	257,000	
TOTAL EMBANKMENT & DITCHING Contract		2,495,000	514,500	3,009,499	
D PUMP STATIONS Contract					
D13 Pumping Plant					
D1301 Missouri Chute Pump Station					
D1301_01 Pump Station					
D1301_01 1 Pump Station - 25 cfs		503,361	125,840	629,202	
TOTAL Pump Station		503,361	125,840	629,202	
D1301_04 Mob . Demob & Preparatory					
D1301_0401 Mob . Demob & Preparatory		25,218	6,305	31,523	
TOTAL Mob . Demob & Preparatory		25,218	6,305	31,523	
TOTAL Missouri Chute Pump Station		528,579	132,145	660,724	
D1302 Jones Cutoff Pump Station					
D1302_01 Pump Station					
D1302_01 1 Pump Station - 30 cfs		503,361	125,840	629,202	
TOTAL Pump Station		503,361	125,840	629,202	
D1302_04 Mob. Demob. & Preparatory cost					

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D1302_04 1 Mob. Demob. & Preparatory cost		25,218	6,305	31,523	
TOTAL Mob. Demob. & Preparatory cost		25,218	6,305	31,523	
TOTAL Jones Cutoff Pump Station		528,579	132,145	660,724	
D1303 Cinque Hommes Pump Station					
D1303_01 Pump Station					
D1303_01 1 Pump Station - 10 cfs		171,123	42,781	213,903	
TOTAL Pump Station		171,123	42,781	213,903	
D1303_04 Mob. Demob. & Preparatory cost					
D1303_04 1 Mob. Demob. & Preparatory cost		8,526	2,132	10,658	
TOTAL Mob. Demob. & Preparatory cost		8,526	2,132	10,658	
TOTAL Cinque Hommes Pump Station		179,649	44,912	224,561	
TOTAL Pumping Plant		1,236,807	309,202	1,546,009	
D30 Planning, Engineering and Design					
D3001 Planning, Engineering and Design					
D3001_01 Engineering - ED-DC Civil Design					
D3001_01 1 Plans/Specification&Gen.Drawings		25,000	0	25,000	
D3001_01 2 Engineering During Construction		3,000	0	3,000	
TOTAL Engineering - ED-DC Civil Design		28,000	0	28,000	
D3001_02 Engineering - ED-GF Geotech					
D3001_02 1 Plans & Specifications		14,000	0	14,000	
D3001_02 2 Engineering During Construction		12,000	0	12,000	
TOTAL Engineering - ED-GF Geotech		26,000	0	26,000	
D3001_03 Engineering - ED-HE Hydrologic					
D3001_03 1 Plans & Specifications		6,000	0	6,000	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D3001_03 2 Engineering During Construction		2,000	0	2,000	
TOTAL Engineering - ED-HE Hydrologic		8,000	0	8,000	
D3001_04 Engineering - ED-C Cost Estimate					
D3001_04 1 Plans & Specs. Bid Opening		15,000	0	15,000	
D3001_04 2 Engineering During Construction		5,000	0	5,000	
TOTAL Engineering - ED-C Cost Estimate		20,000	0	20,000	
D3001_05 Engineering - ED-DA Structures					
D3001_05 1 Plans & Specifications,Drawings		142,000	0	142,000	
D3001_05 4 Engineering During Construction		7,000	0	7,000	
TOTAL Engineering - ED-DA Structures		149,000	0	149,000	
D3001_06 Engineering - ED-DM Mechanical					
D3001_06 1 Modifiy Pump Discharge Pipes		9,000	0	9,000	
D3001_06 2 Engineering During Const.-Pipes		8,000	0	8,000	
D3001_06 3 Pump Station Design-4 each		90,000	0	90,000	
D3001_06 4 Eng during Const-4 Pump Stations		39,000	0	39,000	
TOTAL Engineering - ED-DM Mechanical		146,000	0	146,000	
D3001_07 Engineering - ED-DM Electrical					
D3001_07 1 Plans & Specification-4 Stations		20,000	0	20,000	
TOTAL Engineering - ED-DM Electrical		20,000	0	20,000	
D3001_08 Value Engineering					
D3001_08 1 Value Engineering-Pump Stations		20,000	0	20,000	
TOTAL Value Engineering		20,000	0	20,000	
D3001_09 Project Management					
D3001_09 1 Plans & Specifications		6,000	0	6,000	
D3001_09 2 Engineering During Construction		2,000	0	2,000	
TOTAL Project Management		8,000	0	8,000	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D3001_10 CT-Contracts						
D3001_10 1 Plans & Specifications			5,000	0	5,000	
D3001_10 2 Engineering During Construction			3,000	0	3,000	
TOTAL CT-Contracts			8,000	0	8,000	
D3001_11 CO-C, AND CO-F						
D3001_11 1 Plans & Specifications			10,000	0	10,000	
TOTAL CO-C, AND CO-F			10,000	0	10,000	
TOTAL Planning, Engineering and Design			443,000	0	443,000	
TOTAL Planning, Engineering and Design			443,000	0	443,000	
D31 Supervision and Administration						
D3123 Construction Contracts						
D3123_11 Supervision and Administration						
D3123_1101 Supervision and Administration			155,000	0	155,000	
TOTAL Supervision and Administration			155,000	0	155,000	
TOTAL Construction Contracts			155,000	0	155,000	
TOTAL Supervision and Administration			155,000	0	155,000	
TOTAL PUMP STATIONS Contract			1,834,807	309,202	2,144,009	
F NON FEDERAL COSTS						
F01 Lands and Damages						
F0102 Acquisition Costs						
F0102_02 Acquisition Costs						
F0102_0202 Permanent Easements						
F0102_0202 A Berms-Seepage	8.96	AC	15,680	3,920	19,600	2187.50
F0102_0202 B Pump Station	4.00	AC	7,000	1,750	8,750	2187.50
F0102_0202 D Drainage Ditch	34.20	AC	59,850	14,963	74,813	2187.50
F0102_0202 E Seepage Berm-North area,	40.00	AC	70,000	17,500	87,500	2187.50

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
	TOTAL Permanent Easements			152,530	38,133	190,663	
F0102_0203	Temporary Easements						
F0102_0203 A	Berms-Seepage	1.60	AC	280	70	350	218.75
F0102_0203 B	Pump Station	4.00	AC	700	175	875	218.75
F0102_0203 D	Borrow Area - "A"	5.70	AC	8,978	2,244	11,222	1968.75
F0102_0203 F	Relief Wells	11.00	AC	1,925	481	2,406	218.75
F0102_0203 G	Drainage Ditch	31.81	AC	5,567	1,392	6,958	218.75
	TOTAL Temporary Easements			17,449	4,362	21,812	
F0102_0204	Severance Damages						
F0102_0204 A	Severance Damages - 10%			17,000	4,250	21,250	
	TOTAL Severance Damages			17,000	4,250	21,250	
F0102_0205	Acquisition Costs-Ownerships-24						
F0102_0205 A	Planning	24.00	EA	36,000	0	36,000	1500.00
F0102_0205 B	Acquisition	24.00	EA	132,000	0	132,000	5500.00
F0102_0205 C	Appraisal	24.00	EA	24,000	0	24,000	1000.00
	TOTAL Acquisition Costs-Ownerships-24			192,000	0	192,000	
F0102_0207	PL 91-646 Relocation Assistance						
F0102_0207 A	Title III Payments-Basic Project	24.00	EA	12,000	0	12,000	500.00
	TOTAL PL 91-646 Relocation Assistance			12,000	0	12,000	
	TOTAL Acquisition Costs			390,979	46,745	437,724	
	TOTAL Acquisition Costs			390,979	46,745	437,724	
	TOTAL Lands and Damages			390,979	46,745	437,724	
	TOTAL NON FEDERAL COSTS			390,979	46,745	437,724	

G FEDERAL COSTS-PART OF 30 ACCOUNT

G30 Planning, Engineering & Design

G3001 Planning, Engineering & Design

** PROJECT OWNER SUMMARY - Level 6 **

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
G3001_01	Design Deficiency Project			1,372,000	0	1,372,000	
	TOTAL Planning, Engineering & Design			1,372,000	0	1,372,000	
	TOTAL Planning, Engineering & Design			1,372,000	0	1,372,000	
	TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			1,372,000	0	1,372,000	
	TOTAL BOIS BRULE-50 YEAR	1.00	EA	15,104,882	2,750,221	17,855,1	0317855103

** PROJECT INDIRECT SUMMARY - Level 1 **

		QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A	RELIEF WELLS # 1 Contract		2,096,119	88,172	84,565	138,517	10,751	2,418,123	
B	RELIEF WELLS # 2 Contract		5,658,303	256,207	245,725	402,498	31,240	6,593,974	
C	EMBANKMENT & DITCHING Contract		2,150,770	94,257	90,401	148,077	11,493	2,495,000	
D	PUMP STATIONS Contract		1,627,934	56,646	54,329	88,991	6,907	1,834,807	
F	NON FEDERAL COSTS		390,979	0	0	0	0	390,979	
G	FEDERAL COSTS-PART OF 30 ACCOUNT		1,372,000	0	0	0	0	1,372,000	
	BOIS BRULE-50 YEAR	1.00 EA	13,296,106	495,282	475,020	778,083	60,391	15,104,88215104882	
	Contingency							2,750,221	
	TOTAL INCL OWNER COSTS							17,855,103	

** PROJECT INDIRECT SUMMARY - Level 2 **

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract									
A11 Levees			1,603,119	88,172	84,565	138,517	10,751	1,925,123	
A30 Planning, Engineering and Design			252,000	0	0	0	0	252,000	
A31 Supervision and Administration			241,000	0	0	0	0	241,000	
TOTAL RELIEF WELLS # 1 Contract			2,096,119	88,172	84,565	138,517	10,751	2,418,123	
B RELIEF WELLS # 2 Contract									
B11 Levees			4,658,303	256,207	245,725	402,498	31,240	5,593,974	
B30 Planning, Engineering and Design			301,000	0	0	0	0	301,000	
B31 Supervision and Administration			699,000	0	0	0	0	699,000	
TOTAL RELIEF WELLS # 2 Contract			5,658,303	256,207	245,725	402,498	31,240	6,593,974	
C EMBANKMENT & DITCHING Contract									
C11 Levees			1,713,770	94,257	90,401	148,077	11,493	2,058,000	
C30 Planning, Engineering and Design			180,000	0	0	0	0	180,000	
C31 Supervision and Administration			257,000	0	0	0	0	257,000	
TOTAL EMBANKMENT & DITCHING Contract			2,150,770	94,257	90,401	148,077	11,493	2,495,000	
D PUMP STATIONS Contract									
D13 Pumping Plant			1,029,934	56,646	54,329	88,991	6,907	1,236,807	
D30 Planning, Engineering and Design			443,000	0	0	0	0	443,000	
D31 Supervision and Administration			155,000	0	0	0	0	155,000	
TOTAL PUMP STATIONS Contract			1,627,934	56,646	54,329	88,991	6,907	1,834,807	
F NON FEDERAL COSTS									
F01 Lands and Damages			390,979	0	0	0	0	390,979	
TOTAL NON FEDERAL COSTS			390,979	0	0	0	0	390,979	
G FEDERAL COSTS-PART OF 30 ACCOUNT									
G30 Planning, Engineering & Design			1,372,000	0	0	0	0	1,372,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			1,372,000	0	0	0	0	1,372,000	
TOTAL BOIS BRULE-50 YEAR	1.00	EA	13,296,106	495,282	475,020	778,083	60,391	15,104,88215104882	

** PROJECT INDIRECT SUMMARY - Level 2 **

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
Contingency								2,750,221	
TOTAL INCL OWNER COSTS								17,855,103	

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract									
A11 Levees									
A1101 Relief Wells-74 each									
A1101_02 Mob, Demob & Preparatory Work									
A1101_02 1 Mobilization and Demobilizatio			76,060	4,183	4,012	6,572	510	91,337	
TOTAL Mob, Demob & Preparatory Wo			76,060	4,183	4,012	6,572	510	91,337	
A1101_99 Associated Levee Items									
A1101_99 1 Relief Wells, Welled Reaches-7	74.00	EA	1,510,207	83,061	79,663	130,489	10,128	1,813,548	24507
A1101_99 2 Seeding	14.80	ACR	16,852	927	889	1,456	113	20,237	1367.35
TOTAL Associated Levee Items			1,527,059	83,988	80,552	131,945	10,241	1,833,785	
TOTAL Relief Wells-74 each	74.00	EA	1,603,119	88,172	84,565	138,517	10,751	1,925,123	26015
TOTAL Levees			1,603,119	88,172	84,565	138,517	10,751	1,925,123	
A30 Planning, Engineering and Design									
A3001 Planning, Engineering and Design									
A3001_01 Engineering - ED-DC Civil Design									
A3001_01 1 Plans/Specification&Gen.Drawin			60,000	0	0	0	0	60,000	
A3001_01 2 Engineering During Constructio			39,000	0	0	0	0	39,000	
TOTAL Engineering - ED-DC Civil D			99,000	0	0	0	0	99,000	
A3001_02 Engineering - ED-GF Geotech									
A3001_02 1 Plans & Specifications			65,000	0	0	0	0	65,000	
A3001_02 2 Engineering During Constructio			40,000	0	0	0	0	40,000	
TOTAL Engineering - ED-GF Geotech			105,000	0	0	0	0	105,000	
A3001_03 Engineering - ED-HE Hydrologic									
A3001_03 1 Plans & Specifications			5,000	0	0	0	0	5,000	
A3001_03 2 Engineering During Constructio			3,500	0	0	0	0	3,500	

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrolo		8,500	0	0	0	0	8,500	
A3001_04 Engineering - ED-C Cost Estimate								
A3001_04 1 Plans & Specs. Bid Opening		11,000	0	0	0	0	11,000	
A3001_04 2 Engineering During Constructio		500	0	0	0	0	500	
TOTAL Engineering - ED-C Cost Est		11,500	0	0	0	0	11,500	
A3001_05 Project Management								
A3001_05 1 Plans & Specifications		6,000	0	0	0	0	6,000	
A3001_05 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Project Management		11,000	0	0	0	0	11,000	
A3001_06 CT-Contracts								
A3001_06 1 Plans & Specifications		5,000	0	0	0	0	5,000	
A3001_06 2 Engineering During Constructio		2,000	0	0	0	0	2,000	
TOTAL CT-Contracts		7,000	0	0	0	0	7,000	
A3001_07 CO-C, AND CO-F								
A3001_07 1 Plans & Specifications		10,000	0	0	0	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	0	0	0	10,000	
TOTAL Planning, Engineering and D		252,000	0	0	0	0	252,000	
TOTAL Planning, Engineering and D		252,000	0	0	0	0	252,000	
A31 Supervision and Administration								
A3123 Construction Contracts								
A3123_11 Supervision and Administration								
A3123_1101 Supervision and Administration		241,000	0	0	0	0	241,000	
TOTAL Supervision and Administrat		241,000	0	0	0	0	241,000	
TOTAL Construction Contracts		241,000	0	0	0	0	241,000	

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Supervision and Administrat			241,000	0	0	0	0	241,000	
TOTAL RELIEF WELLS # 1 Contract			2,096,119	88,172	84,565	138,517	10,751	2,418,123	
B RELIEF WELLS # 2 Contract									
B11 Levees									
B1101 Relief Wells-210									
B1101_02 Mob, Demob & Preparatory Work									
B1101_02 1 Mobilization and Demobilizatio			272,000	14,960	14,348	23,502	1,824	326,634	
TOTAL Mob, Demob & Preparatory Wo			272,000	14,960	14,348	23,502	1,824	326,634	
B1101_99 Associated Levee Items									
B1101_99 1 Relief Wells for hot spot are	62.00	EA	1,265,309	69,592	66,745	109,328	8,486	1,519,459	24507
B1101_99 2 Relief Wells, Welled Reaches	18.00	EA	367,348	20,204	19,378	31,740	2,464	441,133	24507
B1101_99 3 Relief Wells, Non-Welled Reach	130.00	EA	2,649,166	145,704	139,744	228,900	17,766	3,181,280	24471
B1101_99 5 Seeding	42.00	ACR	47,823	2,630	2,523	4,132	321	57,429	1367.35
TOTAL Associated Levee Items			4,329,646	238,131	228,389	374,101	29,036	5,199,302	
TOTAL Relief Wells-210	210.00	EA	4,601,646	253,091	242,737	397,603	30,860	5,525,936	26314
B1102 Piezometers									
B1102_01 Piezometers									
B1102_01 1 Piezometers	68.00	EA	56,658	3,116	2,989	4,895	380	68,038	1000.56
TOTAL Piezometers	68.00	EA	56,658	3,116	2,989	4,895	380	68,038	1000.56
TOTAL Piezometers	68.00	EA	56,658	3,116	2,989	4,895	380	68,038	1000.56
TOTAL Levees			4,658,303	256,207	245,725	402,498	31,240	5,593,974	
B30 Planning, Engineering and Design									
B3001 Planning, Engineering and Design									
B3001_01 Engineering - ED-DC Civil Design									
B3001_01 1 Plans/Specification&Gen.Drawin			52,000	0	0	0	0	52,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
B3001_01 2 Engineering During Constructio		43,000	0	0	0	0	43,000	
TOTAL Engineering - ED-DC Civil D		95,000	0	0	0	0	95,000	
B3001_02 Engineering - ED-GF Geotech								
B3001_02 1 Plans & Specifications		67,000	0	0	0	0	67,000	
B3001_02 2 Engineering During Constructio		58,000	0	0	0	0	58,000	
TOTAL Engineering - ED-GF Geotech		125,000	0	0	0	0	125,000	
B3001_03 Engineering - ED-HE Hydrologic								
B3001_03 1 Plans & Specifications		5,000	0	0	0	0	5,000	
B3001_03 2 Engineering During Constructio		7,000	0	0	0	0	7,000	
TOTAL Engineering - ED-HE Hydrolo		12,000	0	0	0	0	12,000	
B3001_04 Engineering - ED-C Cost Estimate								
B3001_04 1 Plans & Specs. Bid Opening		14,000	0	0	0	0	14,000	
B3001_04 2 Engineering During Constructio		6,000	0	0	0	0	6,000	
TOTAL Engineering - ED-C Cost Est		20,000	0	0	0	0	20,000	
B3001_05 Project Management								
B3001_05 1 Plans & Specifications		7,000	0	0	0	0	7,000	
B3001_05 2 Engineering During Constructio		16,000	0	0	0	0	16,000	
TOTAL Project Management		23,000	0	0	0	0	23,000	
B3001_06 CT-Contracts								
B3001_06 1 Plans & Specifications		6,000	0	0	0	0	6,000	
B3001_06 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL CT-Contracts		16,000	0	0	0	0	16,000	
B3001_07 CO-C, AND CO-F								
B3001_07 1 Plans & Specifications		10,000	0	0	0	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	0	0	0	10,000	

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Planning, Engineering and D		301,000	0	0	0	0	301,000	
TOTAL Planning, Engineering and D		301,000	0	0	0	0	301,000	
B31 Supervision and Administration								
B3123 Construction Contracts								
B3123_11 Supervision and Administration								
B3123_1101 Supervision and Administration		699,000	0	0	0	0	699,000	
TOTAL Supervision and Administrat		699,000	0	0	0	0	699,000	
TOTAL Construction Contracts		699,000	0	0	0	0	699,000	
TOTAL Supervision and Administrat		699,000	0	0	0	0	699,000	
TOTAL RELIEF WELLS # 2 Contract		5,658,303	256,207	245,725	402,498	31,240	6,593,974	
C EMBANKMENT & DITCHING Contract								
C11 Levees								
C1101 Levee Raise and Seepage Berms								
C1101_02 Mob, Demob & Preparatory Work								
C1101_02 1 Mobilization and Demobilizatio		49,300	2,712	2,601	4,260	331	59,202	
TOTAL Mob, Demob & Preparatory Wo		49,300	2,712	2,601	4,260	331	59,202	
C1101_04 Permanent Access Road								
C1101_04 1 Road on Levee Crown		125,507	6,903	6,620	10,844	842	150,716	
TOTAL Permanent Access Road		125,507	6,903	6,620	10,844	842	150,716	
C1101_99 Associated Levee Items								
C1101_99 1 Embankment In Place	62000 CY	217,973	11,989	11,498	18,834	1,462	261,756	4.22
C1101_99 2 Seepage Berms-Bois Brule Pump	223600 CY	786,111	43,236	41,467	67,923	5,272	944,009	4.22
C1101_99 3 Landside Seepage Berms-Perviou	82000 CY	288,287	15,856	15,207	24,909	1,933	346,193	4.22
C1101_99 5 Establishment of Turf	50.00 ACR	51,364	2,825	2,709	4,438	344	61,682	1233.63
TOTAL Associated Levee Items		1,343,736	73,905	70,882	116,105	9,011	1,613,640	

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Levee Raise and Seepage Ber			1,518,543	83,520	80,103	131,209	10,184	1,823,558	
C1102 Drainage Ditching									
C1102_01 Jones Cutoff Drainage Area									
C1102_01 1 Ditch Excavation	16644	CY	59,571	3,276	3,142	5,147	399	71,536	4.30
C1102_01 2 Establishment of Turf	20.00	ACR	20,546	1,130	1,084	1,775	138	24,673	1233.63
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	5,078	279	268	439	34	6,097	72.59
TOTAL Jones Cutoff Drainage Area			85,194	4,686	4,494	7,361	571	102,306	
C1102_02 Cinque Holmes Drainage Area									
C1102_02 1 Ditch Excavation	16528	CY	59,155	3,254	3,120	5,111	397	71,037	4.30
C1102_02 2 Establishment of Turf	20.00	ACR	20,546	1,130	1,084	1,775	138	24,673	1233.63
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	5,078	279	268	439	34	6,097	72.59
TOTAL Cinque Holmes Drainage Area			84,779	4,663	4,472	7,325	569	101,807	
TOTAL Drainage Ditching			169,973	9,348	8,966	14,686	1,140	204,113	
C1103 Highway 51 Closure Structure									
C1103_02 Demolish High. 51 Closure Struct									
C1103_02 1 Remove Reinforced Concrete Str	105.00	CY	22,050	1,213	1,163	1,905	148	26,479	252.18
C1103_02 2 Excavation	50.00	CY	200	11	11	17	1	240	4.80
C1103_02 3 Backfill to Grade	150.00	CY	1,005	55	53	87	7	1,207	8.05
C1103_02 4 Disposal of Steel Panels			2,000	110	106	173	13	2,402	
TOTAL Demolish High. 51 Closure S			25,255	1,389	1,332	2,182	169	30,328	
TOTAL Highway 51 Closure Structur			25,255	1,389	1,332	2,182	169	30,328	
TOTAL Levees			1,713,770	94,257	90,401	148,077	11,493	2,058,000	
C30 Planning, Engineering and Design									
C3001 Planning, Engineering and Design									
C3001_01 Engineering - ED-DC Civil Design									
C3001_01 1 Plans/Specification&Gen.Drawin			60,000	0	0	0	0	60,000	
C3001_01 2 Engineering During Constructio			40,000	0	0	0	0	40,000	
TOTAL Engineering - ED-DC Civil D			100,000	0	0	0	0	100,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
C3001_02 Engineering - ED-GF Geotech								
C3001_02 1 Plans & Specifications		23,000	0	0	0	0	23,000	
C3001_02 2 Engineering During Constructio		20,000	0	0	0	0	20,000	
TOTAL Engineering - ED-GF Geotech		43,000	0	0	0	0	43,000	
C3001_03 Engineering - ED-HE Hydrologic								
C3001_03 1 Plans & Specifications		3,000	0	0	0	0	3,000	
C3001_03 2 Engineering During Constructio		3,000	0	0	0	0	3,000	
TOTAL Engineering - ED-HE Hydrolo		6,000	0	0	0	0	6,000	
C3001_04 Engineering - ED-C Cost Estimate								
C3001_04 1 Plans & Specs. Bid Opening		12,000	0	0	0	0	12,000	
C3001_04 2 Engineering During Constructio		2,000	0	0	0	0	2,000	
TOTAL Engineering - ED-C Cost Est		14,000	0	0	0	0	14,000	
C3001_05 Project Management								
C3001_05 1 Plans & Specifications		2,000	0	0	0	0	2,000	
C3001_05 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Project Management		7,000	0	0	0	0	7,000	
C3001_06 CT-Contracts								
C3001_06 1 Plans & Specifications		3,000	0	0	0	0	3,000	
C3001_06 2 Engineering During Constructio		3,000	0	0	0	0	3,000	
TOTAL CT-Contracts		6,000	0	0	0	0	6,000	
C3001_07 CO-C, AND CO-F								
C3001_07 1 Plans & Specifications		4,000	0	0	0	0	4,000	
TOTAL CO-C, AND CO-F		4,000	0	0	0	0	4,000	
TOTAL Planning, Engineering and D		180,000	0	0	0	0	180,000	
TOTAL Planning, Engineering and D		180,000	0	0	0	0	180,000	

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
C31 Supervision and Administration								
C3123 Construction Contracts								
C3123_11 Supervision and Administration								
C3123_1101 Supervision and Administration		257,000	0	0	0	0	257,000	
TOTAL Supervision and Administrat		257,000	0	0	0	0	257,000	
TOTAL Construction Contracts		257,000	0	0	0	0	257,000	
TOTAL Supervision and Administrat		257,000	0	0	0	0	257,000	
TOTAL EMBANKMENT & DITCHING Contr		2,150,770	94,257	90,401	148,077	11,493	2,495,000	
D PUMP STATIONS Contract								
D13 Pumping Plant								
D1301 Missouri Chute Pump Station								
D1301_01 Pump Station								
D1301_01 1 Pump Station - 25 cfs		419,167	23,054	22,111	36,218	2,811	503,361	
TOTAL Pump Station		419,167	23,054	22,111	36,218	2,811	503,361	
D1301_04 Mob . Demob & Preparatory								
D1301_0401 Mob . Demob & Preparatory		21,000	1,155	1,108	1,814	141	25,218	
TOTAL Mob . Demob & Preparatory		21,000	1,155	1,108	1,814	141	25,218	
TOTAL Missouri Chute Pump Station		440,167	24,209	23,219	38,032	2,952	528,579	
D1302 Jones Cutoff Pump Station								
D1302_01 Pump Station								
D1302_01 1 Pump Station - 30 cfs		419,167	23,054	22,111	36,218	2,811	503,361	
TOTAL Pump Station		419,167	23,054	22,111	36,218	2,811	503,361	
D1302_04 Mob. Demob. & Preparatory cost								

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D1302_04 1 Mob. Demob. & Preparatory cost		21,000	1,155	1,108	1,814	141	25,218	
TOTAL Mob. Demob. & Preparatory c		21,000	1,155	1,108	1,814	141	25,218	
TOTAL Jones Cutoff Pump Station		440,167	24,209	23,219	38,032	2,952	528,579	
D1303 Cinque Hommes Pump Station								
D1303_01 Pump Station								
D1303_01 1 Pump Station - 10 cfs		142,500	7,838	7,517	12,313	956	171,123	
TOTAL Pump Station		142,500	7,838	7,517	12,313	956	171,123	
D1303_04 Mob. Demob. & Preparatory cost								
D1303_04 1 Mob. Demob. & Preparatory cost		7,100	391	375	613	48	8,526	
TOTAL Mob. Demob. & Preparatory c		7,100	391	375	613	48	8,526	
TOTAL Cinque Hommes Pump Station		149,600	8,228	7,891	12,926	1,003	179,649	
TOTAL Pumping Plant		1,029,934	56,646	54,329	88,991	6,907	1,236,807	
D30 Planning, Engineering and Design								
D3001 Planning, Engineering and Design								
D3001_01 Engineering - ED-DC Civil Design								
D3001_01 1 Plans/Specification&Gen.Drawin		25,000	0	0	0	0	25,000	
D3001_01 2 Engineering During Constructio		3,000	0	0	0	0	3,000	
TOTAL Engineering - ED-DC Civil D		28,000	0	0	0	0	28,000	
D3001_02 Engineering - ED-GF Geotech								
D3001_02 1 Plans & Specifications		14,000	0	0	0	0	14,000	
D3001_02 2 Engineering During Constructio		12,000	0	0	0	0	12,000	
TOTAL Engineering - ED-GF Geotech		26,000	0	0	0	0	26,000	
D3001_03 Engineering - ED-HE Hydrologic								
D3001_03 1 Plans & Specifications		6,000	0	0	0	0	6,000	

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D3001_03 2 Engineering During Constructio		2,000	0	0	0	0	2,000	
TOTAL Engineering - ED-HE Hydrolo		8,000	0	0	0	0	8,000	
D3001_04 Engineering - ED-C Cost Estimate								
D3001_04 1 Plans & Specs. Bid Opening		15,000	0	0	0	0	15,000	
D3001_04 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Engineering - ED-C Cost Est		20,000	0	0	0	0	20,000	
D3001_05 Engineering - ED-DA Structures								
D3001_05 1 Plans & Specifications,Drawing		142,000	0	0	0	0	142,000	
D3001_05 4 Engineering During Constructio		7,000	0	0	0	0	7,000	
TOTAL Engineering - ED-DA Structu		149,000	0	0	0	0	149,000	
D3001_06 Engineering - ED-DM Mechanical								
D3001_06 1 Modifiy Pump Discharge Pipes		9,000	0	0	0	0	9,000	
D3001_06 2 Engineering During Const.-Pipe		8,000	0	0	0	0	8,000	
D3001_06 3 Pump Station Design-4 each		90,000	0	0	0	0	90,000	
D3001_06 4 Eng during Const-4 Pump Statio		39,000	0	0	0	0	39,000	
TOTAL Engineering - ED-DM Mechani		146,000	0	0	0	0	146,000	
D3001_07 Engineering - ED-DM Electrical								
D3001_07 1 Plans & Specification-4 Statio		20,000	0	0	0	0	20,000	
TOTAL Engineering - ED-DM Electri		20,000	0	0	0	0	20,000	
D3001_08 Value Engineering								
D3001_08 1 Value Engineering-Pump Station		20,000	0	0	0	0	20,000	
TOTAL Value Engineering		20,000	0	0	0	0	20,000	
D3001_09 Project Management								
D3001_09 1 Plans & Specifications		6,000	0	0	0	0	6,000	
D3001_09 2 Engineering During Constructio		2,000	0	0	0	0	2,000	
TOTAL Project Management		8,000	0	0	0	0	8,000	

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D3001_10 CT-Contracts								
D3001_10 1 Plans & Specifications		5,000	0	0	0	0	5,000	
D3001_10 2 Engineering During Constructio		3,000	0	0	0	0	3,000	
TOTAL CT-Contracts		8,000	0	0	0	0	8,000	
D3001_11 CO-C, AND CO-F								
D3001_11 1 Plans & Specifications		10,000	0	0	0	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	0	0	0	10,000	
TOTAL Planning, Engineering and D		443,000	0	0	0	0	443,000	
TOTAL Planning, Engineering and D		443,000	0	0	0	0	443,000	
D31 Supervision and Administration								
D3123 Construction Contracts								
D3123_11 Supervision and Administration								
D3123_1101 Supervision and Administration		155,000	0	0	0	0	155,000	
TOTAL Supervision and Administrat		155,000	0	0	0	0	155,000	
TOTAL Construction Contracts		155,000	0	0	0	0	155,000	
TOTAL Supervision and Administrat		155,000	0	0	0	0	155,000	
TOTAL PUMP STATIONS Contract		1,627,934	56,646	54,329	88,991	6,907	1,834,807	
F NON FEDERAL COSTS								
F01 Lands and Damages								
F0102 Acquisition Costs								
F0102_02 Acquisition Costs								
F0102_0202 Permanent Easements								
F0102_0202 A Berms-Seepage	8.96 AC	15,680	0	0	0	0	15,680	1750.00
F0102_0202 B Pump Station	4.00 AC	7,000	0	0	0	0	7,000	1750.00
F0102_0202 D Drainage Ditch	34.20 AC	59,850	0	0	0	0	59,850	1750.00
F0102_0202 E Seepage Berm-North area,	40.00 AC	70,000	0	0	0	0	70,000	1750.00

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Permanent Easements			152,530	0	0	0	0	152,530	
F0102_0203 Temporary Easements									
F0102_0203 A Berms-Seepage	1.60	AC	280	0	0	0	0	280	175.00
F0102_0203 B Pump Station	4.00	AC	700	0	0	0	0	700	175.00
F0102_0203 D Borrow Area - "A"	5.70	AC	8,978	0	0	0	0	8,978	1575.00
F0102_0203 F Relief Wells	11.00	AC	1,925	0	0	0	0	1,925	175.00
F0102_0203 G Drainage Ditch	31.81	AC	5,567	0	0	0	0	5,567	175.00
TOTAL Temporary Easements			17,449	0	0	0	0	17,449	
F0102_0204 Severance Damages									
F0102_0204 A Severance Damages - 10%			17,000	0	0	0	0	17,000	
TOTAL Severance Damages			17,000	0	0	0	0	17,000	
F0102_0205 Acquisition Costs-Ownerships-2									
F0102_0205 A Planning	24.00	EA	36,000	0	0	0	0	36,000	1500.00
F0102_0205 B Acquisition	24.00	EA	132,000	0	0	0	0	132,000	5500.00
F0102_0205 C Appraisal	24.00	EA	24,000	0	0	0	0	24,000	1000.00
TOTAL Acquisition Costs-Ownership			192,000	0	0	0	0	192,000	
F0102_0207 PL 91-646 Relocation Assistanc									
F0102_0207 A Title III Payments-Basic Pr	24.00	EA	12,000	0	0	0	0	12,000	500.00
TOTAL PL 91-646 Relocation Assist			12,000	0	0	0	0	12,000	
TOTAL Acquisition Costs			390,979	0	0	0	0	390,979	
TOTAL Acquisition Costs			390,979	0	0	0	0	390,979	
TOTAL Lands and Damages			390,979	0	0	0	0	390,979	
TOTAL NON FEDERAL COSTS			390,979	0	0	0	0	390,979	

G FEDERAL COSTS-PART OF 30 ACCOUNT

G30 Planning, Engineering & Design

G3001 Planning, Engineering & Design

** PROJECT INDIRECT SUMMARY - Level 6 **

		QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
G3001_01	Design Deficiency Project		1,372,000	0	0	0	0	1,372,000	
	TOTAL Planning, Engineering & Des		1,372,000	0	0	0	0	1,372,000	
	TOTAL Planning, Engineering & Des		1,372,000	0	0	0	0	1,372,000	
	TOTAL FEDERAL COSTS-PART OF 30 AC		1,372,000	0	0	0	0	1,372,000	
	TOTAL BOIS BRULE-50 YEAR	1.00 EA	13,296,106	495,282	475,020	778,083	60,391	15,104,88215104882	
Contingency								2,750,221	
TOTAL INCL OWNER COSTS								17,855,103	

** PROJECT DIRECT SUMMARY - Level 1 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract			127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract			396,423	337,266	454,314	4,470,300	5,658,303	
C EMBANKMENT & DITCHING Contract			589,219	934,845	115,151	511,555	2,150,770	
D PUMP STATIONS Contract			0	0	0	1,627,934	1,627,934	
F NON FEDERAL COSTS			0	0	0	390,979	390,979	
G FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	1,372,000	1,372,000	
TOTAL BOIS BRULE-50 YEAR	1.00	EA	1112989	1390958	723,311	10,068,848	13,296,1	0613296106
Field Office Overhead							495,282	
SUBTOTAL							13,791,388	
Home Office Overhead							475,020	
SUBTOTAL							14,266,408	
Profit							778,083	
SUBTOTAL							15,044,492	
Bond							60,391	
TOTAL INCL INDIRECTS							15,104,882	
Contingency							2,750,221	
TOTAL INCL OWNER COSTS							17,855,103	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract								
A11 Levees			127,347	118,846	153,846	1,203,080	1,603,119	
A30 Planning, Engineering and Design			0	0	0	252,000	252,000	
A31 Supervision and Administration			0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract			127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract								
B11 Levees			396,423	337,266	454,314	3,470,300	4,658,303	
B30 Planning, Engineering and Design			0	0	0	301,000	301,000	
B31 Supervision and Administration			0	0	0	699,000	699,000	
TOTAL RELIEF WELLS # 2 Contract			396,423	337,266	454,314	4,470,300	5,658,303	
C EMBANKMENT & DITCHING Contract								
C11 Levees			589,219	934,845	115,151	74,555	1,713,770	
C30 Planning, Engineering and Design			0	0	0	180,000	180,000	
C31 Supervision and Administration			0	0	0	257,000	257,000	
TOTAL EMBANKMENT & DITCHING Contract			589,219	934,845	115,151	511,555	2,150,770	
D PUMP STATIONS Contract								
D13 Pumping Plant			0	0	0	1,029,934	1,029,934	
D30 Planning, Engineering and Design			0	0	0	443,000	443,000	
D31 Supervision and Administration			0	0	0	155,000	155,000	
TOTAL PUMP STATIONS Contract			0	0	0	1,627,934	1,627,934	
F NON FEDERAL COSTS								
F01 Lands and Damages			0	0	0	390,979	390,979	
TOTAL NON FEDERAL COSTS			0	0	0	390,979	390,979	
G FEDERAL COSTS-PART OF 30 ACCOUNT								
G30 Planning, Engineering & Design			0	0	0	1,372,000	1,372,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	1,372,000	1,372,000	
TOTAL BOIS BRULE-50 YEAR	1.00	EA	1112989	1390958	723,311	10,068,848	13,296,1	0613296106

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
Field Office Overhead							495,282	
SUBTOTAL							13,791,388	
Home Office Overhead							475,020	
SUBTOTAL							14,266,408	
Profit							778,083	
SUBTOTAL							15,044,492	
Bond							60,391	
TOTAL INCL INDIRECTS							15,104,882	
Contingency							2,750,221	
TOTAL INCL OWNER COSTS							17,855,103	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract								
A11 Levees								
A1101 Relief Wells-74 each								
A1101_02 Mob, Demob & Preparatory Work								
A1101_02 1 Mobilization and Demobilization			0	0	0	76,060	76,060	
TOTAL Mob, Demob & Preparatory Work			0	0	0	76,060	76,060	
A1101_99 Associated Levee Items								
A1101_99 1 Relief Wells, Welled Reaches-74	74.00	EA	123,973	117,504	141,710	1,127,020	1,510,207	20408
A1101_99 2 Seeding	14.80	ACR	3,374	1,342	12,136	0	16,852	1138.65
TOTAL Associated Levee Items			127,347	118,846	153,846	1,127,020	1,527,059	
TOTAL Relief Wells-74 each	74.00	EA	127,347	118,846	153,846	1,203,080	1,603,119	21664
TOTAL Levees			127,347	118,846	153,846	1,203,080	1,603,119	
A30 Planning, Engineering and Design								
A3001 Planning, Engineering and Design								
A3001_01 Engineering - ED-DC Civil Design								
A3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	60,000	60,000	
A3001_01 2 Engineering During Construction			0	0	0	39,000	39,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	99,000	99,000	
A3001_02 Engineering - ED-GF Geotech								
A3001_02 1 Plans & Specifications			0	0	0	65,000	65,000	
A3001_02 2 Engineering During Construction			0	0	0	40,000	40,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	105,000	105,000	
A3001_03 Engineering - ED-HE Hydrologic								
A3001_03 1 Plans & Specifications			0	0	0	5,000	5,000	
A3001_03 2 Engineering During Construction			0	0	0	3,500	3,500	

	QUANTY UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrologic		0	0	0	8,500	8,500	
A3001_04 Engineering - ED-C Cost Estimate							
A3001_04 1 Plans & Specs. Bid Opening		0	0	0	11,000	11,000	
A3001_04 2 Engineering During Construction		0	0	0	500	500	
TOTAL Engineering - ED-C Cost Estimate		0	0	0	11,500	11,500	
A3001_05 Project Management							
A3001_05 1 Plans & Specifications		0	0	0	6,000	6,000	
A3001_05 2 Engineering During Construction		0	0	0	5,000	5,000	
TOTAL Project Management		0	0	0	11,000	11,000	
A3001_06 CT-Contracts							
A3001_06 1 Plans & Specifications		0	0	0	5,000	5,000	
A3001_06 2 Engineering During Construction		0	0	0	2,000	2,000	
TOTAL CT-Contracts		0	0	0	7,000	7,000	
A3001_07 CO-C, AND CO-F							
A3001_07 1 Plans & Specifications		0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F		0	0	0	10,000	10,000	
TOTAL Planning, Engineering and Design		0	0	0	252,000	252,000	
TOTAL Planning, Engineering and Design		0	0	0	252,000	252,000	
A31 Supervision and Administration							
A3123 Construction Contracts							
A3123_11 Supervision and Administration							
A3123_1101 Supervision and Administration		0	0	0	241,000	241,000	
TOTAL Supervision and Administration		0	0	0	241,000	241,000	
TOTAL Construction Contracts		0	0	0	241,000	241,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Supervision and Administration			0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract			127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract								
B11 Levees								
B1101 Relief Wells-210								
B1101_02 Mob, Demob & Preparatory Work								
B1101_02 1 Mobilization and Demobilization			0	0	0	272,000	272,000	
TOTAL Mob, Demob & Preparatory Work			0	0	0	272,000	272,000	
B1101_99 Associated Levee Items								
B1101_99 1 Relief Wells for hot spot areas	62.00	EA	103,869	98,449	118,730	944,260	1,265,309	20408
B1101_99 2 Relief Wells, Welled Reaches	18.00	EA	30,156	28,582	34,470	274,140	367,348	20408
B1101_99 3 Relief Wells, Non-Welled Reaches	130.00	EA	217,791	206,426	245,050	1,979,900	2,649,166	20378
B1101_99 5 Seeding	42.00	ACR	9,574	3,809	34,440	0	47,823	1138.65
TOTAL Associated Levee Items			361,389	337,266	432,690	3,198,300	4,329,646	
TOTAL Relief Wells-210	210.00	EA	361,389	337,266	432,690	3,470,300	4,601,646	21913
B1102 Piezometers								
B1102_01 Piezometers								
B1102_01 1 Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Levees			396,423	337,266	454,314	3,470,300	4,658,303	
B30 Planning, Engineering and Design								
B3001 Planning, Engineering and Design								
B3001_01 Engineering - ED-DC Civil Design								
B3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	52,000	52,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B3001_01 2 Engineering During Construction			0	0	0	43,000	43,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	95,000	95,000	
B3001_02 Engineering - ED-GF Geotech								
B3001_02 1 Plans & Specifications			0	0	0	67,000	67,000	
B3001_02 2 Engineering During Construction			0	0	0	58,000	58,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	125,000	125,000	
B3001_03 Engineering - ED-HE Hydrologic								
B3001_03 1 Plans & Specifications			0	0	0	5,000	5,000	
B3001_03 2 Engineering During Construction			0	0	0	7,000	7,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	12,000	12,000	
B3001_04 Engineering - ED-C Cost Estimate								
B3001_04 1 Plans & Specs. Bid Opening			0	0	0	14,000	14,000	
B3001_04 2 Engineering During Construction			0	0	0	6,000	6,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	20,000	20,000	
B3001_05 Project Management								
B3001_05 1 Plans & Specifications			0	0	0	7,000	7,000	
B3001_05 2 Engineering During Construction			0	0	0	16,000	16,000	
TOTAL Project Management			0	0	0	23,000	23,000	
B3001_06 CT-Contracts								
B3001_06 1 Plans & Specifications			0	0	0	6,000	6,000	
B3001_06 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL CT-Contracts			0	0	0	16,000	16,000	
B3001_07 CO-C, AND CO-F								
B3001_07 1 Plans & Specifications			0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F			0	0	0	10,000	10,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Planning, Engineering and Design			0	0	0	301,000	301,000	
TOTAL Planning, Engineering and Design			0	0	0	301,000	301,000	
B31 Supervision and Administration								
B3123 Construction Contracts								
B3123_11 Supervision and Administration								
B3123_1101 Supervision and Administration			0	0	0	699,000	699,000	
TOTAL Supervision and Administration			0	0	0	699,000	699,000	
TOTAL Construction Contracts			0	0	0	699,000	699,000	
TOTAL Supervision and Administration			0	0	0	699,000	699,000	
TOTAL RELIEF WELLS # 2 Contract			396,423	337,266	454,314	4,470,300	5,658,303	
C EMBANKMENT & DITCHING Contract								
C11 Levees								
C1101 Levee Raise and Seepage Berms								
C1101_02 Mob, Demob & Preparatory Work								
C1101_02 1 Mobilization and Demobilization			0	0	0	49,300	49,300	
TOTAL Mob, Demob & Preparatory Work			0	0	0	49,300	49,300	
C1101_04 Permanent Access Road								
C1101_04 1 Road on Levee Crown			50,691	37,216	37,600	0	125,507	
TOTAL Permanent Access Road			50,691	37,216	37,600	0	125,507	
C1101_99 Associated Levee Items								
C1101_99 1 Embankment In Place	62000	CY	80,395	137,578	0	0	217,973	3.52
C1101_99 2 Seepage Berms-Bois Brule Pump	223600	CY	289,942	496,168	0	0	786,111	3.52
C1101_99 3 Landside Seepage Berms-Pervious	82000	CY	106,329	181,958	0	0	288,287	3.52
C1101_99 5 Establishment of Turf	50.00	ACR	8,487	3,377	39,500	0	51,364	1027.29
TOTAL Associated Levee Items			485,154	819,082	39,500	0	1,343,736	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Levee Raise and Seepage Berms			535,846	856,297	77,100	49,300	1,518,543	
C1102 Drainage Ditching								
C1102_01 Jones Cutoff Drainage Area								
C1102_01 1 Ditch Excavation	16644	CY	21,972	37,599	0	0	59,571	3.58
C1102_01 2 Establishment of Turf	20.00	ACR	3,395	1,351	15,800	0	20,546	1027.29
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	1,397	455	3,226	0	5,078	60.45
TOTAL Jones Cutoff Drainage Area			26,763	39,405	19,026	0	85,194	
C1102_02 Cinque Holmes Drainage Area								
C1102_02 1 Ditch Excavation	16528	CY	21,819	37,337	0	0	59,155	3.58
C1102_02 2 Establishment of Turf	20.00	ACR	3,395	1,351	15,800	0	20,546	1027.29
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	1,397	455	3,226	0	5,078	60.45
TOTAL Cinque Holmes Drainage Area			26,610	39,143	19,026	0	84,779	
TOTAL Drainage Ditching			53,373	78,548	38,051	0	169,973	
C1103 Highway 51 Closure Structure								
C1103_02 Demolish High. 51 Closure Struct								
C1103_02 1 Remove Reinforced Concrete Struc	105.00	CY	0	0	0	22,050	22,050	210.00
C1103_02 2 Excavation	50.00	CY	0	0	0	200	200	4.00
C1103_02 3 Backfill to Grade	150.00	CY	0	0	0	1,005	1,005	6.70
C1103_02 4 Disposal of Steel Panels			0	0	0	2,000	2,000	
TOTAL Demolish High. 51 Closure Struct			0	0	0	25,255	25,255	
TOTAL Highway 51 Closure Structure			0	0	0	25,255	25,255	
TOTAL Levees			589,219	934,845	115,151	74,555	1,713,770	
C30 Planning, Engineering and Design								
C3001 Planning, Engineering and Design								
C3001_01 Engineering - ED-DC Civil Design								
C3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	60,000	60,000	
C3001_01 2 Engineering During Construction			0	0	0	40,000	40,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	100,000	100,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C3001_02 Engineering - ED-GF Geotech								
C3001_02 1 Plans & Specifications			0	0	0	23,000	23,000	
C3001_02 2 Engineering During Construction			0	0	0	20,000	20,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	43,000	43,000	
C3001_03 Engineering - ED-HE Hydrologic								
C3001_03 1 Plans & Specifications			0	0	0	3,000	3,000	
C3001_03 2 Engineering During Construction			0	0	0	3,000	3,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	6,000	6,000	
C3001_04 Engineering - ED-C Cost Estimate								
C3001_04 1 Plans & Specs. Bid Opening			0	0	0	12,000	12,000	
C3001_04 2 Engineering During Construction			0	0	0	2,000	2,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	14,000	14,000	
C3001_05 Project Management								
C3001_05 1 Plans & Specifications			0	0	0	2,000	2,000	
C3001_05 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL Project Management			0	0	0	7,000	7,000	
C3001_06 CT-Contracts								
C3001_06 1 Plans & Specifications			0	0	0	3,000	3,000	
C3001_06 2 Engineering During Construction			0	0	0	3,000	3,000	
TOTAL CT-Contracts			0	0	0	6,000	6,000	
C3001_07 CO-C, AND CO-F								
C3001_07 1 Plans & Specifications			0	0	0	4,000	4,000	
TOTAL CO-C, AND CO-F			0	0	0	4,000	4,000	
TOTAL Planning, Engineering and Design			0	0	0	180,000	180,000	
TOTAL Planning, Engineering and Design			0	0	0	180,000	180,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C31 Supervision and Administration								
C3123 Construction Contracts								
C3123_11 Supervision and Administration								
C3123_1101 Supervision and Administration			0	0	0	257,000	257,000	
TOTAL Supervision and Administration			0	0	0	257,000	257,000	
TOTAL Construction Contracts			0	0	0	257,000	257,000	
TOTAL Supervision and Administration			0	0	0	257,000	257,000	
TOTAL EMBANKMENT & DITCHING Contract			589,219	934,845	115,151	511,555	2,150,770	
D PUMP STATIONS Contract								
D13 Pumping Plant								
D1301 Missouri Chute Pump Station								
D1301_01 Pump Station								
D1301_01 1 Pump Station - 25 cfs			0	0	0	419,167	419,167	
TOTAL Pump Station			0	0	0	419,167	419,167	
D1301_04 Mob . Demob & Preparatory								
D1301_0401 Mob . Demob & Preparatory			0	0	0	21,000	21,000	
TOTAL Mob . Demob & Preparatory			0	0	0	21,000	21,000	
TOTAL Missouri Chute Pump Station			0	0	0	440,167	440,167	
D1302 Jones Cutoff Pump Station								
D1302_01 Pump Station								
D1302_01 1 Pump Station - 30 cfs			0	0	0	419,167	419,167	
TOTAL Pump Station			0	0	0	419,167	419,167	
D1302_04 Mob. Demob. & Preparatory cost								

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D1302_04 1 Mob. Demob. & Preparatory cost			0	0	0	21,000	21,000	
TOTAL Mob. Demob. & Preparatory cost			0	0	0	21,000	21,000	
TOTAL Jones Cutoff Pump Station			0	0	0	440,167	440,167	
D1303 Cinque Hommes Pump Station								
D1303_01 Pump Station								
D1303_01 1 Pump Station - 10 cfs			0	0	0	142,500	142,500	
TOTAL Pump Station			0	0	0	142,500	142,500	
D1303_04 Mob. Demob. & Preparatory cost								
D1303_04 1 Mob. Demob. & Preparatory cost			0	0	0	7,100	7,100	
TOTAL Mob. Demob. & Preparatory cost			0	0	0	7,100	7,100	
TOTAL Cinque Hommes Pump Station			0	0	0	149,600	149,600	
TOTAL Pumping Plant			0	0	0	1,029,934	1,029,934	
D30 Planning, Engineering and Design								
D3001 Planning, Engineering and Design								
D3001_01 Engineering - ED-DC Civil Design								
D3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	25,000	25,000	
D3001_01 2 Engineering During Construction			0	0	0	3,000	3,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	28,000	28,000	
D3001_02 Engineering - ED-GF Geotech								
D3001_02 1 Plans & Specifications			0	0	0	14,000	14,000	
D3001_02 2 Engineering During Construction			0	0	0	12,000	12,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	26,000	26,000	
D3001_03 Engineering - ED-HE Hydrologic								
D3001_03 1 Plans & Specifications			0	0	0	6,000	6,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_03 2 Engineering During Construction			0	0	0	2,000	2,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	8,000	8,000	
D3001_04 Engineering - ED-C Cost Estimate								
D3001_04 1 Plans & Specs. Bid Opening			0	0	0	15,000	15,000	
D3001_04 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	20,000	20,000	
D3001_05 Engineering - ED-DA Structures								
D3001_05 1 Plans & Specifications,Drawings			0	0	0	142,000	142,000	
D3001_05 4 Engineering During Construction			0	0	0	7,000	7,000	
TOTAL Engineering - ED-DA Structures			0	0	0	149,000	149,000	
D3001_06 Engineering - ED-DM Mechanical								
D3001_06 1 Modifiy Pump Discharge Pipes			0	0	0	9,000	9,000	
D3001_06 2 Engineering During Const.-Pipes			0	0	0	8,000	8,000	
D3001_06 3 Pump Station Design-4 each			0	0	0	90,000	90,000	
D3001_06 4 Eng during Const-4 Pump Stations			0	0	0	39,000	39,000	
TOTAL Engineering - ED-DM Mechanical			0	0	0	146,000	146,000	
D3001_07 Engineering - ED-DM Electrical								
D3001_07 1 Plans & Specification-4 Stations			0	0	0	20,000	20,000	
TOTAL Engineering - ED-DM Electrical			0	0	0	20,000	20,000	
D3001_08 Value Engineering								
D3001_08 1 Value Engineering-Pump Stations			0	0	0	20,000	20,000	
TOTAL Value Engineering			0	0	0	20,000	20,000	
D3001_09 Project Management								
D3001_09 1 Plans & Specifications			0	0	0	6,000	6,000	
D3001_09 2 Engineering During Construction			0	0	0	2,000	2,000	
TOTAL Project Management			0	0	0	8,000	8,000	

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_10 CT-Contracts								
D3001_10 1 Plans & Specifications			0	0	0	5,000	5,000	
D3001_10 2 Engineering During Construction			0	0	0	3,000	3,000	
TOTAL CT-Contracts			0	0	0	8,000	8,000	
D3001_11 CO-C, AND CO-F								
D3001_11 1 Plans & Specifications			0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F			0	0	0	10,000	10,000	
TOTAL Planning, Engineering and Design			0	0	0	443,000	443,000	
TOTAL Planning, Engineering and Design			0	0	0	443,000	443,000	
D31 Supervision and Administration								
D3123 Construction Contracts								
D3123_11 Supervision and Administration								
D3123_1101 Supervision and Administration			0	0	0	155,000	155,000	
TOTAL Supervision and Administration			0	0	0	155,000	155,000	
TOTAL Construction Contracts			0	0	0	155,000	155,000	
TOTAL Supervision and Administration			0	0	0	155,000	155,000	
TOTAL PUMP STATIONS Contract			0	0	0	1,627,934	1,627,934	
F NON FEDERAL COSTS								
F01 Lands and Damages								
F0102 Acquisition Costs								
F0102_02 Acquisition Costs								
F0102_0202 Permanent Easements								
F0102_0202 A Berms-Seepage	8.96	AC	0	0	0	15,680	15,680	1750.00
F0102_0202 B Pump Station	4.00	AC	0	0	0	7,000	7,000	1750.00
F0102_0202 D Drainage Ditch	34.20	AC	0	0	0	59,850	59,850	1750.00
F0102_0202 E Seepage Berm-North area,	40.00	AC	0	0	0	70,000	70,000	1750.00

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Permanent Easements			0	0	0	152,530	152,530	
F0102_0203 Temporary Easements								
F0102_0203 A Berms-Seepage	1.60	AC	0	0	0	280	280	175.00
F0102_0203 B Pump Station	4.00	AC	0	0	0	700	700	175.00
F0102_0203 D Borrow Area - "A"	5.70	AC	0	0	0	8,978	8,978	1575.00
F0102_0203 F Relief Wells	11.00	AC	0	0	0	1,925	1,925	175.00
F0102_0203 G Drainage Ditch	31.81	AC	0	0	0	5,567	5,567	175.00
TOTAL Temporary Easements			0	0	0	17,449	17,449	
F0102_0204 Severance Damages								
F0102_0204 A Severance Damages - 10%			0	0	0	17,000	17,000	
TOTAL Severance Damages			0	0	0	17,000	17,000	
F0102_0205 Acquisition Costs-Ownerships-24								
F0102_0205 A Planning	24.00	EA	0	0	0	36,000	36,000	1500.00
F0102_0205 B Acquisition	24.00	EA	0	0	0	132,000	132,000	5500.00
F0102_0205 C Appraisal	24.00	EA	0	0	0	24,000	24,000	1000.00
TOTAL Acquisition Costs-Ownerships-24			0	0	0	192,000	192,000	
F0102_0207 PL 91-646 Relocation Assistance								
F0102_0207 A Title III Payments-Basic Project	24.00	EA	0	0	0	12,000	12,000	500.00
TOTAL PL 91-646 Relocation Assistance			0	0	0	12,000	12,000	
TOTAL Acquisition Costs			0	0	0	390,979	390,979	
TOTAL Acquisition Costs			0	0	0	390,979	390,979	
TOTAL Lands and Damages			0	0	0	390,979	390,979	
TOTAL NON FEDERAL COSTS			0	0	0	390,979	390,979	

G FEDERAL COSTS-PART OF 30 ACCOUNT

G30 Planning, Engineering & Design

G3001 Planning, Engineering & Design

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
G3001_01 Design Deficiency Project			0	0	0	1,372,000	1,372,000	
TOTAL Planning, Engineering & Design			0	0	0	1,372,000	1,372,000	
TOTAL Planning, Engineering & Design			0	0	0	1,372,000	1,372,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	1,372,000	1,372,000	
TOTAL BOIS BRULE-50 YEAR	1.00	EA	1112989	1390958	723,311	10,068,848	13,296,1	0613296106
Field Office Overhead							495,282	
SUBTOTAL							13,791,388	
Home Office Overhead							475,020	
SUBTOTAL							14,266,408	
Profit							778,083	
SUBTOTAL							15,044,492	
Bond							60,391	
TOTAL INCL INDIRECTS							15,104,882	
Contingency							2,750,221	
TOTAL INCL OWNER COSTS							17,855,103	

A11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A. RELIEF WELLS # 1 Contract										
A11. Levees										
A1101. Relief Wells-74 each										
A1101_02. Mob, Demob & Preparatory Work										
A1101_02 1. Mobilization and Demobilization										
USR PM Mobilization and Demobilizat					0.00	0.00	0.00	76060.00	76060.00	
ion	1.00	LS		0.00	0	0	0	76,060	76,060	76060
TOTAL Mobilization and Demobilizat					0	0	0	76,060	76,060	
TOTAL Mob, Demob & Preparatory Wor					0	0	0	76,060	76,060	
A1101_99. Associated Levee Items										
A1101_99 1. Relief Wells, Welled Reaches-74										
These wells don't need additional ROW for installation because the contractor could work off of the existing berm. These wells are needed for the deficiency study. These wells are also needed for the 100-yr feasibility study but because these new wells will be installed between existing relief wells, no change in the location of a well is necessary between the deficiency well or the 100-yr feasibility study well.										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	4440.00	LF		0.00	0	0	0	666,000	666,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	1110.00	LF		0.00	0	0	0	210,900	210,900	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well housing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	74.00	EA		0.00	0	0	0	250,120	250,120	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	5550.00	LF	XXQMO	5.00	94,408	107,817	138,750	0	340,975	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	148.00	HR	XTBCA	1.00	29,565	9,687	2,960	0	42,212	285.21
TOTAL Relief Wells, Welled Reaches	74.00	EA			123,973	117,504	141,710	1,127,020	1,510,207	20408

A11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A1101_99 2. Seeding										
B MIL PM Mechanical Seeding, 450#/acre, Assume 0.2 acre of seeding per well. 74 wells x 0.2 = 14.8 acres of seeding	14.80	ACR	COELB66	0.18	227.94 3,374	90.70 1,342	820.00 12,136	0.00 0	1138.65 16,852	1138.65
TOTAL Seeding	14.80	ACR			3,374	1,342	12,136	0	16,852	1138.65
TOTAL Associated Levee Items					127,347	118,846	153,846	1,127,020	1,527,059	
TOTAL Relief Wells-74 each	74.00	EA			127,347	118,846	153,846	1,203,080	1,603,119	21664
TOTAL Levees					127,347	118,846	153,846	1,203,080	1,603,119	
A30. Planning, Engineering and Design										
A3001. Planning, Engineering and Design										
A3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	60,000	60,000	
TOTAL Engineering During Construct					0	0	0	39,000	39,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	99,000	99,000	
A3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	65,000	65,000	
TOTAL Engineering During Construct					0	0	0	40,000	40,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	105,000	105,000	
A3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	3,500	3,500	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	8,500	8,500	

A30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	11,000	11,000	
TOTAL Engineering During Construct					0	0	0	500	500	
TOTAL Engineering - ED-C Cost Esti					0	0	0	11,500	11,500	
A3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	6,000	6,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Project Management					0	0	0	11,000	11,000	
A3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	2,000	2,000	
TOTAL CT-Contracts					0	0	0	7,000	7,000	
A3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F					0	0	0	10,000	10,000	
TOTAL Planning, Engineering and De					0	0	0	252,000	252,000	
TOTAL Planning, Engineering and De					0	0	0	252,000	252,000	
A31. Supervision and Administration										
A3123. Construction Contracts										
A3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL Construction Contracts					0	0	0	241,000	241,000	
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract					127,347	118,846	153,846	1,696,080	2,096,119	

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B. RELIEF WELLS # 2 Contract										
B11. Levees										
B1101. Relief Wells-210										
B1101_02. Mob, Demob & Preparatory Work										
B1101_02 1. Mobilization and Demobilization										
USR PM Mobilization and Demobilizat					0.00	0.00	0.00	272000.00	272000.00	
ion	1.00	LS		0.00	0	0	0	272,000	272,000	272000
TOTAL Mobilization and Demobilizat					0	0	0	272,000	272,000	
TOTAL Mob, Demob & Preparatory Wor					0	0	0	272,000	272,000	
B1101_99. Associated Levee Items										
B1101_99 1. Relief Wells for hot spot areas Total number of relief wells in contract No. 2 is 210. a. 7 hot spot area = 62 each, b. welled reaches = 18 each, c. Non-welled reaches = 130 each. Total Relief Wells = 210 each										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	3720.00	LF		0.00	0	0	0	558,000	558,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	930.00	LF		0.00	0	0	0	176,700	176,700	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous	62.00	EA		0.00	0	0	0	209,560	209,560	3380.00
ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)										
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	4650.00	LF	XXQMO	5.00	79,099	90,333	116,250	0	285,682	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	124.00	HR	XTBCA	1.00	24,771	8,116	2,480	0	35,367	285.21
TOTAL Relief Wells for hot spot a	62.00	EA			103,869	98,449	118,730	944,260	1,265,309	20408

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B1101_99 2. Relief Wells, Welded Reaches										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	1080.00	LF		0.00	0	0	0	162,000	162,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	270.00	LF		0.00	0	0	0	51,300	51,300	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	18.00	EA		0.00	0	0	0	60,840	60,840	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	1350.00	LF	XXQMO	5.00	22,964	26,226	33,750	0	82,940	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	36.00	HR	XTBCA	1.00	7,191	2,356	720	0	10,268	285.21
TOTAL Relief Wells, Welded Reaches	18.00	EA			30,156	28,582	34,470	274,140	367,348	20408
B1101_99 3. Relief Wells, Non-Welled Reaches										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	7800.00	LF		0.00	0	0	0	1,170,000	1,170,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	1950.00	LF		0.00	0	0	0	370,500	370,500	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	130.00	EA		0.00	0	0	0	439,400	439,400	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	9750.00	LF	XXQMO	5.00	165,852	189,408	243,750	0	599,011	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	5.00	0.00	270.21	
	260.00	HR	XTBCA	1.00	51,938	17,017	1,300	0	70,256	270.21
TOTAL Relief Wells, Non-Welled Rea	130.00	EA			217,791	206,426	245,050	1,979,900	2,649,166	20378

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B1101_99 5. Seeding										
B MIL PM Mechanical Seeding, 450#/acre, Assume 0.2 acre of seeding per relief well. 210 wells x 0.2 = 42 acres of seeding.					227.94	90.70	820.00	0.00	1138.65	
	42.00	ACR	COELB66	0.18	9,574	3,809	34,440	0	47,823	1138.65
TOTAL Seeding	42.00	ACR			9,574	3,809	34,440	0	47,823	1138.65
TOTAL Associated Levee Items					361,389	337,266	432,690	3,198,300	4,329,646	
TOTAL Relief Wells-210	210.00	EA			361,389	337,266	432,690	3,470,300	4,601,646	21913
B1102. Piezometers										
B1102_01. Piezometers										
B1102_01 1. Piezometers										
B TUN PM Install Piezometers					515.20	0.00	318.00	0.00	833.20	
	68.00	EA	EELEELEC2	0.20	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Levees					396,423	337,266	454,314	3,470,300	4,658,303	
B30. Planning, Engineering and Design										
B3001. Planning, Engineering and Design										
B3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	52,000	52,000	
TOTAL Engineering During Construct					0	0	0	43,000	43,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	95,000	95,000	

B30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	67,000	67,000	
TOTAL Engineering During Construct					0	0	0	58,000	58,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	125,000	125,000	
B3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	7,000	7,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	12,000	12,000	
B3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	14,000	14,000	
TOTAL Engineering During Construct					0	0	0	6,000	6,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	20,000	20,000	
B3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	7,000	7,000	
TOTAL Engineering During Construct					0	0	0	16,000	16,000	
TOTAL Project Management					0	0	0	23,000	23,000	
B3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	6,000	6,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL CT-Contracts					0	0	0	16,000	16,000	
B3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F					0	0	0	10,000	10,000	
TOTAL Planning, Engineering and De					0	0	0	301,000	301,000	
TOTAL Planning, Engineering and De					0	0	0	301,000	301,000	

B31. Supervision and Administration	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B31. Supervision and Administration										
B3123. Construction Contracts										
B3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	699,000	699,000	
TOTAL Supervision and Administrati					0	0	0	699,000	699,000	
TOTAL Construction Contracts					0	0	0	699,000	699,000	
TOTAL Supervision and Administrati					0	0	0	699,000	699,000	
TOTAL RELIEF WELLS # 2 Contract					396,423	337,266	454,314	4,470,300	5,658,303	

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT

C. EMBANKMENT & DITCHING Contract

C11. Levees

C1101. Levee Raise and Seepage Berms

C1101_02. Mob, Demob & Preparatory Work
THis item covers mob. Demob and preparatory work for levee raise & berms, access road on top of levee and drainage ditching, and highway 51 closure structure removal.

C1101_02 1. Mobilization and Demobilization

USR PM	Mobilization and Demobilizat				0.00	0.00	0.00	49300.00	49300.00	
	ion	1.00	LS	0.00	0	0	0	49,300	49,300	49300
TOTAL	Mobilization and Demobilizat				0	0	0	49,300	49,300	
TOTAL	Mob, Demob & Preparatory Wor				0	0	0	49,300	49,300	

C1101_04. Permanent Access Road

C1101_04 1. Road on Levee Crown

B USR PM	Graded Crushed Agg Rdwy Base				5.39	3.96	4.00	0.00	13.35	
	Crs	9400.00	TON	XSABA 55.00	50,691	37,216	37,600	0	125,507	13.35
TOTAL	Road on Levee Crown				50,691	37,216	37,600	0	125,507	
TOTAL	Permanent Access Road				50,691	37,216	37,600	0	125,507	

C1101_99. Associated Levee Items

C1101_99 1. Embankment In Place

USR PM	Embankment In Place Material				1.30	2.22	0.00	0.00	3.52	
	Assume the following; Quanti ty	62000	CY	ZBBLEVEE 565.00	80,395	137,578	0	0	217,973	3.52
	in place = 62,000cy									
	Average haul dist.= 1 mile									
TOTAL	Embankment In Place	62000	CY		80,395	137,578	0	0	217,973	3.52

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C1101_99 2. Seepage Berms-Bois Brule Pump Station Drainage Area										
USR PM Seepage Berms-Bois Brule Pump					1.30	2.22	0.00	0.00	3.52	
	223600	CY	ZBBLEVEE	565.00	289,942	496,168	0	0	786,111	3.52
TOTAL Seepage Berms-Bois Brule Pum	223600	CY			289,942	496,168	0	0	786,111	3.52
C1101_99 3. Landside Seepage Berms-Pervious										
USR PM Landside Seepage Berms-Pervious					1.30	2.22	0.00	0.00	3.52	
	82000	CY	ZBBLEVEE	565.00	106,329	181,958	0	0	288,287	3.52
TOTAL Landside Seepage Berms-Pervi	82000	CY			106,329	181,958	0	0	288,287	3.52
C1101_99 5. Establishment of Turf										
M MIL PM Seeding, seeding					169.74	67.54	790.00	0.00	1027.29	
	50.00	ACR	COELB66	0.24	8,487	3,377	39,500	0	51,364	1027.29
TOTAL Establishment of Turf	50.00	ACR			8,487	3,377	39,500	0	51,364	1027.29
TOTAL Associated Levee Items					485,154	819,082	39,500	0	1,343,736	
TOTAL Levee Raise and Seepage Berm					535,846	856,297	77,100	49,300	1,518,543	
C1102. Drainage Ditching										
C1102_01. Jones Cutoff Drainage Area										
C1102_01 1. Ditch Excavation										
USR PM Ditch Excavation, Material used in the enbankment. This item covers cost to excavate and load on trucks. The hauling, spreading, and compaction cost is covered in embankment cost.					1.32	2.26	0.00	0.00	3.58	
	16644	CY	ZBBLEVEE	555.00	21,972	37,599	0	0	59,571	3.58
TOTAL Ditch Excavation	16644	CY			21,972	37,599	0	0	59,571	3.58

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C1102_01 2. Establishment of Turf										
M MIL PM Mechanical Seeding					169.74	67.54	790.00	0.00	1027.29	
	20.00	ACR	COELB66	0.24	3,395	1,351	15,800	0	20,546	1027.29
TOTAL Establishment of Turf	20.00	ACR			3,395	1,351	15,800	0	20,546	1027.29
C1102_01 3. 36" Dia. Corrugated Metal Pipe two each x 42 lf/ea = 84 lin ft										
MIL PM 36" dia, 12ga, CMP, bitum ct					16.63	5.42	38.40	0.00	60.45	
d, 2 ea x 42'=84 Lin Ft w/paved invert	84.00	LF	CLABB13	15.00	1,397	455	3,226	0	5,078	60.45
TOTAL 36" Dia. Corrugated Metal Pi	84.00	LF			1,397	455	3,226	0	5,078	60.45
TOTAL Jones Cutoff Drainage Area					26,763	39,405	19,026	0	85,194	
C1102_02. Cinque Holmes Drainage Area										
C1102_02 1. Ditch Excavation										
USR PM Ditch Excavation, Material u					1.32	2.26	0.00	0.00	3.58	
sed in the embankment. This item covers cost to excavate and load on trucks. Hauling, spreading and compaction covered in embankment item.	16528	CY	ZBBLEVEE	555.00	21,819	37,337	0	0	59,155	3.58
TOTAL Ditch Excavation	16528	CY			21,819	37,337	0	0	59,155	3.58
C1102_02 2. Establishment of Turf										
M MIL PM Seeding, seeding					169.74	67.54	790.00	0.00	1027.29	
	20.00	ACR	COELB66	0.24	3,395	1,351	15,800	0	20,546	1027.29
TOTAL Establishment of Turf	20.00	ACR			3,395	1,351	15,800	0	20,546	1027.29
C1102_02 3. 36" Dia. Corrugated Metal Pipe two each x 42 lf/ea = 84 lin ft										
MIL PM 36" dia, 12ga, CMP, bitum ct					16.63	5.42	38.40	0.00	60.45	
d, 2 ea x 42'=84 Lin Ft w/paved invert	84.00	LF	CLABB13	15.00	1,397	455	3,226	0	5,078	60.45

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL 36" Dia. Corrugated Metal Pi	84.00	LF			1,397	455	3,226	0	5,078	60.45
TOTAL Cinque Holmes Drainage Area					26,610	39,143	19,026	0	84,779	
TOTAL Drainage Ditching					53,373	78,548	38,051	0	169,973	
C1103. Highway 51 Closure Structure										
C1103_02. Demolish High. 51 Closure Struct										
TOTAL Remove Reinforced Concrete S	105.00	CY			0	0	0	22,050	22,050	210.00
TOTAL Excavation	50.00	CY			0	0	0	200	200	4.00
TOTAL Backfill to Grade	150.00	CY			0	0	0	1,005	1,005	6.70
TOTAL Disposal of Steel Panels					0	0	0	2,000	2,000	
TOTAL Demolish High. 51 Closure St					0	0	0	25,255	25,255	
TOTAL Highway 51 Closure Structure					0	0	0	25,255	25,255	
TOTAL Levees					589,219	934,845	115,151	74,555	1,713,770	
C30. Planning, Engineering and Design										
C3001. Planning, Engineering and Design										
C3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	60,000	60,000	
TOTAL Engineering During Construct					0	0	0	40,000	40,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	100,000	100,000	
C3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	23,000	23,000	
TOTAL Engineering During Construct					0	0	0	20,000	20,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	43,000	43,000	

C30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	3,000	3,000	
TOTAL Engineering During Construct					0	0	0	3,000	3,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	6,000	6,000	
C3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	12,000	12,000	
TOTAL Engineering During Construct					0	0	0	2,000	2,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	14,000	14,000	
C3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	2,000	2,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Project Management					0	0	0	7,000	7,000	
C3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	3,000	3,000	
TOTAL Engineering During Construct					0	0	0	3,000	3,000	
TOTAL CT-Contracts					0	0	0	6,000	6,000	
C3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	4,000	4,000	
TOTAL CO-C, AND CO-F					0	0	0	4,000	4,000	
TOTAL Planning, Engineering and De					0	0	0	180,000	180,000	
TOTAL Planning, Engineering and De					0	0	0	180,000	180,000	

C31. Supervision and Administration	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C31. Supervision and Administration										
C3123. Construction Contracts										
C3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	257,000	257,000	
TOTAL Supervision and Administrati					0	0	0	257,000	257,000	
TOTAL Construction Contracts					0	0	0	257,000	257,000	
TOTAL Supervision and Administrati					0	0	0	257,000	257,000	
TOTAL EMBANKMENT & DITCHING Contra					589,219	934,845	115,151	511,555	2,150,770	

D13. Pumping Plant	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D. PUMP STATIONS Contract										
D13. Pumping Plant										
D1301. Missouri Chute Pump Station										
D1301_01. Pump Station										
TOTAL Pump Station - 25 cfs					0	0	0	419,167	419,167	
TOTAL Pump Station					0	0	0	419,167	419,167	
D1301_04. Mob . Demob & Preparatory										
TOTAL Mob . Demob & Preparatory					0	0	0	21,000	21,000	
TOTAL Mob . Demob & Preparatory					0	0	0	21,000	21,000	
TOTAL Missouri Chute Pump Station					0	0	0	440,167	440,167	
D1302. Jones Cutoff Pump Station										
D1302_01. Pump Station										
TOTAL Pump Station - 30 cfs					0	0	0	419,167	419,167	
TOTAL Pump Station					0	0	0	419,167	419,167	
D1302_04. Mob. Demob. & Preparatory cost										
TOTAL Mob. Demob. & Preparatory co					0	0	0	21,000	21,000	
TOTAL Mob. Demob. & Preparatory co					0	0	0	21,000	21,000	
TOTAL Jones Cutoff Pump Station					0	0	0	440,167	440,167	
D1303. Cinque Hommes Pump Station										
D1303_01. Pump Station										
TOTAL Pump Station - 10 cfs					0	0	0	142,500	142,500	
TOTAL Pump Station					0	0	0	142,500	142,500	
D1303_04. Mob. Demob. & Preparatory cost										
TOTAL Mob. Demob. & Preparatory co					0	0	0	7,100	7,100	
TOTAL Mob. Demob. & Preparatory co					0	0	0	7,100	7,100	

D13. Pumping Plant	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Cinque Hommes Pump Station					0	0	0	149,600	149,600	
TOTAL Pumping Plant					0	0	0	1,029,934	1,029,934	
D30. Planning, Engineering and Design										
D3001. Planning, Engineering and Design										
D3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	25,000	25,000	
TOTAL Engineering During Construct					0	0	0	3,000	3,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	28,000	28,000	
D3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	14,000	14,000	
TOTAL Engineering During Construct					0	0	0	12,000	12,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	26,000	26,000	
D3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	6,000	6,000	
TOTAL Engineering During Construct					0	0	0	2,000	2,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	8,000	8,000	
D3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	15,000	15,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	20,000	20,000	
D3001_05. Engineering - ED-DA Structures										
TOTAL Plans & Specifications,Drawi					0	0	0	142,000	142,000	
TOTAL Engineering During Construct					0	0	0	7,000	7,000	
TOTAL Engineering - ED-DA Structur					0	0	0	149,000	149,000	

D30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_06. Engineering - ED-DM Mechanical										
TOTAL Modifiy Pump Discharge Pipe					0	0	0	9,000	9,000	
TOTAL Engineering During Const.-Pi					0	0	0	8,000	8,000	
TOTAL Pump Station Design-4 each					0	0	0	90,000	90,000	
TOTAL Eng during Const-4 Pump Stat					0	0	0	39,000	39,000	
TOTAL Engineering - ED-DM Mechanic					0	0	0	146,000	146,000	
D3001_07. Engineering - ED-DM Electrical										
TOTAL Plans & Specification-4 Stat					0	0	0	20,000	20,000	
TOTAL Engineering - ED-DM Electric					0	0	0	20,000	20,000	
D3001_08. Value Engineering										
TOTAL Value Engineering-Pump Stati					0	0	0	20,000	20,000	
TOTAL Value Engineering					0	0	0	20,000	20,000	
D3001_09. Project Management										
TOTAL Plans & Specifications					0	0	0	6,000	6,000	
TOTAL Engineering During Construct					0	0	0	2,000	2,000	
TOTAL Project Management					0	0	0	8,000	8,000	
D3001_10. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	3,000	3,000	
TOTAL CT-Contracts					0	0	0	8,000	8,000	
D3001_11. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F					0	0	0	10,000	10,000	
TOTAL Planning, Engineering and De					0	0	0	443,000	443,000	
TOTAL Planning, Engineering and De					0	0	0	443,000	443,000	

D31. Supervision and Administration	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D31. Supervision and Administration										
D3123. Construction Contracts										
D3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	155,000	155,000	
TOTAL Supervision and Administrati					0	0	0	155,000	155,000	
TOTAL Construction Contracts					0	0	0	155,000	155,000	
TOTAL Supervision and Administrati					0	0	0	155,000	155,000	
TOTAL PUMP STATIONS Contract					0	0	0	1,627,934	1,627,934	

F01. Lands and Damages	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F. NON FEDERAL COSTS										
F01. Lands and Damages										
F0102. Acquisition Costs										
F0102_02. Acquisition Costs										
F0102_0202. Permanent Easements										
TOTAL Berms-Seepage	8.96	AC			0	0	0	15,680	15,680	1750.00
TOTAL Pump Station	4.00	AC			0	0	0	7,000	7,000	1750.00
TOTAL Drainage Ditch	34.20	AC			0	0	0	59,850	59,850	1750.00
F0102_0202 E. Seepage Berm-North area, in Bois Brule Pump Station Drainage Area										
TOTAL Seepage Berm-North area,	40.00	AC			0	0	0	70,000	70,000	1750.00
					-------	-------	---------	----------	----------	
TOTAL Permanent Easements					0	0	0	152,530	152,530	
F0102_0203. Temporary Easements										
TOTAL Berms-Seepage	1.60	AC			0	0	0	280	280	175.00
TOTAL Pump Station	4.00	AC			0	0	0	700	700	175.00
TOTAL Borrow Area - "A"	5.70	AC			0	0	0	8,978	8,978	1575.00
TOTAL Relief Wells	11.00	AC			0	0	0	1,925	1,925	175.00
TOTAL Drainage Ditch	31.81	AC			0	0	0	5,567	5,567	175.00
					-------	-------	---------	----------	----------	
TOTAL Temporary Easements					0	0	0	17,449	17,449	
F0102_0204. Severance Damages										
TOTAL Severance Damages - 10%					0	0	0	17,000	17,000	
					-------	-------	---------	----------	----------	
TOTAL Severance Damages					0	0	0	17,000	17,000	
F0102_0205. Acquisition Costs-Ownerships-24										
F0102_0205 A. Planning Planning cost at $ 1,000 per ownership, Number of ownerships = 24 each										
TOTAL Planning	24.00	EA			0	0	0	36,000	36,000	1500.00

F. NON FEDERAL COSTS

F01. Lands and Damages	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0102_0205 B. Acquisition								
Acquisition cost at $ 5,500 per ownership,								
Number of ownerships = 45 each								
TOTAL Acquisition	24.00 EA		0	0	0	132,000	132,000	5500.00
F0102_0205 C. Appraisal								
Appraisal cost at $ 1,500 per ownership,								
Number of ownerships = 45 each								
TOTAL Appraisal	24.00 EA		0	0	0	24,000	24,000	1000.00
TOTAL Acquisition Costs-Ownerships			0	0	0	192,000	192,000	
F0102_0207. PL 91-646 Relocation Assistance								
F0102_0207 A. Title III Payments-Basic Project								
Relocation Assistance Public Law 91-646 24 ownerships at $ 500 per ownership.								
TOTAL Title III Payments-Basic Pro	24.00 EA		0	0	0	12,000	12,000	500.00
TOTAL PL 91-646 Relocation Assista			0	0	0	12,000	12,000	
TOTAL Acquisition Costs			0	0	0	390,979	390,979	
TOTAL Acquisition Costs			0	0	0	390,979	390,979	
TOTAL Lands and Damages			0	0	0	390,979	390,979	
TOTAL NON FEDERAL COSTS			0	0	0	390,979	390,979	

G30. Planning, Engineering & Design	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
G. FEDERAL COSTS-PART OF 30 ACCOUNT								
G30. Planning, Engineering & Design								
G3001. Planning, Engineering & Design								
G3001_01. Design Deficiency Project								
USR Sunk Costs-Design Deficiency			0.00	0.00	0.00	135000.00	135000.00	
Thru FY01	1.00 LS	0.00	0	0	0	135,000	135,000	135000
USR Design Deficiency Report FY0			0.00	0.00	0.00	90000.00	90000.00	
2 &	1.00 LS	0.00	0	0	0	90,000	90,000	90000
FY03								
USR Project Man Plan/Quality Con			0.00	0.00	0.00	55000.00	55000.00	
trol	1.00 LS	0.00	0	0	0	55,000	55,000	55000
USR Project Cooperation Agreemen			0.00	0.00	0.00	43000.00	43000.00	
t	1.00 LS	0.00	0	0	0	43,000	43,000	43000
USR Soil Boring/Testing-All Feat			0.00	0.00	0.00	426000.00	426000.00	
ures	1.00 LS	0.00	0	0	0	426,000	426,000	426000
USR Surveys & Mapping-District			0.00	0.00	0.00	105000.00	105000.00	
	1.00 LS	0.00	0	0	0	105,000	105,000	105000
USR Interior Drainage Analysis			0.00	0.00	0.00	20000.00	20000.00	
	1.00 LS	0.00	0	0	0	20,000	20,000	20000
USR Pump Station OMRRR Manual			0.00	0.00	0.00	28000.00	28000.00	
	1.00 LS	0.00	0	0	0	28,000	28,000	28000
USR ROW & Relocations Drawings			0.00	0.00	0.00	50000.00	50000.00	
	1.00 LS	0.00	0	0	0	50,000	50,000	50000
USR Levee OMRRR Manual/as-builts			0.00	0.00	0.00	12000.00	12000.00	
	1.00 LS	0.00	0	0	0	12,000	12,000	12000
USR Real Estate Fed Activities n			0.00	0.00	0.00	58000.00	58000.00	
ot	1.00 LS	0.00	0	0	0	58,000	58,000	58000
including induced flooding								
USR Environmental-not including			0.00	0.00	0.00	24000.00	24000.00	
P&S	1.00 LS	0.00	0	0	0	24,000	24,000	24000

G30. Planning, Engineering & Design		QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
USR	Regulatory-not including P&S			0.00	0.00	0.00	15000.00	15000.00	
		1.00 LS	0.00	0	0	0	15,000	15,000	15000
USR	Project Management-Not inclu			0.00	0.00	0.00	290000.00	290000.00	
	ding	1.00 LS	0.00	0	0	0	290,000	290,000	290000
	combined report, PMP, QCP								
USR	Economics combined report, P			0.00	0.00	0.00	21000.00	21000.00	
	MP,	1.00 LS	0.00	0	0	0	21,000	21,000	21000
	QCP								
TOTAL	Design Deficiency Project			0	0	0	1,372,000	1,372,000	
TOTAL	Planning, Engineering & Desi			0	0	0	1,372,000	1,372,000	
TOTAL	Planning, Engineering & Desi			0	0	0	1,372,000	1,372,000	
TOTAL	FEDERAL COSTS-PART OF 30 ACC			0	0	0	1,372,000	1,372,000	
TOTAL	BOIS BRULE-50 YEAR	1.00 EA		1112989	1390958	723,311	10,068,848	13,296,106	13296106

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	CLABB13	5 laborers + 1 crane, hydr, trk mtd, 60 ton			PROD =	100%		CREW HOURS =		11
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	35.59	1.00	35.59			35.59
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	34.59	4.00	138.36			138.36
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	40.66	1.00	40.66			40.66
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	34.78	1.00	34.78			34.78
GEN	C80Z2280 E	CRANE, HYD, TRUCK MTD, 60 TON	1.00	HR	81.32			1.00	81.32	81.32
	TOTAL					7.00	249.39	1.00	81.32	330.71
	COELB66	1 eqoprlt + 1 loader, BH, wheel, 0.80 CY F/E bkt			PROD =	100%		CREW HOURS =		708
MIL	B-EQOPRLT L	Equip. Operators, Light	1.00	HR	39.89	1.00	39.89			39.89
GEN	L50Z4640 E	LOADER/BH, WH, 0.80 CY (0.6 M3)	1.00	HR	12.96			1.00	12.96	12.96
GEN	L15Z4040 E	DRY CHEMICAL SPREADER, 85 CF	1.00	HR	2.92			1.00	2.92	2.92
	TOTAL					1.00	39.89	2.00	15.87	55.76
	EELEELEC2	2 electrns			PROD =	100%		CREW HOURS =		340
MIL	B-ELECTRN L	Electricians	2.00	HR	51.52	2.00	103.04			103.04
	TOTAL					2.00	103.04	0.00	0.00	103.04
*	XSABA	3 eqoprmed + 1 Grader, 2 Rollers, 3 Trucks			PROD =	100%		CREW HOURS =		171
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	3.00	HR	34.59	3.00	103.77			103.77
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	2.00	HR	40.17	2.00	80.34			80.34
MIL	X-TRKDVRLTL	Outside Truck Drivers, Light	2.00	HR	35.66	2.00	71.32			71.32
MIL	G15CA003 E	GRADER,MOTOR, ARTIC, CAT 12-G	1.00	HR	32.89			1.00	32.89	32.89
MIL	T60KI002 E	TRK,WTR,OF-HY, 6000GAL,W/CAT621	1.00	HR	61.38			1.00	61.38	61.38
MIL	A10ET001 E	CHIPSPREADER,S/P, 10'W, MECH	1.00	HR	20.70			1.00	20.70	20.70
GEN	L35Z4240 E	LOADER, F/E, CRWLR, 1.50 CY	1.00	HR	32.84			1.00	32.84	32.84
GEN	T15Z6570 E	DOZER, CRWLR, 300-340 HP	1.00	HR	69.94			1.00	69.94	69.94
MIL	X-EQOPRMEDF	Outside Equip. Operators, Mediu	1.00	HR	41.17	1.00	41.17			41.17
	TOTAL					8.00	296.60	5.00	217.75	514.35
	XTBCA	3 laborer + 1 Water Truck, Backhoe, Compactor			PROD =	100%		CREW HOURS =		568
MIL	C10WC003 E	COMPACTOR, RAMMER, 13"X11" SHOE	2.00	HR	2.46			2.00	4.91	4.91
MIL	L50CA003 E	LDR,BH,WH, 1.38CY FE BKT, 30"DI	1.00	HR	19.78			1.00	19.78	19.78
MIL	T40XX033 E	WATER TANK, 3000 GAL (ADD TRK	1.00	HR	3.54			1.00	3.54	3.54
MIL	T50KE003 E	TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00	HR	37.22			1.00	37.22	37.22
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	3.00	HR	34.59	3.00	103.77			103.77
MIL	X-EQOPRLT L	Outside Equip. Operators, Light	1.00	HR	39.89	1.00	39.89			39.89
MIL	X-EQOPRLT F	Outside Equip. Operators, Light	0.50	HR	40.89	0.50	20.45			20.45
MIL	X-TRKDVRLTL	Outside Truck Drivers, Light	1.00	HR	35.66	1.00	35.66			35.66
	TOTAL					5.50	199.76	5.00	65.45	265.21
*	XXQMO	1 eqoprmed + 1 Rotary Drill, 250 Hp			PROD =	100%		CREW HOURS =		4260
GEN	D35Z2970 E	DRILL, ROTARY-BLASTHOLE, 7"- 9"	1.00	HR	97.13			1.00	97.13	97.13
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	1.00	HR	34.59	1.00	34.59			34.59
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	1.00	HR	40.17	1.00	40.17			40.17
MIL	X-EQOPRMEDF	Outside Equip. Operators, Mediu	0.25	HR	41.17	0.25	10.29			10.29
	TOTAL					2.25	85.05	1.00	97.13	182.19

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ZBBLEVEE	Embankment			PROD = 0.00%				CREW HOURS =	710
EP	R30CA005	E SOIL COMP,SHPSFT,S/P 35T, 88"W	2.00	HR	86.49			2.00	172.98	172.98
MAP	S20CA003	E SCRAPER,TAND, 21-31CY, 37.5T PS	6.00	HR	130.44			6.00	782.62	782.62
EP	T15CA008	E DOZER,CWLR, D6M XL PS,W/BLADE	1.00	HR	45.67			1.00	45.67	45.67
MAP	T15CA016	E DOZER,CWLR, D-8R PS,W/BLADE	1.00	HR	60.94			1.00	60.94	60.94
MAP	T10CA017	E BLADE, UNIVERSAL, HYDR, D-8	1.00	HR	8.67			1.00	8.67	8.67
MAP	T15CA017	E DOZER,CWLR, D-9R PS,W/BLADE	1.00	HR	83.13			1.00	83.13	83.13
MAP	T10CA022	E BLADE, UNIVERSAL, HYDR, D-9	1.00	HR	12.50			1.00	12.50	12.50
EP	T60KI003	E TRK,WTR,OF-HY, 8000GAL,W/CAT631	1.00	HR	87.22			1.00	87.22	87.22
MIL	X-EQOPRHVYL	Outside Equip. Operators, Heavy	12.00	HR	40.66	12.00	487.92			487.92
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	4.00	HR	34.59	4.00	138.36			138.36
MIL	X-TRKDVRHVL	Outside Truck Drivers, Heavy	2.00	HR	35.88	2.00	71.76			71.76
MIL	X-LABORER L	Laborer Foreman	1.00	HR	34.59	1.00	34.59			34.59
	TOTAL					19.00	732.63	14.00	1253.74	1986.37

** LABOR BACKUP **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-ELECTRN	Electricians	26.65	0.0%	40.0%	14.21	0.00	51.52	HR	04/10/02	27.92	680
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	20.75	0.0%	40.0%	11.61	0.00	40.66	HR	04/10/02	23.41	11
MIL	B-EQOPRLT	Equip. Operators, Light	20.20	0.0%	40.0%	11.61	0.00	39.89	HR	04/10/02	15.97	708
MIL	B-EQOPROIL	Equip. Operators, Oilers	16.55	0.0%	40.0%	11.61	0.00	34.78	HR	04/10/02	15.97	11
MIL	B-LABORER	Laborers, (Semi-Skilled)	20.35	0.0%	40.0%	6.10	0.00	34.59	HR	04/10/02	12.50	56
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	20.75	0.0%	40.0%	11.61	0.00	40.66	HR	04/10/02	23.41	8525
MIL	X-EQOPRLT	Outside Equip. Operators, Light	20.20	0.0%	40.0%	11.61	0.00	39.89	HR	04/10/02	15.96	852
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	20.40	0.0%	40.0%	11.61	0.00	40.17	HR	04/23/02	21.21	5838
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	20.35	0.0%	40.0%	6.10	0.00	34.59	HR	04/10/02	9.72	10029
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	21.88	0.0%	40.0%	5.25	0.00	35.88	HR	04/10/02	19.23	1421
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	21.72	0.0%	40.0%	5.25	0.00	35.66	HR	04/10/02	17.09	910

** EQUIPMENT BACKUP **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
MAP	A10ET001	CHIP SPREADER,S/P, 10' W, MECH	6.68	1.81	3.54	0.98	0.12	0.02	7.55	20.70 HR	171
MAP	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.67	0.10	0.40	0.11			1.18	2.46 HR	1136
GEN	C80Z2280	CRANE, HYD, TRUCK MTD, 65T	28.15	10.71	10.63	3.30	0.92	0.15	27.47	81.32 HR	11
GEN	D35Z2970	DRILL, ROTARY-BLASTHOLE, 7"-9"	26.05	9.53	16.22	7.20			38.13	97.13 HR	4260
EP	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-H	10.60	4.34	3.99	1.60	0.47	0.08	11.82	32.89 HR	171
GEN	L15Z4040	SPREADER, DRY CHEMICAL 85CF	1.38	0.16			0.03	0.00	1.34	2.92 HR	708
GEN	L35Z4240	LOADER, F/E, CRWLR, 1.50CY	8.93	1.96	2.98	1.32			17.65	32.84 HR	171
EP	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	6.08	1.84	2.70	1.02	0.46	0.08	7.60	19.78 HR	568
GEN	L50Z4640	LOADER/BCK-HOE,WH, 0.80CY(0.6M3)	3.73	1.17	1.82	0.69	0.72	0.12	4.70	12.96 HR	708
EP	R30CA005	SOIL COMP,SHPSFT,S/P 35T, 88"W	30.60	8.22	9.56	2.65			35.45	86.49 HR	1421
MAP	S20CA003	SCRAPER,TAND, 21-31CY, 37.5T PS	38.91	16.03	20.61	6.41	11.05	1.84	35.60	130.44 HR	4262
MAP	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.50	0.94		0.13			4.10	8.67 HR	710
MAP	T10CA022	BLADE, UNIVERSAL, HYDR, D-9	5.04	1.35		0.19			5.91	12.50 HR	710
EP	T15CA008	DOZER,CWLR, D6M XL PS,W/BLADE	12.33	3.64	4.64	1.96			23.11	45.67 HR	710
MAP	T15CA016	DOZER,CWLR, D-8R PS,W/BLADE	16.21	7.51	10.10	3.36			23.75	60.94 HR	710
MAP	T15CA017	DOZER,CWLR, D-9R PS,W/BLADE	22.29	10.33	13.41	4.47			32.64	83.13 HR	710
GEN	T15Z6570	DOZER, CRAWLER, 300-340HP	19.06	8.83	10.60	3.53			27.92	69.94 HR	171
MAP	T50KE003	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.79	2.44	10.04	3.34	0.97	0.16	9.48	37.22 HR	568
MAP	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.24	6.16	10.02	3.78	3.45	0.57	19.16	61.38 HR	171
EP	T60KI003	TRK,WTR,OF-HY, 8000GAL,W/CAT631E	26.31	8.86	13.66	5.16	4.83	0.80	27.61	87.22 HR	710

No errors detected...

* * * END OF ERROR REPORT * * *

BOIS BRULE-100 YEAR LEVEL OF
PROTECTION & 50 YEAR DESIGN
DEFICIENCY PROJECT-COMBINED

Designed By: ST. LOUIS DISTRICT, COE
Estimated By: ST. LOUIS DISTRICT, COE

Prepared By: DAWAYNE SANDERS, P.E.

Preparation Date: 04/30/02
Effective Date of Pricing: 04/30/02

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

M C A C E S f o r W i n d o w s
Software Copyright (c) 1985-1997
by Building Systems Design, Inc.
Release 1.2

** CONTRACTOR SETTINGS **

	AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
PM Prime Contractor										
Field Office Overhead	P	5.50								
Home Office Overhead	P	5.00								
Profit	P	7.80								
Bond	C		(Class: A)							
EL Electrical										
Field Office Overhead	P	3.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							
ME Mechanical										
Field Office Overhead	P	3.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							
DW Dewatering										
Field Office Overhead	P	5.00								
Home Office Overhead	P	5.00								
Profit	P	8.00								
Bond	C		(Class: B)							

SUMMARY REPORTS SUMMARY PAGE

PROJECT OWNER SUMMARY - Level 1.....1
PROJECT OWNER SUMMARY - Level 2.....2
PROJECT OWNER SUMMARY - Level 6.....4
PROJECT INDIRECT SUMMARY - Level 1.....23
PROJECT INDIRECT SUMMARY - Level 2.....24
PROJECT INDIRECT SUMMARY - Level 6.....26
PROJECT DIRECT SUMMARY - Level 1.....45
PROJECT DIRECT SUMMARY - Level 2.....46
PROJECT DIRECT SUMMARY - Level 6.....48

DETAILED ESTIMATE DETAIL PAGE

A. RELIEF WELLS # 1 Contract
11. Levees
01. Relief Wells
02. Mob, Demob & Preparatory Work
1. Mobilization and Demobilization.....1
99. Associated Levee Items
1. Relief Wells, Welled Reaches-74.....1
2. Seeding.....2
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....2
2. Engineering During Construction.....2
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....2
2. Engineering During Construction.....2
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....2
2. Engineering During Construction.....2
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....3
2. Engineering During Construction.....3
05. Project Management
1. Plans & Specifications.....3
2. Engineering During Construction.....3
06. CT-Contracts
1. Plans & Specifications.....3
2. Engineering During Construction.....3
07. CO-C, AND CO-F
1. Plans & Specifications.....3
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....3
B. RELIEF WELLS # 2 Contract
11. Levees
01. Relief Wells
02. Mob, Demob & Preparatory Work

DETAILED ESTIMATE DETAIL PAGE

1. Mobilization and Demobilization.....4
99. Associated Levee Items
1. Relief Wells for 7 hot spot area.....4
2. Relief Wells, Welled Reaches.....5
3. Relief Wells, Non-Welled Reaches.....5
4. Modify Existing Relief Wells.....5
5. Seeding.....6
02. Piezometers
01. Piezometers
1. Piezometers.....6
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....6
2. Engineering During Construction.....6
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....7
2. Engineering During Construction.....7
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....7
2. Engineering During Construction.....7
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....7
2. Engineering During Construction.....7
05. Project Management
1. Plans & Specifications.....7
2. Engineering During Construction.....7
06. CT-Contracts
1. Plans & Specifications.....7
2. Engineering During Construction.....7
07. CO-C, AND CO-F
1. Plans & Specifications.....7
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....8
C. EMBANKMENT & DITCHING Contract
11. Levees
01. Levee Raise and Seepage Berms
02. Mob, Demob & Preparatory Work
1. Mobilization and Demobilization.....9
04. Permanent Access Road
1. Road on Levee Crown.....9
99. Associated Levee Items
1. Embankment In Place.....9
2. Embankment - Variable Freeboard.....10
3. Landside Seepage Berms-Pervious.....10
4. Gravity Drain Extenstions.....10
5. Establishment of Turf.....10
02. Drainage Ditching
01. Jones Cutoff Drainage Area

DETAILED ESTIMATE DETAIL PAGE

1. Ditch Excavation.....10
2. Establishment of Turf.....11
3. 36" Dia. Corrugated Metal Pipe.....11
02. Cinque Holmes Drainage Area
1. Ditch Excavation.....11
2. Establishment of Turf.....11
3. 36" Dia. Corrugated Metal Pipe.....11
03. Bois Brule Drainage Area
1. Ditch Excavation.....12
2. Establishment of Turf.....12
3. 36" Dia. Corrugated Metal Pipe.....12
03. Highway 51 Closure Structure
02. Demolish High. 51 Closure Struct
1. Remove Reinforced Concrete Struc.....13
2. Excavation.....13
3. Backfill to Grade.....13
4. Disposal of Steel Panels.....13
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....13
2. Engineering During Construction.....13
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....13
2. Engineering During Construction.....13
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....13
2. Engineering During Construction.....13
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....14
2. Engineering During Construction.....14
05. Project Management
1. Plans & Specifications.....14
2. Engineering During Construction.....14
06. CT-Contracts
1. Plans & Specifications.....14
2. Engineering During Construction.....14
07. CO-C, AND CO-F
1. Plans & Specifications.....14
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....14
D. PUMP STATIONS Contract
13. Pumping Plant
01. Missouri Chute Pump Station
01. Pump Station
1. Pump Station - 48 cfs.....15
02. Raise Discharge Pipe
1. Raise Discharge Pipe-36" Dia.....15
03. Dresser Couplings

DETAILED ESTIMATE DETAIL PAGE

1. Dresser Couplings for Pipe.....15
04. Mob . Demob & Preparatory
01. Mob . Demob & Preparatory.....15
02. Jones Cutoff Pump Station
01. Pump Station
1. Pump Station - 57 cfs.....15
02. Raise Discharge Pipe
1. Raise Discharge Pipe-36" Dia.....15
03. Dresser Couplings
1. Dresser Couplings for Pipe.....16
04. Mob. Demob. & Preparatory cost
1. Mob. Demob. & Preparatory cost.....16
03. Cinque Hommes Pump Station
01. Pump Station
1. Pump Station - 16 cfs.....16
02. Raise Discharge Pipe
1. Raise Discharge Pipe-36" Dia.....16
03. Dresser Couplings
1. Dresser Couplings for Pipe.....16
04. Mob. Demob. & Preparatory cost
1. Mob. Demob. & Preparatory cost.....16
04. Bois Brule Pump Station
01. Pump Station
1. Pump Station - 41 cfs.....17
02. Mob. Demob. & Preparatory cost
1. Mob. Demob. & Preparatory cost.....17
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....17
2. Engineering During Construction.....17
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....17
2. Engineering During Construction.....17
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....17
2. Engineering During Construction.....17
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....18
2. Engineering During Construction.....18
05. Engineering - ED-DA Structures
1. Plans & Specifications,Drawings.....18
4. Engineering During Construction.....18
06. Engineering - ED-DM Mechanical
1. Modifiy Pump Discharge Pipes.....18
2. Engineering During Const.-Pipes.....18
3. Pump Station Design-4 each.....18
4. Eng during Const-4 Pump Stations.....18
07. Engineering - ED-DM Electrical
1. Plans & Specification-4 Stations.....18
08. Value Engineering

DETAILED ESTIMATE DETAIL PAGE

1. Value Engineering-Pump Stations.....18
09. Project Management
1. Plans & Specifications.....18
2. Engineering During Construction.....18
10. CT-Contracts
1. Plans & Specifications.....19
2. Engineering During Construction.....19
11. CO-C, AND CO-F
1. Plans & Specifications.....19
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....19
E. RAILROAD CLOSURE Contract
11. Levees
01. North Railroad Closure-Replace
01. Mob, Demob & Preparatory Work
01. Mobilization and Demobilization.....20
02. Site Work
01. Clearing, Grubbing and Stripping.....20
02. Structural Excavation.....20
03. Structural Backfill.....20
04. Bedding Material.....21
05. Riprap.....21
06. Establishment of Turf.....21
07. Demolition of Existing Closure.....21
03. Closure Structure-Pile Founded
01. Concrete Formwork.....22
02. Concrete Reinforcing Steel.....22
03. Concrete-Cast in Place.....22
05. HP14 Pile Points.....23
06. PZ27 Steel Sheet Pile.....23
07. Steel H Pile, HP14x73-58 x42.75'.....23
08. Swing Gate & J-Seals.....23
09. Miscellaneous Embedded Metals.....23
10. Painting.....24
04. Traffic Control
01. Flagmen.....24
30. Planning, Engineering and Design
01. Planning, Engineering and Design
01. Engineering - ED-DC Civil Design
1. Plans/Specification&Gen.Drawings.....25
2. Engineering During Construction.....25
02. Engineering - ED-GF Geotech
1. Plans & Specifications.....25
2. Engineering During Construction.....25
03. Engineering - ED-HE Hydrologic
1. Plans & Specifications.....25
2. Engineering During Construction.....25
04. Engineering - ED-C Cost Estimate
1. Plans & Specs. Bid Opening.....25

DETAILED ESTIMATE DETAIL PAGE

2. Engineering During Construction.....25
05. Engineering - ED-DA Structures
1. Plans & Specifications.....25
2. Engineering During Construction.....25
06. Project Management
1. Plans & Specifications.....26
2. Engineering During Construction.....26
07. CT-Contracts
1. Plans & Specifications.....26
2. Engineering During Construction.....26
08. CO-C, AND CO-F
1. Plans & Specifications.....26
31. Supervision and Administration
23. Construction Contracts
11. Supervision and Administration
01. Supervision and Administration.....26
F. NON FEDERAL COSTS
01. Lands and Damages
02. Acquisition Costs
01. Levee Raise - Acquisition Costs
02. Permanent Easements
A. Berms-Stability & Seepage.....27
B. Pump Station.....27
C. Railroad Closure.....27
D. Drainage Ditch.....27
03. Temporary Easements
A. Berms-Stability & Seepage.....27
B. Pump Station.....27
C. Railroad Closure.....27
D. Borrow Area - "A".....27
E. Borrow Area - "B".....27
F. Relief Wells.....27
G. Drainage Ditch.....27
H. Roads.....27
04. Severance Damages
A. Severance Damages - 10%.....28
05. Acquisition Costs-Ownerships-102
A. Planning.....28
B. Acquisition.....28
C. Appraisal.....28
07. PL 91-646 Relocation Assistance
A. Title III Payments-Basic Project.....28
02. Induced Flooding-AcquisitionCost
02. Permanent Easements
E. Flowage (Induced Flooding)-A.....28
F. Flowage (Induced Flooding)-B.....28
04. Severance Damages
A. Severance Damages - 10%.....29
06. Acquisition-Induced Flooding-216
A. Induced Flooding-216 Tracts.....29
07. PL 91-646 Relocation Assistance

DETAILED ESTIMATE DETAIL PAGE

B. Induced Flooding.....29
03. Environmental Mitigation Lands
01. Environmental Mitigation-
A. Environmental Mitigation-.....29
02. Relocations
01. Embankment & Ditching
01. Utilities
01. Electric Utility.....29
02. Pipeline
01. Pipeline Crossing Extension.....30
02. North Railroad Closure Relocatio
01. Railroad Relocation - SHOO-FLY
01. Railroad Relocation - SHOO-FLY.....30
02. BNSF cost for SHOO-FLY Relocatio
01. BNSF cost for SHOO-FLY Relocatio.....31
30. Planning, Engineering, & Design
01. Planning, Engineering, & Design
01. Planning, Engineering, & Design
01. Relocations.....31
31. Supervision and Administration
01. Supervision and Administration
01. Supervision and Administration
01. Relocation-Embankment, Ditching.....31
02. Relocations for Railroad Closure.....31
G. FEDERAL COSTS-PART OF 30 ACCOUNT
30. Planning, Engineering & Design
01. Planning, Engineering & Design
01. Combined Design Deficiency.....32

BACKUP REPORTS BACKUP PAGE

CREW BACKUP.....1
LABOR BACKUP.....5
EQUIPMENT BACKUP.....6

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Level 1 **

		QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A	RELIEF WELLS # 1 Contract		2,416,852	480,963	2,897,815	
B	RELIEF WELLS # 2 Contract		12,643,191	2,714,048	15,357,239	
C	EMBANKMENT & DITCHING Contract		11,409,311	2,335,328	13,744,639	
D	PUMP STATIONS Contract		4,731,613	869,153	5,600,766	
E	RAILROAD CLOSURE Contract		1,401,095	212,524	1,613,619	
F	NON FEDERAL COSTS		4,648,687	299,181	4,947,868	
G	FEDERAL COSTS-PART OF 30 ACCOUNT		2,414,000	0	2,414,000	
TOTAL	BOIS BRULE-100 YEAR LEVEL OF	1.00 EA	39,664,750	6,911,197	46,575,94746575947	

** PROJECT OWNER SUMMARY - Level 2 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract					
A11 Levees		1,923,852	480,963	2,404,815	
A30 Planning, Engineering and Design		252,000	0	252,000	
A31 Supervision and Administration		241,000	0	241,000	
TOTAL RELIEF WELLS # 1 Contract		2,416,852	480,963	2,897,815	
B RELIEF WELLS # 2 Contract					
B11 Levees		10,856,191	2,714,048	13,570,239	
B30 Planning, Engineering and Design		430,000	0	430,000	
B31 Supervision and Administration		1,357,000	0	1,357,000	
TOTAL RELIEF WELLS # 2 Contract		12,643,191	2,714,048	15,357,239	
C EMBANKMENT & DITCHING Contract					
C11 Levees		9,341,311	2,335,328	11,676,639	
C30 Planning, Engineering and Design		900,000	0	900,000	
C31 Supervision and Administration		1,168,000	0	1,168,000	
TOTAL EMBANKMENT & DITCHING Contract		11,409,311	2,335,328	13,744,639	
D PUMP STATIONS Contract					
D13 Pumping Plant		3,476,613	869,153	4,345,766	
D30 Planning, Engineering and Design		820,000	0	820,000	
D31 Supervision and Administration		435,000	0	435,000	
TOTAL PUMP STATIONS Contract		4,731,613	869,153	5,600,766	
E RAILROAD CLOSURE Contract					
E11 Levees		850,095	212,524	1,062,619	
E30 Planning, Engineering and Design		445,000	0	445,000	
E31 Supervision and Administration		106,000	0	106,000	
TOTAL RAILROAD CLOSURE Contract		1,401,095	212,524	1,613,619	
F NON FEDERAL COSTS					
F01 Lands and Damages		4,139,270	224,568	4,363,838	
F02 Relocations		397,417	74,613	472,030	
F30 Planning, Engineering, & Design		65,000	0	65,000	

** PROJECT OWNER SUMMARY - Level 2 **

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
F31 Supervision and Administration			47,000	0	47,000	
TOTAL NON FEDERAL COSTS			4,648,687	299,181	4,947,868	
G FEDERAL COSTS-PART OF 30 ACCOUNT						
G30 Planning, Engineering & Design			2,414,000	0	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			2,414,000	0	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00	EA	39,664,750	6,911,197	46,575,94746575947	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract					
A11 Levees					
A1101 Relief Wells					
A1101_02 Mob, Demob & Preparatory Work					
A1101_02 1 Mobilization and Demobilization		91,277	22,819	114,096	
TOTAL Mob, Demob & Preparatory Work		91,277	22,819	114,096	
A1101_99 Associated Levee Items					
A1101_99 1 Relief Wells, Welled Reaches-74	74.00 EA	1,812,351	453,088	2,265,439	30614
A1101_99 2 Seeding	14.80 ACR	20,223	5,056	25,279	1708.06
TOTAL Associated Levee Items		1,832,575	458,144	2,290,718	
TOTAL Relief Wells	74.00 EA	1,923,852	480,963	2,404,815	32497
TOTAL Levees		1,923,852	480,963	2,404,815	
A30 Planning, Engineering and Design					
A3001 Planning, Engineering and Design					
A3001_01 Engineering - ED-DC Civil Design					
A3001_01 1 Plans/Specification&Gen.Drawings		60,000	0	60,000	
A3001_01 2 Engineering During Construction		39,000	0	39,000	
TOTAL Engineering - ED-DC Civil Design		99,000	0	99,000	
A3001_02 Engineering - ED-GF Geotech					
A3001_02 1 Plans & Specifications		65,000	0	65,000	
A3001_02 2 Engineering During Construction		40,000	0	40,000	
TOTAL Engineering - ED-GF Geotech		105,000	0	105,000	
A3001_03 Engineering - ED-HE Hydrologic					
A3001_03 1 Plans & Specifications		5,000	0	5,000	
A3001_03 2 Engineering During Construction		3,500	0	3,500	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrologic		8,500	0	8,500	
A3001_04 Engineering - ED-C Cost Estimate					
A3001_04 1 Plans & Specs. Bid Opening		11,000	0	11,000	
A3001_04 2 Engineering During Construction		500	0	500	
TOTAL Engineering - ED-C Cost Estimate		11,500	0	11,500	
A3001_05 Project Management					
A3001_05 1 Plans & Specifications		6,000	0	6,000	
A3001_05 2 Engineering During Construction		5,000	0	5,000	
TOTAL Project Management		11,000	0	11,000	
A3001_06 CT-Contracts					
A3001_06 1 Plans & Specifications		5,000	0	5,000	
A3001_06 2 Engineering During Construction		2,000	0	2,000	
TOTAL CT-Contracts		7,000	0	7,000	
A3001_07 CO-C, AND CO-F					
A3001_07 1 Plans & Specifications		10,000	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	10,000	
TOTAL Planning, Engineering and Design		252,000	0	252,000	
TOTAL Planning, Engineering and Design		252,000	0	252,000	
A31 Supervision and Administration					
A3123 Construction Contracts					
A3123_11 Supervision and Administration					
A3123_1101 Supervision and Administration		241,000	0	241,000	
TOTAL Supervision and Administration		241,000	0	241,000	
TOTAL Construction Contracts		241,000	0	241,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Supervision and Administration			241,000	0	241,000	
TOTAL RELIEF WELLS # 1 Contract			2,416,852	480,963	2,897,815	
B RELIEF WELLS # 2 Contract						
B11 Levees						
B1101 Relief Wells						
B1101_02 Mob, Demob & Preparatory Work						
B1101_02 1 Mobilization and Demobilization			520,830	130,207	651,037	
TOTAL Mob, Demob & Preparatory Work			520,830	130,207	651,037	
B1101_99 Associated Levee Items						
B1101_99 1 Relief Wells for 7 hot spot area	62.00	EA	1,518,456	379,614	1,898,070	30614
B1101_99 2 Relief Wells, Welled Reaches	98.00	EA	2,400,141	600,035	3,000,176	30614
B1101_99 3 Relief Wells, Non-Welled Reaches	254.00	EA	6,211,628	1,552,907	7,764,535	30569
B1101_99 4 Modify Existing Relief Wells	5.00	EA	24,001	6,000	30,002	6000.34
B1101_99 5 Seeding	82.80	ACR	113,142	28,286	141,428	1708.06
TOTAL Associated Levee Items			10,267,369	2,566,842	12,834,211	
TOTAL Relief Wells	414.00	EA	10,788,198	2,697,050	13,485,248	32573
B1102 Piezometers						
B1102_01 Piezometers						
B1102_01 1 Piezometers	68.00	EA	67,993	16,998	84,991	1249.87
TOTAL Piezometers	68.00	EA	67,993	16,998	84,991	1249.87
TOTAL Piezometers	68.00	EA	67,993	16,998	84,991	1249.87
TOTAL Levees			10,856,191	2,714,048	13,570,239	
B30 Planning, Engineering and Design						
B3001 Planning, Engineering and Design						
B3001_01 Engineering - ED-DC Civil Design						
B3001_01 1 Plans/Specification&Gen.Drawings			80,000	0	80,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
B3001_01 2 Engineering During Construction		60,000	0	60,000	
TOTAL Engineering - ED-DC Civil Design		140,000	0	140,000	
B3001_02 Engineering - ED-GF Geotech					
B3001_02 1 Plans & Specifications		85,000	0	85,000	
B3001_02 2 Engineering During Construction		80,000	0	80,000	
TOTAL Engineering - ED-GF Geotech		165,000	0	165,000	
B3001_03 Engineering - ED-HE Hydrologic					
B3001_03 1 Plans & Specifications		10,000	0	10,000	
B3001_03 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-HE Hydrologic		20,000	0	20,000	
B3001_04 Engineering - ED-C Cost Estimate					
B3001_04 1 Plans & Specs. Bid Opening		16,000	0	16,000	
B3001_04 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-C Cost Estimate		26,000	0	26,000	
B3001_05 Project Management					
B3001_05 1 Plans & Specifications		11,000	0	11,000	
B3001_05 2 Engineering During Construction		25,000	0	25,000	
TOTAL Project Management		36,000	0	36,000	
B3001_06 CT-Contracts					
B3001_06 1 Plans & Specifications		10,000	0	10,000	
B3001_06 2 Engineering During Construction		15,000	0	15,000	
TOTAL CT-Contracts		25,000	0	25,000	
B3001_07 CO-C, AND CO-F					
B3001_07 1 Plans & Specifications		18,000	0	18,000	
TOTAL CO-C, AND CO-F		18,000	0	18,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Planning, Engineering and Design		430,000	0	430,000	
TOTAL Planning, Engineering and Design		430,000	0	430,000	
B31 Supervision and Administration					
B3123 Construction Contracts					
B3123_11 Supervision and Administration					
B3123_1101 Supervision and Administration		1,357,000	0	1,357,000	
TOTAL Supervision and Administration		1,357,000	0	1,357,000	
TOTAL Construction Contracts		1,357,000	0	1,357,000	
TOTAL Supervision and Administration		1,357,000	0	1,357,000	
TOTAL RELIEF WELLS # 2 Contract		12,643,191	2,714,048	15,357,239	
C EMBANKMENT & DITCHING Contract					
C11 Levees					
C1101 Levee Raise and Seepage Berms					
C1101_02 Mob, Demob & Preparatory Work					
C1101_02 1 Mobilization and Demobilization		240,014	60,003	300,017	
TOTAL Mob, Demob & Preparatory Work		240,014	60,003	300,017	
C1101_04 Permanent Access Road					
C1101_04 1 Road on Levee Crown		1,509,373	377,343	1,886,716	
TOTAL Permanent Access Road		1,509,373	377,343	1,886,716	
C1101_99 Associated Levee Items					
C1101_99 1 Embankment In Place	1257200 CY	5,304,226	1,326,057	6,630,283	5.27
C1101_99 2 Embankment - Variable Freeboard	200000 CY	843,816	210,954	1,054,770	5.27
C1101_99 3 Landside Seepage Berms-Pervious	145000 CY	611,766	152,942	764,708	5.27
C1101_99 4 Gravity Drain Extenstions		21,361	5,340	26,702	
C1101_99 5 Establishment of Turf	363.00 ACR	447,512	111,878	559,391	1541.02

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Associated Levee Items			7,228,682	1,807,171	9,035,853	
TOTAL Levee Raise and Seepage Berms			8,978,069	2,244,517	11,222,586	
C1102 Drainage Ditching						
C1102_01 Jones Cutoff Drainage Area						
C1102_01 1 Ditch Excavation	16644	CY	71,489	17,872	89,361	5.37
C1102_01 2 Establishment of Turf	20.00	ACR	24,656	6,164	30,820	1541.02
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	6,093	1,523	7,617	90.68
TOTAL Jones Cutoff Drainage Area			102,238	25,560	127,798	
C1102_02 Cinque Holmes Drainage Area						
C1102_02 1 Ditch Excavation	16528	CY	70,990	17,748	88,738	5.37
C1102_02 2 Establishment of Turf	20.00	ACR	24,656	6,164	30,820	1541.02
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	6,093	1,523	7,617	90.68
TOTAL Cinque Holmes Drainage Area			101,740	25,435	127,175	
C1102_03 Bois Brule Drainage Area						
C1102_03 1 Ditch Excavation	20720	CY	88,996	22,249	111,245	5.37
C1102_03 2 Establishment of Turf	25.00	ACR	30,820	7,705	38,526	1541.02
C1102_03 3 36" Dia. Corrugated Metal Pipe	126.00	LF	9,140	2,285	11,425	90.68
TOTAL Bois Brule Drainage Area			128,956	32,239	161,195	
TOTAL Drainage Ditching			332,935	83,234	416,169	
C1103 Highway 51 Closure Structure						
C1103_02 Demolish High. 51 Closure Struct						
C1103_02 1 Remove Reinforced Concrete Struc	105.00	CY	26,461	6,615	33,077	315.02
C1103_02 2 Excavation	50.00	CY	240	60	300	6.00
C1103_02 3 Backfill to Grade	150.00	CY	1,206	302	1,508	10.05
C1103_02 4 Disposal of Steel Panels			2,400	600	3,000	
TOTAL Demolish High. 51 Closure Struct			30,308	7,577	37,885	
TOTAL Highway 51 Closure Structure			30,308	7,577	37,885	
TOTAL Levees			9,341,311	2,335,328	11,676,639	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
C30 Planning, Engineering and Design					
C3001 Planning, Engineering and Design					
C3001_01 Engineering - ED-DC Civil Design					
C3001_01 1 Plans/Specification&Gen.Drawings		300,000	0	300,000	
C3001_01 2 Engineering During Construction		215,000	0	215,000	
TOTAL Engineering - ED-DC Civil Design		515,000	0	515,000	
C3001_02 Engineering - ED-GF Geotech					
C3001_02 1 Plans & Specifications		120,000	0	120,000	
C3001_02 2 Engineering During Construction		110,000	0	110,000	
TOTAL Engineering - ED-GF Geotech		230,000	0	230,000	
C3001_03 Engineering - ED-HE Hydrologic					
C3001_03 1 Plans & Specifications		15,000	0	15,000	
C3001_03 2 Engineering During Construction		20,000	0	20,000	
TOTAL Engineering - ED-HE Hydrologic		35,000	0	35,000	
C3001_04 Engineering - ED-C Cost Estimate					
C3001_04 1 Plans & Specs. Bid Opening		20,000	0	20,000	
C3001_04 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-C Cost Estimate		30,000	0	30,000	
C3001_05 Project Management					
C3001_05 1 Plans & Specifications		10,000	0	10,000	
C3001_05 2 Engineering During Construction		25,000	0	25,000	
TOTAL Project Management		35,000	0	35,000	
C3001_06 CT-Contracts					
C3001_06 1 Plans & Specifications		15,000	0	15,000	
C3001_06 2 Engineering During Construction		20,000	0	20,000	
TOTAL CT-Contracts		35,000	0	35,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
C3001_07 CO-C, AND CO-F					
C3001_07 1 Plans & Specifications		20,000	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	20,000	
TOTAL Planning, Engineering and Design		900,000	0	900,000	
TOTAL Planning, Engineering and Design		900,000	0	900,000	
C31 Supervision and Administration					
C3123 Construction Contracts					
C3123_11 Supervision and Administration					
C3123_1101 Supervision and Administration		1,168,000	0	1,168,000	
TOTAL Supervision and Administration		1,168,000	0	1,168,000	
TOTAL Construction Contracts		1,168,000	0	1,168,000	
TOTAL Supervision and Administration		1,168,000	0	1,168,000	
TOTAL EMBANKMENT & DITCHING Contract		11,409,311	2,335,328	13,744,639	
D PUMP STATIONS Contract					
D13 Pumping Plant					
D1301 Missouri Chute Pump Station					
D1301_01 Pump Station					
D1301_01 1 Pump Station - 48 cfs		960,054	240,014	1,200,068	
TOTAL Pump Station		960,054	240,014	1,200,068	
D1301_02 Raise Discharge Pipe					
D1301_02 1 Raise Discharge Pipe-36" Dia	248.00 LF	19,842	4,961	24,803	100.01
TOTAL Raise Discharge Pipe		19,842	4,961	24,803	
D1301_03 Dresser Couplings					

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D1301_03 1 Dresser Couplings for Pipe	6.00 EA	19,203	4,801	24,004	4000.73
TOTAL Dresser Couplings		19,203	4,801	24,004	
D1301_04 Mob . Demob & Preparatory					
D1301_0401 Mob . Demob & Preparatory		30,002	7,500	37,502	
TOTAL Mob . Demob & Preparatory		30,002	7,500	37,502	
TOTAL Missouri Chute Pump Station		1,029,102	257,275	1,286,377	
D1302 Jones Cutoff Pump Station					
D1302_01 Pump Station					
D1302_01 1 Pump Station - 57 cfs		960,054	240,014	1,200,068	
TOTAL Pump Station		960,054	240,014	1,200,068	
D1302_02 Raise Discharge Pipe					
D1302_02 1 Raise Discharge Pipe-36" Dia	396.00 LF	31,683	7,921	39,604	100.01
TOTAL Raise Discharge Pipe		31,683	7,921	39,604	
D1302_03 Dresser Couplings					
D1302_03 1 Dresser Couplings for Pipe	12.00 EA	38,407	9,602	48,009	4000.73
TOTAL Dresser Couplings		38,407	9,602	48,009	
D1302_04 Mob. Demob. & Preparatory cost					
D1302_04 1 Mob. Demob. & Preparatory cost		30,002	7,500	37,502	
TOTAL Mob. Demob. & Preparatory cost		30,002	7,500	37,502	
TOTAL Jones Cutoff Pump Station		1,060,146	265,037	1,325,183	
D1303 Cinque Hommes Pump Station					
D1303_01 Pump Station					

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D1303_01 1 Pump Station - 16 cfs		320,058	80,015	400,073	
TOTAL Pump Station		320,058	80,015	400,073	
D1303_02 Raise Discharge Pipe					
D1303_02 1 Raise Discharge Pipe-36" Dia	391.00 LF	31,283	7,821	39,104	100.01
TOTAL Raise Discharge Pipe		31,283	7,821	39,104	
D1303_03 Dresser Couplings					
D1303_03 1 Dresser Couplings for Pipe	12.00 EA	38,407	9,602	48,009	4000.73
TOTAL Dresser Couplings		38,407	9,602	48,009	
D1303_04 Mob. Demob. & Preparatory cost					
D1303_04 1 Mob. Demob. & Preparatory cost		15,961	3,990	19,951	
TOTAL Mob. Demob. & Preparatory cost		15,961	3,990	19,951	
TOTAL Cinque Hommes Pump Station		405,709	101,427	507,137	
D1304 Bois Brule Pump Station					
D1304_01 Pump Station					
D1304_01 1 Pump Station - 41 cfs		960,054	240,014	1,200,068	
TOTAL Pump Station		960,054	240,014	1,200,068	
D1304_02 Mob. Demob. & Preparatory cost					
D1304_02 1 Mob. Demob. & Preparatory cost		21,601	5,400	27,002	
TOTAL Mob. Demob. & Preparatory cost		21,601	5,400	27,002	
TOTAL Bois Brule Pump Station		981,656	245,414	1,227,070	
TOTAL Pumping Plant		3,476,613	869,153	4,345,766	
D30 Planning, Engineering and Design					
D3001 Planning, Engineering and Design					

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D3001_01 Engineering - ED-DC Civil Design					
D3001_01 1 Plans/Specification&Gen.Drawings		50,000	0	50,000	
D3001_01 2 Engineering During Construction		8,000	0	8,000	
TOTAL Engineering - ED-DC Civil Design		58,000	0	58,000	
D3001_02 Engineering - ED-GF Geotech					
D3001_02 1 Plans & Specifications		45,000	0	45,000	
D3001_02 2 Engineering During Construction		15,000	0	15,000	
TOTAL Engineering - ED-GF Geotech		60,000	0	60,000	
D3001_03 Engineering - ED-HE Hydrologic					
D3001_03 1 Plans & Specifications		10,000	0	10,000	
D3001_03 2 Engineering During Construction		5,000	0	5,000	
TOTAL Engineering - ED-HE Hydrologic		15,000	0	15,000	
D3001_04 Engineering - ED-C Cost Estimate					
D3001_04 1 Plans & Specs. Bid Opening		20,000	0	20,000	
D3001_04 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-C Cost Estimate		30,000	0	30,000	
D3001_05 Engineering - ED-DA Structures					
D3001_05 1 Plans & Specifications,Drawings		235,000	0	235,000	
D3001_05 4 Engineering During Construction		9,000	0	9,000	
TOTAL Engineering - ED-DA Structures		244,000	0	244,000	
D3001_06 Engineering - ED-DM Mechanical					
D3001_06 1 Modifiy Pump Discharge Pipes		18,000	0	18,000	
D3001_06 2 Engineering During Const.-Pipes		16,000	0	16,000	
D3001_06 3 Pump Station Design-4 each		172,000	0	172,000	
D3001_06 4 Eng during Const-4 Pump Stations		77,000	0	77,000	
TOTAL Engineering - ED-DM Mechanical		283,000	0	283,000	
D3001_07 Engineering - ED-DM Electrical					

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
D3001_07 1 Plans & Specification-4 Stations		40,000	0	40,000	
TOTAL Engineering - ED-DM Electrical		40,000	0	40,000	
D3001_08 Value Engineering					
D3001_08 1 Value Engineering-Pump Stations		40,000	0	40,000	
TOTAL Value Engineering		40,000	0	40,000	
D3001_09 Project Management					
D3001_09 1 Plans & Specifications		10,000	0	10,000	
D3001_09 2 Engineering During Construction		5,000	0	5,000	
TOTAL Project Management		15,000	0	15,000	
D3001_10 CT-Contracts					
D3001_10 1 Plans & Specifications		10,000	0	10,000	
D3001_10 2 Engineering During Construction		5,000	0	5,000	
TOTAL CT-Contracts		15,000	0	15,000	
D3001_11 CO-C, AND CO-F					
D3001_11 1 Plans & Specifications		20,000	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	20,000	
TOTAL Planning, Engineering and Design		820,000	0	820,000	
TOTAL Planning, Engineering and Design		820,000	0	820,000	
D31 Supervision and Administration					
D3123 Construction Contracts					
D3123_11 Supervision and Administration					
D3123_1101 Supervision and Administration		435,000	0	435,000	
TOTAL Supervision and Administration		435,000	0	435,000	
TOTAL Construction Contracts		435,000	0	435,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Supervision and Administration			435,000	0	435,000	
TOTAL PUMP STATIONS Contract			4,731,613	869,153	5,600,766	
E RAILROAD CLOSURE Contract						
E11 Levees						
E1101 North Railroad Closure-Replace						
E1101_01 Mob, Demob & Preparatory Work						
E1101_0101 Mobilization and Demobilization			60,003	15,001	75,004	
TOTAL Mob, Demob & Preparatory Work			60,003	15,001	75,004	
E1101_02 Site Work						
E1101_0201 Clearing, Grubbing and Stripping			14,735	3,684	18,419	
E1101_0202 Structural Excavation	1131.00	CY	4,340	1,085	5,425	4.80
E1101_0203 Structural Backfill	779.00	CY	2,607	652	3,258	4.18
E1101_0204 Bedding Material	1700.00	TON	27,239	6,810	34,049	20.03
E1101_0205 Riprap	3500.00	TON	76,879	19,220	96,099	27.46
E1101_0206 Establishment of Turf			12,448	3,112	15,560	
E1101_0207 Demolition of Existing Closure			14,991	3,748	18,739	
TOTAL Site Work			153,240	38,310	191,550	
E1101_03 Closure Structure-Pile Founded						
E1101_0301 Concrete Formwork			46,191	11,548	57,738	
E1101_0302 Concrete Reinforcing Steel	50.40	TON	64,126	16,031	80,157	1590.43
E1101_0303 Concrete-Cast in Place	480.00	CY	117,332	29,333	146,665	305.55
E1101_0305 HP14 Pile Points	58.00	EA	10,154	2,538	12,692	218.83
E1101_0306 PZ27 Steel Sheet Pile	8813.00	SF	229,186	57,297	286,483	32.51
E1101_0307 Steel H Pile, HP14x73-58 x42.75'	2480.00	LF	98,881	24,720	123,602	49.84
E1101_0308 Swing Gate & J-Seals	7.23	TON	58,715	14,679	73,393	10151
E1101_0309 Miscellaneous Embedded Metals	0.60	TON	4,762	1,191	5,953	9921.59
E1101_0310 Painting	1460.00	SF	4,392	1,098	5,490	3.76
TOTAL Closure Structure-Pile Founded			633,739	158,435	792,173	
E1101_04 Traffic Control						
E1101_0401 Flagmen	2.00	EA	3,113	778	3,892	1945.80

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Traffic Control		3,113	778	3,892	
TOTAL North Railroad Closure-Replace		850,095	212,524	1,062,619	
TOTAL Levees		850,095	212,524	1,062,619	
E30 Planning, Engineering and Design					
E3001 Planning, Engineering and Design					
E3001_01 Engineering - ED-DC Civil Design					
E3001_01 1 Plans/Specification&Gen.Drawings		60,000	0	60,000	
E3001_01 2 Engineering During Construction		15,000	0	15,000	
TOTAL Engineering - ED-DC Civil Design		75,000	0	75,000	
E3001_02 Engineering - ED-GF Geotech					
E3001_02 1 Plans & Specifications		55,000	0	55,000	
E3001_02 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-GF Geotech		65,000	0	65,000	
E3001_03 Engineering - ED-HE Hydrologic					
E3001_03 1 Plans & Specifications		10,000	0	10,000	
E3001_03 2 Engineering During Construction		5,000	0	5,000	
TOTAL Engineering - ED-HE Hydrologic		15,000	0	15,000	
E3001_04 Engineering - ED-C Cost Estimate					
E3001_04 1 Plans & Specs. Bid Opening		20,000	0	20,000	
E3001_04 2 Engineering During Construction		5,000	0	5,000	
TOTAL Engineering - ED-C Cost Estimate		25,000	0	25,000	
E3001_05 Engineering - ED-DA Structures					
E3001_05 1 Plans & Specifications		165,000	0	165,000	
E3001_05 2 Engineering During Construction		10,000	0	10,000	
TOTAL Engineering - ED-DA Structures		175,000	0	175,000	

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
E3001_06 Project Management					
E3001_06 1 Plans & Specifications		30,000	0	30,000	
E3001_06 2 Engineering During Construction		15,000	0	15,000	
TOTAL Project Management		45,000	0	45,000	
E3001_07 CT-Contracts					
E3001_07 1 Plans & Specifications		15,000	0	15,000	
E3001_07 2 Engineering During Construction		10,000	0	10,000	
TOTAL CT-Contracts		25,000	0	25,000	
E3001_08 CO-C, AND CO-F					
E3001_08 1 Plans & Specifications		20,000	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	20,000	
TOTAL Planning, Engineering and Design		445,000	0	445,000	
TOTAL Planning, Engineering and Design		445,000	0	445,000	
E31 Supervision and Administration					
E3123 Construction Contracts					
E3123_11 Supervision and Administration					
E3123_1101 Supervision and Administration		106,000	0	106,000	
TOTAL Supervision and Administration		106,000	0	106,000	
TOTAL Construction Contracts		106,000	0	106,000	
TOTAL Supervision and Administration		106,000	0	106,000	
TOTAL RAILROAD CLOSURE Contract		1,401,095	212,524	1,613,619	
F NON FEDERAL COSTS					
F01 Lands and Damages					
F0102 Acquisition Costs					
F0102_01 Levee Raise - Acquisition Costs					

** PROJECT OWNER SUMMARY - Level 6 **

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
F0102_0102	Permanent Easements						
F0102_0102 A	Berms-Stability & Seepage	32.81	AC	57,418	14,354	71,772	2187.50
F0102_0102 B	Pump Station	4.00	AC	7,000	1,750	8,750	2187.50
F0102_0102 C	Railroad Closure	9.60	AC	16,800	4,200	21,000	2187.50
F0102_0102 D	Drainage Ditch	34.20	AC	59,850	14,963	74,813	2187.50
TOTAL	Permanent Easements			141,068	35,267	176,334	
F0102_0103	Temporary Easements						
F0102_0103 A	Berms-Stability & Seepage	74.80	AC	13,090	3,273	16,363	218.75
F0102_0103 B	Pump Station	4.00	AC	700	175	875	218.75
F0102_0103 C	Railroad Closure	40.70	AC	7,123	1,781	8,903	218.75
F0102_0103 D	Borrow Area - "A"	186.40	AC	293,580	73,395	366,975	1968.75
F0102_0103 E	Borrow Area - "B"	260.30	AC	234,270	58,568	292,838	1125.00
F0102_0103 F	Relief Wells	17.00	AC	2,975	744	3,719	218.75
F0102_0103 G	Drainage Ditch	31.81	AC	5,567	1,392	6,958	218.75
F0102_0103 H	Roads	38.50	AC	6,738	1,684	8,422	218.75
TOTAL	Temporary Easements			564,042	141,010	705,052	
F0102_0104	Severance Damages						
F0102_0104 A	Severance Damages - 10%			70,511	17,628	88,139	
TOTAL	Severance Damages			70,511	17,628	88,139	
F0102_0105	Acquisition Costs-Ownerships-102						
F0102_0105 A	Planning	102.00	EA	153,000	0	153,000	1500.00
F0102_0105 B	Acquisition	102.00	EA	561,000	0	561,000	5500.00
F0102_0105 C	Appraisal	102.00	EA	102,000	0	102,000	1000.00
TOTAL	Acquisition Costs-Ownerships-102			816,000	0	816,000	
F0102_0107	PL 91-646 Relocation Assistance						
F0102_0107 A	Title III Payments-Basic Project	102.00	EA	51,000	0	51,000	500.00
TOTAL	PL 91-646 Relocation Assistance			51,000	0	51,000	
TOTAL	Levee Raise - Acquisition Costs			1,642,620	193,905	1,836,525	
F0102_02	Induced Flooding-AcquisitionCost						

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
F0102_0202 Permanent Easements						
F0102_0202 E Flowage (Induced Flooding)-A	436.00	AC	109,000	27,250	136,250	312.50
F0102_0202 F Flowage (Induced Flooding)-B	4.00	AC	2,500	625	3,125	781.25
TOTAL Permanent Easements			111,500	27,875	139,375	
F0102_0204 Severance Damages						
F0102_0204 A Severance Damages - 10%			11,150	2,788	13,938	
TOTAL Severance Damages			11,150	2,788	13,938	
F0102_0206 Acquisition-Induced Flooding-216						
F0102_0206 A Induced Flooding-216 Tracts	216.00	EA	1,728,000	0	1,728,000	8000.00
TOTAL Acquisition-Induced Flooding-216			1,728,000	0	1,728,000	
F0102_0207 PL 91-646 Relocation Assistance						
F0102_0207 B Induced Flooding	216.00	EA	108,000	0	108,000	500.00
TOTAL PL 91-646 Relocation Assistance			108,000	0	108,000	
TOTAL Induced Flooding-AcquisitionCost			1,958,650	30,663	1,989,313	
F0102_03 Environmental Mitigation Lands						
F0102_0301 Environmental Mitigation-						
F0102_0301 A Environmental Mitigation-			538,000	0	538,000	
TOTAL Environmental Mitigation-			538,000	0	538,000	
TOTAL Environmental Mitigation Lands			538,000	0	538,000	
TOTAL Acquisition Costs			4,139,270	224,568	4,363,838	
TOTAL Lands and Damages			4,139,270	224,568	4,363,838	
F02 Relocations						
F0201 Embankment & Ditching						
F0201_01 Utilities						

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
F0201_0101 Electric Utility		52,600	7,890	60,490	
TOTAL Utilities		52,600	7,890	60,490	
F0201_02 Pipeline					
F0201_0201 Pipeline Crossing Extension		44,800	6,720	51,520	
TOTAL Pipeline		44,800	6,720	51,520	
TOTAL Embankment & Ditching		97,400	14,610	112,010	
F0202 North Railroad Closure Relocatio					
F0202_01 Railroad Relocation - SHOO-FLY					
F0202_0101 Railroad Relocation - SHOO-FLY		230,017	46,003	276,020	
TOTAL Railroad Relocation - SHOO-FLY		230,017	46,003	276,020	
F0202_02 BNSF cost for SHOO-FLY Relocatio					
F0202_0201 BNSF cost for SHOO-FLY Relocatio		70,000	14,000	84,000	
TOTAL BNSF cost for SHOO-FLY Relocatio		70,000	14,000	84,000	
TOTAL North Railroad Closure Relocatio		300,017	60,003	360,020	
TOTAL Relocations		397,417	74,613	472,030	
F30 Planning, Engineering, & Design					
F3001 Planning, Engineering, & Design					
F3001_01 Planning, Engineering, & Design					
F3001_0101 Relocations		65,000	0	65,000	
TOTAL Planning, Engineering, & Design		65,000	0	65,000	
TOTAL Planning, Engineering, & Design		65,000	0	65,000	
TOTAL Planning, Engineering, & Design		65,000	0	65,000	
F31 Supervision and Administration					

** PROJECT OWNER SUMMARY - Level 6 **

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
F3101 Supervision and Administration					
F3101_01 Supervision and Administration					
F3101_0101 Relocation-Embankment, Ditching		11,000	0	11,000	
F3101_0102 Relocations for Railroad Closure		36,000	0	36,000	
TOTAL Supervision and Administration		47,000	0	47,000	
TOTAL Supervision and Administration		47,000	0	47,000	
TOTAL Supervision and Administration		47,000	0	47,000	
TOTAL NON FEDERAL COSTS		4,648,687	299,181	4,947,868	
G FEDERAL COSTS-PART OF 30 ACCOUNT					
G30 Planning, Engineering & Design					
G3001 Planning, Engineering & Design					
G3001_01 Combined Design Deficiency		2,414,000	0	2,414,000	
TOTAL Planning, Engineering & Design		2,414,000	0	2,414,000	
TOTAL Planning, Engineering & Design		2,414,000	0	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT		2,414,000	0	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00 EA	39,664,750	6,911,197	46,575,94746575947	

** PROJECT INDIRECT SUMMARY - Level 1 **

		QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A	RELIEF WELLS # 1 Contract		2,096,119	88,172	84,565	138,517	9,480	2,416,852	
B	RELIEF WELLS # 2 Contract		10,833,313	497,547	477,193	781,642	53,495	12,643,191	
C	EMBANKMENT & DITCHING Contract		9,851,985	428,119	410,605	672,571	46,031	11,409,311	
D	PUMP STATIONS Contract		4,152,013	159,336	152,817	250,315	17,131	4,731,613	
E	RAILROAD CLOSURE Contract		1,259,373	38,960	37,367	61,207	4,189	1,401,095	
F	NON FEDERAL COSTS		4,610,340	10,542	10,111	16,561	1,133	4,648,687	
G	FEDERAL COSTS-PART OF 30 ACCOUNT		2,414,000	0	0	0	0	2,414,000	
	BOIS BRULE-100 YEAR LEVEL OF	1.00 EA	35,217,144	1,222,676	1,172,657	1,920,813	131,460	39,664,75039664750	
	Contingency							6,911,197	
	TOTAL INCL OWNER COSTS							46,575,947	

** PROJECT INDIRECT SUMMARY - Level 2 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract								
A11 Levees		1,603,119	88,172	84,565	138,517	9,480	1,923,852	
A30 Planning, Engineering and Design		252,000	0	0	0	0	252,000	
A31 Supervision and Administration		241,000	0	0	0	0	241,000	
TOTAL RELIEF WELLS # 1 Contract		2,096,119	88,172	84,565	138,517	9,480	2,416,852	
B RELIEF WELLS # 2 Contract								
B11 Levees		9,046,313	497,547	477,193	781,642	53,495	10,856,191	
B30 Planning, Engineering and Design		430,000	0	0	0	0	430,000	
B31 Supervision and Administration		1,357,000	0	0	0	0	1,357,000	
TOTAL RELIEF WELLS # 2 Contract		10,833,313	497,547	477,193	781,642	53,495	12,643,191	
C EMBANKMENT & DITCHING Contract								
C11 Levees		7,783,985	428,119	410,605	672,571	46,031	9,341,311	
C30 Planning, Engineering and Design		900,000	0	0	0	0	900,000	
C31 Supervision and Administration		1,168,000	0	0	0	0	1,168,000	
TOTAL EMBANKMENT & DITCHING Contract		9,851,985	428,119	410,605	672,571	46,031	11,409,311	
D PUMP STATIONS Contract								
D13 Pumping Plant		2,897,013	159,336	152,817	250,315	17,131	3,476,613	
D30 Planning, Engineering and Design		820,000	0	0	0	0	820,000	
D31 Supervision and Administration		435,000	0	0	0	0	435,000	
TOTAL PUMP STATIONS Contract		4,152,013	159,336	152,817	250,315	17,131	4,731,613	
E RAILROAD CLOSURE Contract								
E11 Levees		708,373	38,960	37,367	61,207	4,189	850,095	
E30 Planning, Engineering and Design		445,000	0	0	0	0	445,000	
E31 Supervision and Administration		106,000	0	0	0	0	106,000	
TOTAL RAILROAD CLOSURE Contract		1,259,373	38,960	37,367	61,207	4,189	1,401,095	
F NON FEDERAL COSTS								
F01 Lands and Damages		4,139,270	0	0	0	0	4,139,270	
F02 Relocations		359,070	10,542	10,111	16,561	1,133	397,417	
F30 Planning, Engineering, & Design		65,000	0	0	0	0	65,000	

** PROJECT INDIRECT SUMMARY - Level 2 **

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
F31 Supervision and Administration			47,000	0	0	0	0	47,000	
TOTAL NON FEDERAL COSTS			4,610,340	10,542	10,111	16,561	1,133	4,648,687	
G FEDERAL COSTS-PART OF 30 ACCOUNT									
G30 Planning, Engineering & Design			2,414,000	0	0	0	0	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			2,414,000	0	0	0	0	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00	EA	35,217,144	1,222,676	1,172,657	1,920,813	131,460	39,664,750	39664750
Contingency								6,911,197	
TOTAL INCL OWNER COSTS								46,575,947	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract								
A11 Levees								
A1101 Relief Wells								
A1101_02 Mob, Demob & Preparatory Work								
A1101_02 1 Mobilization and Demobilizatio		76,060	4,183	4,012	6,572	450	91,277	
TOTAL Mob, Demob & Preparatory Wo		76,060	4,183	4,012	6,572	450	91,277	
A1101_99 Associated Levee Items								
A1101_99 1 Relief Wells, Welled Reaches-7	74.00 EA	1,510,207	83,061	79,663	130,489	8,931	1,812,351	24491
A1101_99 2 Seeding	14.80 ACR	16,852	927	889	1,456	100	20,223	1366.45
TOTAL Associated Levee Items		1,527,059	83,988	80,552	131,945	9,030	1,832,575	
TOTAL Relief Wells	74.00 EA	1,603,119	88,172	84,565	138,517	9,480	1,923,852	25998
TOTAL Levees		1,603,119	88,172	84,565	138,517	9,480	1,923,852	
A30 Planning, Engineering and Design								
A3001 Planning, Engineering and Design								
A3001_01 Engineering - ED-DC Civil Design								
A3001_01 1 Plans/Specification&Gen.Drawin		60,000	0	0	0	0	60,000	
A3001_01 2 Engineering During Constructio		39,000	0	0	0	0	39,000	
TOTAL Engineering - ED-DC Civil D		99,000	0	0	0	0	99,000	
A3001_02 Engineering - ED-GF Geotech								
A3001_02 1 Plans & Specifications		65,000	0	0	0	0	65,000	
A3001_02 2 Engineering During Constructio		40,000	0	0	0	0	40,000	
TOTAL Engineering - ED-GF Geotech		105,000	0	0	0	0	105,000	
A3001_03 Engineering - ED-HE Hydrologic								
A3001_03 1 Plans & Specifications		5,000	0	0	0	0	5,000	
A3001_03 2 Engineering During Constructio		3,500	0	0	0	0	3,500	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrolo		8,500	0	0	0	0	8,500	
A3001_04 Engineering - ED-C Cost Estimate								
A3001_04 1 Plans & Specs. Bid Opening		11,000	0	0	0	0	11,000	
A3001_04 2 Engineering During Constructio		500	0	0	0	0	500	
TOTAL Engineering - ED-C Cost Est		11,500	0	0	0	0	11,500	
A3001_05 Project Management								
A3001_05 1 Plans & Specifications		6,000	0	0	0	0	6,000	
A3001_05 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Project Management		11,000	0	0	0	0	11,000	
A3001_06 CT-Contracts								
A3001_06 1 Plans & Specifications		5,000	0	0	0	0	5,000	
A3001_06 2 Engineering During Constructio		2,000	0	0	0	0	2,000	
TOTAL CT-Contracts		7,000	0	0	0	0	7,000	
A3001_07 CO-C, AND CO-F								
A3001_07 1 Plans & Specifications		10,000	0	0	0	0	10,000	
TOTAL CO-C, AND CO-F		10,000	0	0	0	0	10,000	
TOTAL Planning, Engineering and D		252,000	0	0	0	0	252,000	
TOTAL Planning, Engineering and D		252,000	0	0	0	0	252,000	
A31 Supervision and Administration								
A3123 Construction Contracts								
A3123_11 Supervision and Administration								
A3123_1101 Supervision and Administration		241,000	0	0	0	0	241,000	
TOTAL Supervision and Administrat		241,000	0	0	0	0	241,000	
TOTAL Construction Contracts		241,000	0	0	0	0	241,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Supervision and Administrat		241,000	0	0	0	0	241,000	
TOTAL RELIEF WELLS # 1 Contract		2,096,119	88,172	84,565	138,517	9,480	2,416,852	
B RELIEF WELLS # 2 Contract								
B11 Levees								
B1101 Relief Wells								
B1101_02 Mob, Demob & Preparatory Work								
B1101_02 1 Mobilization and Demobilizatio		434,000	23,870	22,894	37,500	2,566	520,830	
TOTAL Mob, Demob & Preparatory Wo		434,000	23,870	22,894	37,500	2,566	520,830	
B1101_99 Associated Levee Items								
B1101_99 1 Relief Wells for 7 hot spot ar	62.00 EA	1,265,309	69,592	66,745	109,328	7,482	1,518,456	24491
B1101_99 2 Relief Wells, Welled Reaches	98.00 EA	2,000,004	110,000	105,500	172,809	11,827	2,400,141	24491
B1101_99 3 Relief Wells, Non-Welled Reach	254.00 EA	5,176,064	284,683	273,037	447,235	30,609	6,211,628	24455
B1101_99 4 Modify Existing Relief Wells	5.00 EA	20,000	1,100	1,055	1,728	118	24,001	4800.27
B1101_99 5 Seeding	82.80 ACR	94,280	5,185	4,973	8,146	558	113,142	1366.45
TOTAL Associated Levee Items		8,555,656	470,561	451,311	739,247	50,594	10,267,369	
TOTAL Relief Wells	414.00 EA	8,989,656	494,431	474,204	776,747	53,160	10,788,198	26058
B1102 Piezometers								
B1102_01 Piezometers								
B1102_01 1 Piezometers	68.00 EA	56,658	3,116	2,989	4,895	335	67,993	999.90
TOTAL Piezometers	68.00 EA	56,658	3,116	2,989	4,895	335	67,993	999.90
TOTAL Piezometers	68.00 EA	56,658	3,116	2,989	4,895	335	67,993	999.90
TOTAL Levees		9,046,313	497,547	477,193	781,642	53,495	10,856,191	
B30 Planning, Engineering and Design								
B3001 Planning, Engineering and Design								
B3001_01 Engineering - ED-DC Civil Design								
B3001_01 1 Plans/Specification&Gen.Drawin		80,000	0	0	0	0	80,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
B3001_01 2 Engineering During Constructio		60,000	0	0	0	0	60,000	
TOTAL Engineering - ED-DC Civil D		140,000	0	0	0	0	140,000	
B3001_02 Engineering - ED-GF Geotech								
B3001_02 1 Plans & Specifications		85,000	0	0	0	0	85,000	
B3001_02 2 Engineering During Constructio		80,000	0	0	0	0	80,000	
TOTAL Engineering - ED-GF Geotech		165,000	0	0	0	0	165,000	
B3001_03 Engineering - ED-HE Hydrologic								
B3001_03 1 Plans & Specifications		10,000	0	0	0	0	10,000	
B3001_03 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-HE Hydrolo		20,000	0	0	0	0	20,000	
B3001_04 Engineering - ED-C Cost Estimate								
B3001_04 1 Plans & Specs. Bid Opening		16,000	0	0	0	0	16,000	
B3001_04 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-C Cost Est		26,000	0	0	0	0	26,000	
B3001_05 Project Management								
B3001_05 1 Plans & Specifications		11,000	0	0	0	0	11,000	
B3001_05 2 Engineering During Constructio		25,000	0	0	0	0	25,000	
TOTAL Project Management		36,000	0	0	0	0	36,000	
B3001_06 CT-Contracts								
B3001_06 1 Plans & Specifications		10,000	0	0	0	0	10,000	
B3001_06 2 Engineering During Constructio		15,000	0	0	0	0	15,000	
TOTAL CT-Contracts		25,000	0	0	0	0	25,000	
B3001_07 CO-C, AND CO-F								
B3001_07 1 Plans & Specifications		18,000	0	0	0	0	18,000	
TOTAL CO-C, AND CO-F		18,000	0	0	0	0	18,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Planning, Engineering and D		430,000	0	0	0	0	430,000	
TOTAL Planning, Engineering and D		430,000	0	0	0	0	430,000	
B31 Supervision and Administration								
B3123 Construction Contracts								
B3123_11 Supervision and Administration								
B3123_1101 Supervision and Administration		1,357,000	0	0	0	0	1,357,000	
TOTAL Supervision and Administrat		1,357,000	0	0	0	0	1,357,000	
TOTAL Construction Contracts		1,357,000	0	0	0	0	1,357,000	
TOTAL Supervision and Administrat		1,357,000	0	0	0	0	1,357,000	
TOTAL RELIEF WELLS # 2 Contract		10,833,313	497,547	477,193	781,642	53,495	12,643,191	
C EMBANKMENT & DITCHING Contract								
C11 Levees								
C1101 Levee Raise and Seepage Berms								
C1101_02 Mob, Demob & Preparatory Work								
C1101_02 1 Mobilization and Demobilizatio		200,000	11,000	10,550	17,281	1,183	240,014	
TOTAL Mob, Demob & Preparatory Wo		200,000	11,000	10,550	17,281	1,183	240,014	
C1101_04 Permanent Access Road								
C1101_04 1 Road on Levee Crown		1,257,740	69,176	66,346	108,674	7,438	1,509,373	
TOTAL Permanent Access Road		1,257,740	69,176	66,346	108,674	7,438	1,509,373	
C1101_99 Associated Levee Items								
C1101_99 1 Embankment In Place	1257200 CY	4,419,938	243,097	233,152	381,903	26,137	5,304,226	4.22
C1101_99 2 Embankment - Variable Freeboar	200000 CY	703,140	38,673	37,091	60,754	4,158	843,816	4.22
C1101_99 3 Landside Seepage Berms-Perviou	145000 CY	509,777	28,038	26,891	44,047	3,015	611,766	4.22
C1101_99 4 Gravity Drain Extenstions		17,800	979	939	1,538	105	21,361	
C1101_99 5 Establishment of Turf	363.00 ACR	372,906	20,510	19,671	32,221	2,205	447,512	1232.82

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Associated Levee Items			6,023,560	331,296	317,743	520,463	35,620	7,228,682	
TOTAL Levee Raise and Seepage Ber			7,481,300	411,472	394,639	646,418	44,241	8,978,069	
C1102 Drainage Ditching									
C1102_01 Jones Cutoff Drainage Area									
C1102_01 1 Ditch Excavation	16644	CY	59,571	3,276	3,142	5,147	352	71,489	4.30
C1102_01 2 Establishment of Turf	20.00	ACR	20,546	1,130	1,084	1,775	121	24,656	1232.82
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	5,078	279	268	439	30	6,093	72.54
TOTAL Jones Cutoff Drainage Area			85,194	4,686	4,494	7,361	504	102,238	
C1102_02 Cinque Holmes Drainage Area									
C1102_02 1 Ditch Excavation	16528	CY	59,155	3,254	3,120	5,111	350	70,990	4.30
C1102_02 2 Establishment of Turf	20.00	ACR	20,546	1,130	1,084	1,775	121	24,656	1232.82
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	5,078	279	268	439	30	6,093	72.54
TOTAL Cinque Holmes Drainage Area			84,779	4,663	4,472	7,325	501	101,740	
C1102_03 Bois Brule Drainage Area									
C1102_03 1 Ditch Excavation	20720	CY	74,159	4,079	3,912	6,408	439	88,996	4.30
C1102_03 2 Establishment of Turf	25.00	ACR	25,682	1,413	1,355	2,219	152	30,820	1232.82
C1102_03 3 36" Dia. Corrugated Metal Pipe	126.00	LF	7,616	419	402	658	45	9,140	72.54
TOTAL Bois Brule Drainage Area			107,458	5,910	5,668	9,285	635	128,956	
TOTAL Drainage Ditching			277,430	15,259	14,634	23,971	1,641	332,935	
C1103 Highway 51 Closure Structure									
C1103_02 Demolish High. 51 Closure Struct									
C1103_02 1 Remove Reinforced Concrete Str	105.00	CY	22,050	1,213	1,163	1,905	130	26,461	252.01
C1103_02 2 Excavation	50.00	CY	200	11	11	17	1	240	4.80
C1103_02 3 Backfill to Grade	150.00	CY	1,005	55	53	87	6	1,206	8.04
C1103_02 4 Disposal of Steel Panels			2,000	110	106	173	12	2,400	
TOTAL Demolish High. 51 Closure S			25,255	1,389	1,332	2,182	149	30,308	
TOTAL Highway 51 Closure Structur			25,255	1,389	1,332	2,182	149	30,308	
TOTAL Levees			7,783,985	428,119	410,605	672,571	46,031	9,341,311	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
C30 Planning, Engineering and Design								
C3001 Planning, Engineering and Design								
C3001_01 Engineering - ED-DC Civil Design								
C3001_01 1 Plans/Specification&Gen.Drawin		300,000	0	0	0	0	300,000	
C3001_01 2 Engineering During Constructio		215,000	0	0	0	0	215,000	
TOTAL Engineering - ED-DC Civil D		515,000	0	0	0	0	515,000	
C3001_02 Engineering - ED-GF Geotech								
C3001_02 1 Plans & Specifications		120,000	0	0	0	0	120,000	
C3001_02 2 Engineering During Constructio		110,000	0	0	0	0	110,000	
TOTAL Engineering - ED-GF Geotech		230,000	0	0	0	0	230,000	
C3001_03 Engineering - ED-HE Hydrologic								
C3001_03 1 Plans & Specifications		15,000	0	0	0	0	15,000	
C3001_03 2 Engineering During Constructio		20,000	0	0	0	0	20,000	
TOTAL Engineering - ED-HE Hydrolo		35,000	0	0	0	0	35,000	
C3001_04 Engineering - ED-C Cost Estimate								
C3001_04 1 Plans & Specs. Bid Opening		20,000	0	0	0	0	20,000	
C3001_04 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-C Cost Est		30,000	0	0	0	0	30,000	
C3001_05 Project Management								
C3001_05 1 Plans & Specifications		10,000	0	0	0	0	10,000	
C3001_05 2 Engineering During Constructio		25,000	0	0	0	0	25,000	
TOTAL Project Management		35,000	0	0	0	0	35,000	
C3001_06 CT-Contracts								
C3001_06 1 Plans & Specifications		15,000	0	0	0	0	15,000	
C3001_06 2 Engineering During Constructio		20,000	0	0	0	0	20,000	
TOTAL CT-Contracts		35,000	0	0	0	0	35,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
C3001_07 CO-C, AND CO-F								
C3001_07 1 Plans & Specifications		20,000	0	0	0	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	0	0	0	20,000	
TOTAL Planning, Engineering and D		900,000	0	0	0	0	900,000	
TOTAL Planning, Engineering and D		900,000	0	0	0	0	900,000	
C31 Supervision and Administration								
C3123 Construction Contracts								
C3123_11 Supervision and Administration								
C3123_1101 Supervision and Administration		1,168,000	0	0	0	0	1,168,000	
TOTAL Supervision and Administrat		1,168,000	0	0	0	0	1,168,000	
TOTAL Construction Contracts		1,168,000	0	0	0	0	1,168,000	
TOTAL Supervision and Administrat		1,168,000	0	0	0	0	1,168,000	
TOTAL EMBANKMENT & DITCHING Contr		9,851,985	428,119	410,605	672,571	46,031	11,409,311	
D PUMP STATIONS Contract								
D13 Pumping Plant								
D1301 Missouri Chute Pump Station								
D1301_01 Pump Station								
D1301_01 1 Pump Station - 48 cfs		800,000	44,000	42,200	69,124	4,731	960,054	
TOTAL Pump Station		800,000	44,000	42,200	69,124	4,731	960,054	
D1301_02 Raise Discharge Pipe								
D1301_02 1 Raise Discharge Pipe-36" Dia	248.00 LF	16,534	909	872	1,429	98	19,842	80.01
TOTAL Raise Discharge Pipe		16,534	909	872	1,429	98	19,842	
D1301_03 Dresser Couplings								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D1301_03 1 Dresser Couplings for Pipe	6.00 EA	16,002	880	844	1,383	95	19,203	3200.58
TOTAL Dresser Couplings		16,002	880	844	1,383	95	19,203	
D1301_04 Mob . Demob & Preparatory								
D1301_0401 Mob . Demob & Preparatory		25,000	1,375	1,319	2,160	148	30,002	
TOTAL Mob . Demob & Preparatory		25,000	1,375	1,319	2,160	148	30,002	
TOTAL Missouri Chute Pump Station		857,536	47,164	45,235	74,095	5,071	1,029,102	
D1302 Jones Cutoff Pump Station								
D1302_01 Pump Station								
D1302_01 1 Pump Station - 57 cfs		800,000	44,000	42,200	69,124	4,731	960,054	
TOTAL Pump Station		800,000	44,000	42,200	69,124	4,731	960,054	
D1302_02 Raise Discharge Pipe								
D1302_02 1 Raise Discharge Pipe-36" Dia	396.00 LF	26,401	1,452	1,393	2,281	156	31,683	80.01
TOTAL Raise Discharge Pipe		26,401	1,452	1,393	2,281	156	31,683	
D1302_03 Dresser Couplings								
D1302_03 1 Dresser Couplings for Pipe	12.00 EA	32,004	1,760	1,688	2,765	189	38,407	3200.58
TOTAL Dresser Couplings		32,004	1,760	1,688	2,765	189	38,407	
D1302_04 Mob. Demob. & Preparatory cost								
D1302_04 1 Mob. Demob. & Preparatory cost		25,000	1,375	1,319	2,160	148	30,002	
TOTAL Mob. Demob. & Preparatory c		25,000	1,375	1,319	2,160	148	30,002	
TOTAL Jones Cutoff Pump Station		883,405	48,587	46,600	76,330	5,224	1,060,146	
D1303 Cinque Hommes Pump Station								
D1303_01 Pump Station								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D1303_01 1 Pump Station - 16 cfs		266,700	14,669	14,068	23,044	1,577	320,058	
TOTAL Pump Station		266,700	14,669	14,068	23,044	1,577	320,058	
D1303_02 Raise Discharge Pipe								
D1303_02 1 Raise Discharge Pipe-36" Dia	391.00 LF	26,068	1,434	1,375	2,252	154	31,283	80.01
TOTAL Raise Discharge Pipe		26,068	1,434	1,375	2,252	154	31,283	
D1303_03 Dresser Couplings								
D1303_03 1 Dresser Couplings for Pipe	12.00 EA	32,004	1,760	1,688	2,765	189	38,407	3200.58
TOTAL Dresser Couplings		32,004	1,760	1,688	2,765	189	38,407	
D1303_04 Mob. Demob. & Preparatory cost								
D1303_04 1 Mob. Demob. & Preparatory cost		13,300	732	702	1,149	79	15,961	
TOTAL Mob. Demob. & Preparatory c		13,300	732	702	1,149	79	15,961	
TOTAL Cinque Hommes Pump Station		338,072	18,594	17,833	29,211	1,999	405,709	
D1304 Bois Brule Pump Station								
D1304_01 Pump Station								
D1304_01 1 Pump Station - 41 cfs		800,000	44,000	42,200	69,124	4,731	960,054	
TOTAL Pump Station		800,000	44,000	42,200	69,124	4,731	960,054	
D1304_02 Mob. Demob. & Preparatory cost								
D1304_02 1 Mob. Demob. & Preparatory cost		18,000	990	950	1,555	106	21,601	
TOTAL Mob. Demob. & Preparatory c		18,000	990	950	1,555	106	21,601	
TOTAL Bois Brule Pump Station		818,000	44,990	43,150	70,679	4,837	981,656	
TOTAL Pumping Plant		2,897,013	159,336	152,817	250,315	17,131	3,476,613	
D30 Planning, Engineering and Design								
D3001 Planning, Engineering and Design								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D3001_01 Engineering - ED-DC Civil Design								
D3001_01 1 Plans/Specification&Gen.Drawin		50,000	0	0	0	0	50,000	
D3001_01 2 Engineering During Constructio		8,000	0	0	0	0	8,000	
TOTAL Engineering - ED-DC Civil D		58,000	0	0	0	0	58,000	
D3001_02 Engineering - ED-GF Geotech								
D3001_02 1 Plans & Specifications		45,000	0	0	0	0	45,000	
D3001_02 2 Engineering During Constructio		15,000	0	0	0	0	15,000	
TOTAL Engineering - ED-GF Geotech		60,000	0	0	0	0	60,000	
D3001_03 Engineering - ED-HE Hydrologic								
D3001_03 1 Plans & Specifications		10,000	0	0	0	0	10,000	
D3001_03 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Engineering - ED-HE Hydrolo		15,000	0	0	0	0	15,000	
D3001_04 Engineering - ED-C Cost Estimate								
D3001_04 1 Plans & Specs. Bid Opening		20,000	0	0	0	0	20,000	
D3001_04 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-C Cost Est		30,000	0	0	0	0	30,000	
D3001_05 Engineering - ED-DA Structures								
D3001_05 1 Plans & Specifications,Drawing		235,000	0	0	0	0	235,000	
D3001_05 4 Engineering During Constructio		9,000	0	0	0	0	9,000	
TOTAL Engineering - ED-DA Structu		244,000	0	0	0	0	244,000	
D3001_06 Engineering - ED-DM Mechanical								
D3001_06 1 Modifiy Pump Discharge Pipes		18,000	0	0	0	0	18,000	
D3001_06 2 Engineering During Const.-Pipe		16,000	0	0	0	0	16,000	
D3001_06 3 Pump Station Design-4 each		172,000	0	0	0	0	172,000	
D3001_06 4 Eng during Const-4 Pump Statio		77,000	0	0	0	0	77,000	
TOTAL Engineering - ED-DM Mechani		283,000	0	0	0	0	283,000	
D3001_07 Engineering - ED-DM Electrical								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
D3001_07 1 Plans & Specification-4 Statio		40,000	0	0	0	0	40,000	
TOTAL Engineering - ED-DM Electri		40,000	0	0	0	0	40,000	
D3001_08 Value Engineering								
D3001_08 1 Value Engineering-Pump Station		40,000	0	0	0	0	40,000	
TOTAL Value Engineering		40,000	0	0	0	0	40,000	
D3001_09 Project Management								
D3001_09 1 Plans & Specifications		10,000	0	0	0	0	10,000	
D3001_09 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Project Management		15,000	0	0	0	0	15,000	
D3001_10 CT-Contracts								
D3001_10 1 Plans & Specifications		10,000	0	0	0	0	10,000	
D3001_10 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL CT-Contracts		15,000	0	0	0	0	15,000	
D3001_11 CO-C, AND CO-F								
D3001_11 1 Plans & Specifications		20,000	0	0	0	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	0	0	0	20,000	
TOTAL Planning, Engineering and D		820,000	0	0	0	0	820,000	
TOTAL Planning, Engineering and D		820,000	0	0	0	0	820,000	
D31 Supervision and Administration								
D3123 Construction Contracts								
D3123_11 Supervision and Administration								
D3123_1101 Supervision and Administration		435,000	0	0	0	0	435,000	
TOTAL Supervision and Administrat		435,000	0	0	0	0	435,000	
TOTAL Construction Contracts		435,000	0	0	0	0	435,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Supervision and Administrat		435,000	0	0	0	0	435,000	
TOTAL PUMP STATIONS Contract		4,152,013	159,336	152,817	250,315	17,131	4,731,613	
E RAILROAD CLOSURE Contract								
E11 Levees								
E1101 North Railroad Closure-Replace								
E1101_01 Mob, Demob & Preparatory Work								
E1101_0101 Mobilization and Demobilizatio		50,000	2,750	2,638	4,320	296	60,003	
TOTAL Mob, Demob & Preparatory Wo		50,000	2,750	2,638	4,320	296	60,003	
E1101_02 Site Work								
E1101_0201 Clearing, Grubbing and Strippi		12,279	675	648	1,061	73	14,735	
E1101_0202 Structural Excavation	1131.00 CY	3,617	199	191	313	21	4,340	3.84
E1101_0203 Structural Backfill	779.00 CY	2,172	119	115	188	13	2,607	3.35
E1101_0204 Bedding Material	1700.00 TON	22,698	1,248	1,197	1,961	134	27,239	16.02
E1101_0205 Riprap	3500.00 TON	64,062	3,523	3,379	5,535	379	76,879	21.97
E1101_0206 Establishment of Turf		10,373	571	547	896	61	12,448	
E1101_0207 Demolition of Existing Closure		12,492	687	659	1,079	74	14,991	
TOTAL Site Work		127,693	7,023	6,736	11,033	755	153,240	
E1101_03 Closure Structure-Pile Founded								
E1101_0301 Concrete Formwork		38,490	2,117	2,030	3,326	228	46,191	
E1101_0302 Concrete Reinforcing Steel	50.40 TON	53,435	2,939	2,819	4,617	316	64,126	1272.34
E1101_0303 Concrete-Cast in Place	480.00 CY	97,771	5,377	5,157	8,448	578	117,332	244.44
E1101_0305 HP14 Pile Points	58.00 EA	8,461	465	446	731	50	10,154	175.07
E1101_0306 PZ27 Steel Sheet Pile	8813.00 SF	190,978	10,504	10,074	16,501	1,129	229,186	26.01
E1101_0307 Steel H Pile, HP14x73-58 x42.7	2480.00 LF	82,397	4,532	4,346	7,119	487	98,881	39.87
E1101_0308 Swing Gate & J-Seals	7.23 TON	48,926	2,691	2,581	4,227	289	58,715	8120.95
E1101_0309 Miscellaneous Embedded Metals	0.60 TON	3,968	218	209	343	23	4,762	7937.27
E1101_0310 Painting	1460.00 SF	3,660	201	193	316	22	4,392	3.01
TOTAL Closure Structure-Pile Foun		528,086	29,045	27,857	45,629	3,123	633,739	
E1101_04 Traffic Control								
E1101_0401 Flagmen	2.00 EA	2,594	143	137	224	15	3,113	1556.64

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
TOTAL Traffic Control		2,594	143	137	224	15	3,113	
TOTAL North Railroad Closure-Repl		708,373	38,960	37,367	61,207	4,189	850,095	
TOTAL Levees		708,373	38,960	37,367	61,207	4,189	850,095	
E30 Planning, Engineering and Design								
E3001 Planning, Engineering and Design								
E3001_01 Engineering - ED-DC Civil Design								
E3001_01 1 Plans/Specification&Gen.Drawin		60,000	0	0	0	0	60,000	
E3001_01 2 Engineering During Constructio		15,000	0	0	0	0	15,000	
TOTAL Engineering - ED-DC Civil D		75,000	0	0	0	0	75,000	
E3001_02 Engineering - ED-GF Geotech								
E3001_02 1 Plans & Specifications		55,000	0	0	0	0	55,000	
E3001_02 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-GF Geotech		65,000	0	0	0	0	65,000	
E3001_03 Engineering - ED-HE Hydrologic								
E3001_03 1 Plans & Specifications		10,000	0	0	0	0	10,000	
E3001_03 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Engineering - ED-HE Hydrolo		15,000	0	0	0	0	15,000	
E3001_04 Engineering - ED-C Cost Estimate								
E3001_04 1 Plans & Specs. Bid Opening		20,000	0	0	0	0	20,000	
E3001_04 2 Engineering During Constructio		5,000	0	0	0	0	5,000	
TOTAL Engineering - ED-C Cost Est		25,000	0	0	0	0	25,000	
E3001_05 Engineering - ED-DA Structures								
E3001_05 1 Plans & Specifications		165,000	0	0	0	0	165,000	
E3001_05 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL Engineering - ED-DA Structu		175,000	0	0	0	0	175,000	

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
E3001_06 Project Management								
E3001_06 1 Plans & Specifications		30,000	0	0	0	0	30,000	
E3001_06 2 Engineering During Constructio		15,000	0	0	0	0	15,000	
TOTAL Project Management		45,000	0	0	0	0	45,000	
E3001_07 CT-Contracts								
E3001_07 1 Plans & Specifications		15,000	0	0	0	0	15,000	
E3001_07 2 Engineering During Constructio		10,000	0	0	0	0	10,000	
TOTAL CT-Contracts		25,000	0	0	0	0	25,000	
E3001_08 CO-C, AND CO-F								
E3001_08 1 Plans & Specifications		20,000	0	0	0	0	20,000	
TOTAL CO-C, AND CO-F		20,000	0	0	0	0	20,000	
TOTAL Planning, Engineering and D		445,000	0	0	0	0	445,000	
TOTAL Planning, Engineering and D		445,000	0	0	0	0	445,000	
E31 Supervision and Administration								
E3123 Construction Contracts								
E3123_11 Supervision and Administration								
E3123_1101 Supervision and Administration		106,000	0	0	0	0	106,000	
TOTAL Supervision and Administrat		106,000	0	0	0	0	106,000	
TOTAL Construction Contracts		106,000	0	0	0	0	106,000	
TOTAL Supervision and Administrat		106,000	0	0	0	0	106,000	
TOTAL RAILROAD CLOSURE Contract		1,259,373	38,960	37,367	61,207	4,189	1,401,095	
F NON FEDERAL COSTS								
F01 Lands and Damages								
F0102 Acquisition Costs								
F0102_01 Levee Raise - Acquisition Costs								

** PROJECT INDIRECT SUMMARY - Level 6 **

		QUANTY	UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
F0102_0102	Permanent Easements									
F0102_0102 A	Berms-Stability & Seepage	32.81	AC	57,418	0	0	0	0	57,418	1750.00
F0102_0102 B	Pump Station	4.00	AC	7,000	0	0	0	0	7,000	1750.00
F0102_0102 C	Railroad Closure	9.60	AC	16,800	0	0	0	0	16,800	1750.00
F0102_0102 D	Drainage Ditch	34.20	AC	59,850	0	0	0	0	59,850	1750.00
TOTAL	Permanent Easements			141,068	0	0	0	0	141,068	
F0102_0103	Temporary Easements									
F0102_0103 A	Berms-Stability & Seepage	74.80	AC	13,090	0	0	0	0	13,090	175.00
F0102_0103 B	Pump Station	4.00	AC	700	0	0	0	0	700	175.00
F0102_0103 C	Railroad Closure	40.70	AC	7,123	0	0	0	0	7,123	175.00
F0102_0103 D	Borrow Area - "A"	186.40	AC	293,580	0	0	0	0	293,580	1575.00
F0102_0103 E	Borrow Area - "B"	260.30	AC	234,270	0	0	0	0	234,270	900.00
F0102_0103 F	Relief Wells	17.00	AC	2,975	0	0	0	0	2,975	175.00
F0102_0103 G	Drainage Ditch	31.81	AC	5,567	0	0	0	0	5,567	175.00
F0102_0103 H	Roads	38.50	AC	6,738	0	0	0	0	6,738	175.00
TOTAL	Temporary Easements			564,042	0	0	0	0	564,042	
F0102_0104	Severance Damages									
F0102_0104 A	Severance Damages - 10%			70,511	0	0	0	0	70,511	
TOTAL	Severance Damages			70,511	0	0	0	0	70,511	
F0102_0105	Acquisition Costs-Ownerships-1									
F0102_0105 A	Planning	102.00	EA	153,000	0	0	0	0	153,000	1500.00
F0102_0105 B	Acquisition	102.00	EA	561,000	0	0	0	0	561,000	5500.00
F0102_0105 C	Appraisal	102.00	EA	102,000	0	0	0	0	102,000	1000.00
TOTAL	Acquisition Costs-Ownership			816,000	0	0	0	0	816,000	
F0102_0107	PL 91-646 Relocation Assistanc									
F0102_0107 A	Title III Payments-Basic Pr	102.00	EA	51,000	0	0	0	0	51,000	500.00
TOTAL	PL 91-646 Relocation Assist			51,000	0	0	0	0	51,000	
TOTAL	Levee Raise - Acquisition C			1,642,620	0	0	0	0	1,642,620	
F0102_02	Induced Flooding-AcquisitionCost									

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
F0102_0202 Permanent Easements								
F0102_0202 E Flowage (Induced Flooding)-	436.00 AC	109,000	0	0	0	0	109,000	250.00
F0102_0202 F Flowage (Induced Flooding)-	4.00 AC	2,500	0	0	0	0	2,500	625.00
TOTAL Permanent Easements		111,500	0	0	0	0	111,500	
F0102_0204 Severance Damages								
F0102_0204 A Severance Damages - 10%		11,150	0	0	0	0	11,150	
TOTAL Severance Damages		11,150	0	0	0	0	11,150	
F0102_0206 Acquisition-Induced Flooding-2								
F0102_0206 A Induced Flooding-216 Tracts	216.00 EA	1,728,000	0	0	0	0	1,728,000	8000.00
TOTAL Acquisition-Induced Floodin		1,728,000	0	0	0	0	1,728,000	
F0102_0207 PL 91-646 Relocation Assistanc								
F0102_0207 B Induced Flooding	216.00 EA	108,000	0	0	0	0	108,000	500.00
TOTAL PL 91-646 Relocation Assist		108,000	0	0	0	0	108,000	
TOTAL Induced Flooding-Acquisitio		1,958,650	0	0	0	0	1,958,650	
F0102_03 Environmental Mitigation Lands								
F0102_0301 Environmental Mitigation-								
F0102_0301 A Environmental Mitigation-		538,000	0	0	0	0	538,000	
TOTAL Environmental Mitigation-		538,000	0	0	0	0	538,000	
TOTAL Environmental Mitigation La		538,000	0	0	0	0	538,000	
TOTAL Acquisition Costs		4,139,270	0	0	0	0	4,139,270	
TOTAL Lands and Damages		4,139,270	0	0	0	0	4,139,270	
F02 Relocations								
F0201 Embankment & Ditching								
F0201_01 Utilities								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
F0201_0101 Electric Utility		52,600	0	0	0	0	52,600	
TOTAL Utilities		52,600	0	0	0	0	52,600	
F0201_02 Pipeline								
F0201_0201 Pipeline Crossing Extension		44,800	0	0	0	0	44,800	
TOTAL Pipeline		44,800	0	0	0	0	44,800	
TOTAL Embankment & Ditching		97,400	0	0	0	0	97,400	
F0202 North Railroad Closure Relocatio								
F0202_01 Railroad Relocation - SHOO-FLY								
F0202_0101 Railroad Relocation - SHOO-FLY		191,670	10,542	10,111	16,561	1,133	230,017	
TOTAL Railroad Relocation - SHOO-		191,670	10,542	10,111	16,561	1,133	230,017	
F0202_02 BNSF cost for SHOO-FLY Relocatio								
F0202_0201 BNSF cost for SHOO-FLY Relocat		70,000	0	0	0	0	70,000	
TOTAL BNSF cost for SHOO-FLY Relo		70,000	0	0	0	0	70,000	
TOTAL North Railroad Closure Relo		261,670	10,542	10,111	16,561	1,133	300,017	
TOTAL Relocations		359,070	10,542	10,111	16,561	1,133	397,417	
F30 Planning, Engineering, & Design								
F3001 Planning, Engineering, & Design								
F3001_01 Planning, Engineering, & Design								
F3001_0101 Relocations		65,000	0	0	0	0	65,000	
TOTAL Planning, Engineering, & De		65,000	0	0	0	0	65,000	
TOTAL Planning, Engineering, & De		65,000	0	0	0	0	65,000	
TOTAL Planning, Engineering, & De		65,000	0	0	0	0	65,000	
F31 Supervision and Administration								

** PROJECT INDIRECT SUMMARY - Level 6 **

	QUANTY UOM	DIRECT	FOOH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
F3101 Supervision and Administration								
F3101_01 Supervision and Administration								
F3101_0101 Relocation-Embankment, Ditchin		11,000	0	0	0	0	11,000	
F3101_0102 Relocations for Railroad Closu		36,000	0	0	0	0	36,000	
TOTAL Supervision and Administrat		47,000	0	0	0	0	47,000	
TOTAL Supervision and Administrat		47,000	0	0	0	0	47,000	
TOTAL Supervision and Administrat		47,000	0	0	0	0	47,000	
TOTAL NON FEDERAL COSTS		4,610,340	10,542	10,111	16,561	1,133	4,648,687	
G FEDERAL COSTS-PART OF 30 ACCOUNT								
G30 Planning, Engineering & Design								
G3001 Planning, Engineering & Design								
G3001_01 Combined Design Deficiency		2,414,000	0	0	0	0	2,414,000	
TOTAL Planning, Engineering & Des		2,414,000	0	0	0	0	2,414,000	
TOTAL Planning, Engineering & Des		2,414,000	0	0	0	0	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 AC		2,414,000	0	0	0	0	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL O	1.00 EA	35,217,144	1,222,676	1,172,657	1,920,813	131,460	39,664,75	039664750
Contingency							6,911,197	
TOTAL INCL OWNER COSTS							46,575,947	

** PROJECT DIRECT SUMMARY - Level 1 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract			127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract			747,487	664,896	874,710	8,546,220	10,833,313	
C EMBANKMENT & DITCHING Contract			2734247	4080474	726,210	2,311,055	9,851,985	
D PUMP STATIONS Contract			0	0	0	4,152,013	4,152,013	
E RAILROAD CLOSURE Contract			160,144	39,512	206,951	852,766	1,259,373	
F NON FEDERAL COSTS			0	0	0	4,610,340	4,610,340	
G FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	2,414,000	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00	EA	3769224	4903729	1,961,716	24,582,475	35,217,1	4435217144

Field Office Overhead	1,222,676
SUBTOTAL	36,439,820
Home Office Overhead	1,172,657
SUBTOTAL	37,612,477
Profit	1,920,813
SUBTOTAL	39,533,290
Bond	131,460
TOTAL INCL INDIRECTS	39,664,750
Contingency	6,911,197
TOTAL INCL OWNER COSTS	46,575,947

** PROJECT DIRECT SUMMARY - Level 2 **

	QUANTY UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract							
A11 Levees		127,347	118,846	153,846	1,203,080	1,603,119	
A30 Planning, Engineering and Design		0	0	0	252,000	252,000	
A31 Supervision and Administration		0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract		127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract							
B11 Levees		747,487	664,896	874,710	6,759,220	9,046,313	
B30 Planning, Engineering and Design		0	0	0	430,000	430,000	
B31 Supervision and Administration		0	0	0	1,357,000	1,357,000	
TOTAL RELIEF WELLS # 2 Contract		747,487	664,896	874,710	8,546,220	10,833,313	
C EMBANKMENT & DITCHING Contract							
C11 Levees		2734247	4080474	726,210	243,055	7,783,985	
C30 Planning, Engineering and Design		0	0	0	900,000	900,000	
C31 Supervision and Administration		0	0	0	1,168,000	1,168,000	
TOTAL EMBANKMENT & DITCHING Contract		2734247	4080474	726,210	2,311,055	9,851,985	
D PUMP STATIONS Contract							
D13 Pumping Plant		0	0	0	2,897,013	2,897,013	
D30 Planning, Engineering and Design		0	0	0	820,000	820,000	
D31 Supervision and Administration		0	0	0	435,000	435,000	
TOTAL PUMP STATIONS Contract		0	0	0	4,152,013	4,152,013	
E RAILROAD CLOSURE Contract							
E11 Levees		160,144	39,512	206,951	301,766	708,373	
E30 Planning, Engineering and Design		0	0	0	445,000	445,000	
E31 Supervision and Administration		0	0	0	106,000	106,000	
TOTAL RAILROAD CLOSURE Contract		160,144	39,512	206,951	852,766	1,259,373	
F NON FEDERAL COSTS							
F01 Lands and Damages		0	0	0	4,139,270	4,139,270	
F02 Relocations		0	0	0	359,070	359,070	
F30 Planning, Engineering, & Design		0	0	0	65,000	65,000	

** PROJECT DIRECT SUMMARY - Level 2 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F31 Supervision and Administration			0	0	0	47,000	47,000	
TOTAL NON FEDERAL COSTS			0	0	0	4,610,340	4,610,340	
G FEDERAL COSTS-PART OF 30 ACCOUNT								
G30 Planning, Engineering & Design			0	0	0	2,414,000	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	2,414,000	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00	EA	3769224	4903729	1,961,716	24,582,475	35,217,14435217144	
Field Office Overhead							1,222,676	
SUBTOTAL							36,439,820	
Home Office Overhead							1,172,657	
SUBTOTAL							37,612,477	
Profit							1,920,813	
SUBTOTAL							39,533,290	
Bond							131,460	
TOTAL INCL INDIRECTS							39,664,750	
Contingency							6,911,197	
TOTAL INCL OWNER COSTS							46,575,947	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A RELIEF WELLS # 1 Contract								
A11 Levees								
A1101 Relief Wells								
A1101_02 Mob, Demob & Preparatory Work								
A1101_02 1 Mobilization and Demobilization			0	0	0	76,060	76,060	
TOTAL Mob, Demob & Preparatory Work			0	0	0	76,060	76,060	
A1101_99 Associated Levee Items								
A1101_99 1 Relief Wells, Welled Reaches-74	74.00	EA	123,973	117,504	141,710	1,127,020	1,510,207	20408
A1101_99 2 Seeding	14.80	ACR	3,374	1,342	12,136	0	16,852	1138.65
TOTAL Associated Levee Items			127,347	118,846	153,846	1,127,020	1,527,059	
TOTAL Relief Wells	74.00	EA	127,347	118,846	153,846	1,203,080	1,603,119	21664
TOTAL Levees			127,347	118,846	153,846	1,203,080	1,603,119	
A30 Planning, Engineering and Design								
A3001 Planning, Engineering and Design								
A3001_01 Engineering - ED-DC Civil Design								
A3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	60,000	60,000	
A3001_01 2 Engineering During Construction			0	0	0	39,000	39,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	99,000	99,000	
A3001_02 Engineering - ED-GF Geotech								
A3001_02 1 Plans & Specifications			0	0	0	65,000	65,000	
A3001_02 2 Engineering During Construction			0	0	0	40,000	40,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	105,000	105,000	
A3001_03 Engineering - ED-HE Hydrologic								
A3001_03 1 Plans & Specifications			0	0	0	5,000	5,000	
A3001_03 2 Engineering During Construction			0	0	0	3,500	3,500	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Engineering - ED-HE Hydrologic			0	0	0	8,500	8,500	
A3001_04 Engineering - ED-C Cost Estimate								
A3001_04 1 Plans & Specs. Bid Opening			0	0	0	11,000	11,000	
A3001_04 2 Engineering During Construction			0	0	0	500	500	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	11,500	11,500	
A3001_05 Project Management								
A3001_05 1 Plans & Specifications			0	0	0	6,000	6,000	
A3001_05 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL Project Management			0	0	0	11,000	11,000	
A3001_06 CT-Contracts								
A3001_06 1 Plans & Specifications			0	0	0	5,000	5,000	
A3001_06 2 Engineering During Construction			0	0	0	2,000	2,000	
TOTAL CT-Contracts			0	0	0	7,000	7,000	
A3001_07 CO-C, AND CO-F								
A3001_07 1 Plans & Specifications			0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F			0	0	0	10,000	10,000	
TOTAL Planning, Engineering and Design			0	0	0	252,000	252,000	
TOTAL Planning, Engineering and Design			0	0	0	252,000	252,000	
A31 Supervision and Administration								
A3123 Construction Contracts								
A3123_11 Supervision and Administration								
A3123_1101 Supervision and Administration			0	0	0	241,000	241,000	
TOTAL Supervision and Administration			0	0	0	241,000	241,000	
TOTAL Construction Contracts			0	0	0	241,000	241,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Supervision and Administration			0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract			127,347	118,846	153,846	1,696,080	2,096,119	
B RELIEF WELLS # 2 Contract								
B11 Levees								
B1101 Relief Wells								
B1101_02 Mob, Demob & Preparatory Work								
B1101_02 1 Mobilization and Demobilization			0	0	0	434,000	434,000	
TOTAL Mob, Demob & Preparatory Work			0	0	0	434,000	434,000	
B1101_99 Associated Levee Items								
B1101_99 1 Relief Wells for 7 hot spot area	62.00	EA	103,869	98,449	118,730	944,260	1,265,309	20408
B1101_99 2 Relief Wells, Welled Reaches	98.00	EA	164,181	155,613	187,670	1,492,540	2,000,004	20408
B1101_99 3 Relief Wells, Non-Welled Reaches	254.00	EA	425,530	403,324	478,790	3,868,420	5,176,064	20378
B1101_99 4 Modify Existing Relief Wells	5.00	EA	0	0	0	20,000	20,000	4000.00
B1101_99 5 Seeding	82.80	ACR	18,874	7,510	67,896	0	94,280	1138.65
TOTAL Associated Levee Items			712,453	664,896	853,086	6,325,220	8,555,656	
TOTAL Relief Wells	414.00	EA	712,453	664,896	853,086	6,759,220	8,989,656	21714
B1102 Piezometers								
B1102_01 Piezometers								
B1102_01 1 Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA	35,034	0	21,624	0	56,658	833.20
TOTAL Levees			747,487	664,896	874,710	6,759,220	9,046,313	
B30 Planning, Engineering and Design								
B3001 Planning, Engineering and Design								
B3001_01 Engineering - ED-DC Civil Design								
B3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	80,000	80,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B3001_01 2 Engineering During Construction			0	0	0	60,000	60,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	140,000	140,000	
B3001_02 Engineering - ED-GF Geotech								
B3001_02 1 Plans & Specifications			0	0	0	85,000	85,000	
B3001_02 2 Engineering During Construction			0	0	0	80,000	80,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	165,000	165,000	
B3001_03 Engineering - ED-HE Hydrologic								
B3001_03 1 Plans & Specifications			0	0	0	10,000	10,000	
B3001_03 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	20,000	20,000	
B3001_04 Engineering - ED-C Cost Estimate								
B3001_04 1 Plans & Specs. Bid Opening			0	0	0	16,000	16,000	
B3001_04 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	26,000	26,000	
B3001_05 Project Management								
B3001_05 1 Plans & Specifications			0	0	0	11,000	11,000	
B3001_05 2 Engineering During Construction			0	0	0	25,000	25,000	
TOTAL Project Management			0	0	0	36,000	36,000	
B3001_06 CT-Contracts								
B3001_06 1 Plans & Specifications			0	0	0	10,000	10,000	
B3001_06 2 Engineering During Construction			0	0	0	15,000	15,000	
TOTAL CT-Contracts			0	0	0	25,000	25,000	
B3001_07 CO-C, AND CO-F								
B3001_07 1 Plans & Specifications			0	0	0	18,000	18,000	
TOTAL CO-C, AND CO-F			0	0	0	18,000	18,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Planning, Engineering and Design			0	0	0	430,000	430,000	
TOTAL Planning, Engineering and Design			0	0	0	430,000	430,000	
B31 Supervision and Administration								
B3123 Construction Contracts								
B3123_11 Supervision and Administration								
B3123_1101 Supervision and Administration			0	0	0	1,357,000	1,357,000	
TOTAL Supervision and Administration			0	0	0	1,357,000	1,357,000	
TOTAL Construction Contracts			0	0	0	1,357,000	1,357,000	
TOTAL Supervision and Administration			0	0	0	1,357,000	1,357,000	
TOTAL RELIEF WELLS # 2 Contract			747,487	664,896	874,710	8,546,220	10,833,313	
C EMBANKMENT & DITCHING Contract								
C11 Levees								
C1101 Levee Raise and Seepage Berms								
C1101_02 Mob, Demob & Preparatory Work								
C1101_02 1 Mobilization and Demobilization			0	0	0	200,000	200,000	
TOTAL Mob, Demob & Preparatory Work			0	0	0	200,000	200,000	
C1101_04 Permanent Access Road								
C1101_04 1 Road on Levee Crown			507,992	372,947	376,800	0	1,257,740	
TOTAL Permanent Access Road			507,992	372,947	376,800	0	1,257,740	
C1101_99 Associated Levee Items								
C1101_99 1 Embankment In Place	1257200	CY	1630211	2789727	0	0	4,419,938	3.52
C1101_99 2 Embankment - Variable Freeboard	200000	CY	259,340	443,800	0	0	703,140	3.52
C1101_99 3 Landside Seepage Berms-Pervious	145000	CY	188,022	321,755	0	0	509,777	3.52
C1101_99 4 Gravity Drain Extenstions			0	0	0	17,800	17,800	
C1101_99 5 Establishment of Turf	363.00	ACR	61,617	24,519	286,770	0	372,906	1027.29

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Associated Levee Items			2139190	3579800	286,770	17,800	6,023,560	
TOTAL Levee Raise and Seepage Berms			2647182	3952748	663,570	217,800	7,481,300	
C1102 Drainage Ditching								
C1102_01 Jones Cutoff Drainage Area								
C1102_01 1 Ditch Excavation	16644	CY	21,972	37,599	0	0	59,571	3.58
C1102_01 2 Establishment of Turf	20.00	ACR	3,395	1,351	15,800	0	20,546	1027.29
C1102_01 3 36" Dia. Corrugated Metal Pipe	84.00	LF	1,397	455	3,226	0	5,078	60.45
TOTAL Jones Cutoff Drainage Area			26,763	39,405	19,026	0	85,194	
C1102_02 Cinque Holmes Drainage Area								
C1102_02 1 Ditch Excavation	16528	CY	21,819	37,337	0	0	59,155	3.58
C1102_02 2 Establishment of Turf	20.00	ACR	3,395	1,351	15,800	0	20,546	1027.29
C1102_02 3 36" Dia. Corrugated Metal Pipe	84.00	LF	1,397	455	3,226	0	5,078	60.45
TOTAL Cinque Holmes Drainage Area			26,610	39,143	19,026	0	84,779	
C1102_03 Bois Brule Drainage Area								
C1102_03 1 Ditch Excavation	20720	CY	27,352	46,806	0	0	74,159	3.58
C1102_03 2 Establishment of Turf	25.00	ACR	4,244	1,689	19,750	0	25,682	1027.29
C1102_03 3 36" Dia. Corrugated Metal Pipe	126.00	LF	2,095	683	4,838	0	7,616	60.45
TOTAL Bois Brule Drainage Area			33,691	49,178	24,588	0	107,458	
TOTAL Drainage Ditching			87,064	127,726	62,640	0	277,430	
C1103 Highway 51 Closure Structure								
C1103_02 Demolish High. 51 Closure Struct								
C1103_02 1 Remove Reinforced Concrete Struc	105.00	CY	0	0	0	22,050	22,050	210.00
C1103_02 2 Excavation	50.00	CY	0	0	0	200	200	4.00
C1103_02 3 Backfill to Grade	150.00	CY	0	0	0	1,005	1,005	6.70
C1103_02 4 Disposal of Steel Panels			0	0	0	2,000	2,000	
TOTAL Demolish High. 51 Closure Struct			0	0	0	25,255	25,255	
TOTAL Highway 51 Closure Structure			0	0	0	25,255	25,255	
TOTAL Levees			2734247	4080474	726,210	243,055	7,783,985	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C30 Planning, Engineering and Design								
C3001 Planning, Engineering and Design								
C3001_01 Engineering - ED-DC Civil Design								
C3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	300,000	300,000	
C3001_01 2 Engineering During Construction			0	0	0	215,000	215,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	515,000	515,000	
C3001_02 Engineering - ED-GF Geotech								
C3001_02 1 Plans & Specifications			0	0	0	120,000	120,000	
C3001_02 2 Engineering During Construction			0	0	0	110,000	110,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	230,000	230,000	
C3001_03 Engineering - ED-HE Hydrologic								
C3001_03 1 Plans & Specifications			0	0	0	15,000	15,000	
C3001_03 2 Engineering During Construction			0	0	0	20,000	20,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	35,000	35,000	
C3001_04 Engineering - ED-C Cost Estimate								
C3001_04 1 Plans & Specs. Bid Opening			0	0	0	20,000	20,000	
C3001_04 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	30,000	30,000	
C3001_05 Project Management								
C3001_05 1 Plans & Specifications			0	0	0	10,000	10,000	
C3001_05 2 Engineering During Construction			0	0	0	25,000	25,000	
TOTAL Project Management			0	0	0	35,000	35,000	
C3001_06 CT-Contracts								
C3001_06 1 Plans & Specifications			0	0	0	15,000	15,000	
C3001_06 2 Engineering During Construction			0	0	0	20,000	20,000	
TOTAL CT-Contracts			0	0	0	35,000	35,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C3001_07 CO-C, AND CO-F								
C3001_07 1 Plans & Specifications			0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F			0	0	0	20,000	20,000	
TOTAL Planning, Engineering and Design			0	0	0	900,000	900,000	
TOTAL Planning, Engineering and Design			0	0	0	900,000	900,000	
C31 Supervision and Administration								
C3123 Construction Contracts								
C3123_11 Supervision and Administration								
C3123_1101 Supervision and Administration			0	0	0	1,168,000	1,168,000	
TOTAL Supervision and Administration			0	0	0	1,168,000	1,168,000	
TOTAL Construction Contracts			0	0	0	1,168,000	1,168,000	
TOTAL Supervision and Administration			0	0	0	1,168,000	1,168,000	
TOTAL EMBANKMENT & DITCHING Contract			2734247	4080474	726,210	2,311,055	9,851,985	
D PUMP STATIONS Contract								
D13 Pumping Plant								
D1301 Missouri Chute Pump Station								
D1301_01 Pump Station								
D1301_01 1 Pump Station - 48 cfs			0	0	0	800,000	800,000	
TOTAL Pump Station			0	0	0	800,000	800,000	
D1301_02 Raise Discharge Pipe								
D1301_02 1 Raise Discharge Pipe-36" Dia	248.00	LF	0	0	0	16,534	16,534	66.67
TOTAL Raise Discharge Pipe			0	0	0	16,534	16,534	
D1301_03 Dresser Couplings								

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D1301_03 1 Dresser Couplings for Pipe	6.00 EA	0	0	0	16,002	16,002	2667.00
TOTAL Dresser Couplings		0	0	0	16,002	16,002	
D1301_04 Mob . Demob & Preparatory							
D1301_0401 Mob . Demob & Preparatory		0	0	0	25,000	25,000	
TOTAL Mob . Demob & Preparatory		0	0	0	25,000	25,000	
TOTAL Missouri Chute Pump Station		0	0	0	857,536	857,536	
D1302 Jones Cutoff Pump Station							
D1302_01 Pump Station							
D1302_01 1 Pump Station - 57 cfs		0	0	0	800,000	800,000	
TOTAL Pump Station		0	0	0	800,000	800,000	
D1302_02 Raise Discharge Pipe							
D1302_02 1 Raise Discharge Pipe-36" Dia	396.00 LF	0	0	0	26,401	26,401	66.67
TOTAL Raise Discharge Pipe		0	0	0	26,401	26,401	
D1302_03 Dresser Couplings							
D1302_03 1 Dresser Couplings for Pipe	12.00 EA	0	0	0	32,004	32,004	2667.00
TOTAL Dresser Couplings		0	0	0	32,004	32,004	
D1302_04 Mob. Demob. & Preparatory cost							
D1302_04 1 Mob. Demob. & Preparatory cost		0	0	0	25,000	25,000	
TOTAL Mob. Demob. & Preparatory cost		0	0	0	25,000	25,000	
TOTAL Jones Cutoff Pump Station		0	0	0	883,405	883,405	
D1303 Cinque Hommes Pump Station							
D1303_01 Pump Station							

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D1303_01 1 Pump Station - 16 cfs		0	0	0	266,700	266,700	
TOTAL Pump Station		0	0	0	266,700	266,700	
D1303_02 Raise Discharge Pipe							
D1303_02 1 Raise Discharge Pipe-36" Dia	391.00 LF	0	0	0	26,068	26,068	66.67
TOTAL Raise Discharge Pipe		0	0	0	26,068	26,068	
D1303_03 Dresser Couplings							
D1303_03 1 Dresser Couplings for Pipe	12.00 EA	0	0	0	32,004	32,004	2667.00
TOTAL Dresser Couplings		0	0	0	32,004	32,004	
D1303_04 Mob. Demob. & Preparatory cost							
D1303_04 1 Mob. Demob. & Preparatory cost		0	0	0	13,300	13,300	
TOTAL Mob. Demob. & Preparatory cost		0	0	0	13,300	13,300	
TOTAL Cinque Hommes Pump Station		0	0	0	338,072	338,072	
D1304 Bois Brule Pump Station							
D1304_01 Pump Station							
D1304_01 1 Pump Station - 41 cfs		0	0	0	800,000	800,000	
TOTAL Pump Station		0	0	0	800,000	800,000	
D1304_02 Mob. Demob. & Preparatory cost							
D1304_02 1 Mob. Demob. & Preparatory cost		0	0	0	18,000	18,000	
TOTAL Mob. Demob. & Preparatory cost		0	0	0	18,000	18,000	
TOTAL Bois Brule Pump Station		0	0	0	818,000	818,000	
TOTAL Pumping Plant		0	0	0	2,897,013	2,897,013	
D30 Planning, Engineering and Design							
D3001 Planning, Engineering and Design							

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_01 Engineering - ED-DC Civil Design								
D3001_01 1 Plans/Specification&Gen.Drawings			0	0	0	50,000	50,000	
D3001_01 2 Engineering During Construction			0	0	0	8,000	8,000	
TOTAL Engineering - ED-DC Civil Design			0	0	0	58,000	58,000	
D3001_02 Engineering - ED-GF Geotech								
D3001_02 1 Plans & Specifications			0	0	0	45,000	45,000	
D3001_02 2 Engineering During Construction			0	0	0	15,000	15,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	60,000	60,000	
D3001_03 Engineering - ED-HE Hydrologic								
D3001_03 1 Plans & Specifications			0	0	0	10,000	10,000	
D3001_03 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL Engineering - ED-HE Hydrologic			0	0	0	15,000	15,000	
D3001_04 Engineering - ED-C Cost Estimate								
D3001_04 1 Plans & Specs. Bid Opening			0	0	0	20,000	20,000	
D3001_04 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Estimate			0	0	0	30,000	30,000	
D3001_05 Engineering - ED-DA Structures								
D3001_05 1 Plans & Specifications,Drawings			0	0	0	235,000	235,000	
D3001_05 4 Engineering During Construction			0	0	0	9,000	9,000	
TOTAL Engineering - ED-DA Structures			0	0	0	244,000	244,000	
D3001_06 Engineering - ED-DM Mechanical								
D3001_06 1 Modifiy Pump Discharge Pipes			0	0	0	18,000	18,000	
D3001_06 2 Engineering During Const.-Pipes			0	0	0	16,000	16,000	
D3001_06 3 Pump Station Design-4 each			0	0	0	172,000	172,000	
D3001_06 4 Eng during Const-4 Pump Stations			0	0	0	77,000	77,000	
TOTAL Engineering - ED-DM Mechanical			0	0	0	283,000	283,000	
D3001_07 Engineering - ED-DM Electrical								

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_07 1 Plans & Specification-4 Stations			0	0	0	40,000	40,000	
TOTAL Engineering - ED-DM Electrical			0	0	0	40,000	40,000	
D3001_08 Value Engineering								
D3001_08 1 Value Engineering-Pump Stations			0	0	0	40,000	40,000	
TOTAL Value Engineering			0	0	0	40,000	40,000	
D3001_09 Project Management								
D3001_09 1 Plans & Specifications			0	0	0	10,000	10,000	
D3001_09 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL Project Management			0	0	0	15,000	15,000	
D3001_10 CT-Contracts								
D3001_10 1 Plans & Specifications			0	0	0	10,000	10,000	
D3001_10 2 Engineering During Construction			0	0	0	5,000	5,000	
TOTAL CT-Contracts			0	0	0	15,000	15,000	
D3001_11 CO-C, AND CO-F								
D3001_11 1 Plans & Specifications			0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F			0	0	0	20,000	20,000	
TOTAL Planning, Engineering and Design			0	0	0	820,000	820,000	
TOTAL Planning, Engineering and Design			0	0	0	820,000	820,000	
D31 Supervision and Administration								
D3123 Construction Contracts								
D3123_11 Supervision and Administration								
D3123_1101 Supervision and Administration			0	0	0	435,000	435,000	
TOTAL Supervision and Administration			0	0	0	435,000	435,000	
TOTAL Construction Contracts			0	0	0	435,000	435,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Supervision and Administration			0	0	0	435,000	435,000	
TOTAL PUMP STATIONS Contract			0	0	0	4,152,013	4,152,013	
E RAILROAD CLOSURE Contract								
E11 Levees								
E1101 North Railroad Closure-Replace								
E1101_01 Mob, Demob & Preparatory Work								
E1101_0101 Mobilization and Demobilization			0	0	0	50,000	50,000	
TOTAL Mob, Demob & Preparatory Work			0	0	0	50,000	50,000	
E1101_02 Site Work								
E1101_0201 Clearing, Grubbing and Stripping			8,565	3,714	0	0	12,279	
E1101_0202 Structural Excavation	1131.00	CY	1,659	1,957	0	0	3,617	3.20
E1101_0203 Structural Backfill	779.00	CY	845	1,327	0	0	2,172	2.79
E1101_0204 Bedding Material	1700.00	TON	9,168	6,730	6,800	0	22,698	13.35
E1101_0205 Riprap	3500.00	TON	32,819	9,368	21,875	0	64,062	18.30
E1101_0206 Establishment of Turf			1,697	675	8,000	0	10,373	
E1101_0207 Demolition of Existing Closure			0	0	0	12,492	12,492	
TOTAL Site Work			54,753	23,773	36,675	12,492	127,693	
E1101_03 Closure Structure-Pile Founded								
E1101_0301 Concrete Formwork			30,927	0	7,563	0	38,490	
E1101_0302 Concrete Reinforcing Steel	50.40	TON	25,211	0	28,224	0	53,435	1060.22
E1101_0303 Concrete-Cast in Place	480.00	CY	26,810	8,561	62,400	0	97,771	203.69
E1101_0305 HP14 Pile Points	58.00	EA	2,845	77	5,539	0	8,461	145.88
E1101_0306 PZ27 Steel Sheet Pile	8813.00	SF	0	0	0	190,978	190,978	21.67
E1101_0307 Steel H Pile, HP14x73-58 x42.75'	2480.00	LF	11,708	7,101	63,588	0	82,397	33.22
E1101_0308 Swing Gate & J-Seals	7.23	TON	94	0	536	48,296	48,926	6767.08
E1101_0309 Miscellaneous Embedded Metals	0.60	TON	2,802	0	1,166	0	3,968	6614.02
E1101_0310 Painting	1460.00	SF	2,400	0	1,260	0	3,660	2.51
TOTAL Closure Structure-Pile Founded			102,797	15,739	170,276	239,274	528,086	
E1101_04 Traffic Control								
E1101_0401 Flagmen	2.00	EA	2,594	0	0	0	2,594	1297.13

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Traffic Control		2,594	0	0	0	2,594	
TOTAL North Railroad Closure-Replace		160,144	39,512	206,951	301,766	708,373	
TOTAL Levees		160,144	39,512	206,951	301,766	708,373	
E30 Planning, Engineering and Design							
E3001 Planning, Engineering and Design							
E3001_01 Engineering - ED-DC Civil Design							
E3001_01 1 Plans/Specification&Gen.Drawings		0	0	0	60,000	60,000	
E3001_01 2 Engineering During Construction		0	0	0	15,000	15,000	
TOTAL Engineering - ED-DC Civil Design		0	0	0	75,000	75,000	
E3001_02 Engineering - ED-GF Geotech							
E3001_02 1 Plans & Specifications		0	0	0	55,000	55,000	
E3001_02 2 Engineering During Construction		0	0	0	10,000	10,000	
TOTAL Engineering - ED-GF Geotech		0	0	0	65,000	65,000	
E3001_03 Engineering - ED-HE Hydrologic							
E3001_03 1 Plans & Specifications		0	0	0	10,000	10,000	
E3001_03 2 Engineering During Construction		0	0	0	5,000	5,000	
TOTAL Engineering - ED-HE Hydrologic		0	0	0	15,000	15,000	
E3001_04 Engineering - ED-C Cost Estimate							
E3001_04 1 Plans & Specs. Bid Opening		0	0	0	20,000	20,000	
E3001_04 2 Engineering During Construction		0	0	0	5,000	5,000	
TOTAL Engineering - ED-C Cost Estimate		0	0	0	25,000	25,000	
E3001_05 Engineering - ED-DA Structures							
E3001_05 1 Plans & Specifications		0	0	0	165,000	165,000	
E3001_05 2 Engineering During Construction		0	0	0	10,000	10,000	
TOTAL Engineering - ED-DA Structures		0	0	0	175,000	175,000	

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E3001_06 Project Management								
E3001_06 1 Plans & Specifications			0	0	0	30,000	30,000	
E3001_06 2 Engineering During Construction			0	0	0	15,000	15,000	
TOTAL Project Management			0	0	0	45,000	45,000	
E3001_07 CT-Contracts								
E3001_07 1 Plans & Specifications			0	0	0	15,000	15,000	
E3001_07 2 Engineering During Construction			0	0	0	10,000	10,000	
TOTAL CT-Contracts			0	0	0	25,000	25,000	
E3001_08 CO-C, AND CO-F								
E3001_08 1 Plans & Specifications			0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F			0	0	0	20,000	20,000	
TOTAL Planning, Engineering and Design			0	0	0	445,000	445,000	
TOTAL Planning, Engineering and Design			0	0	0	445,000	445,000	
E31 Supervision and Administration								
E3123 Construction Contracts								
E3123_11 Supervision and Administration								
E3123_1101 Supervision and Administration			0	0	0	106,000	106,000	
TOTAL Supervision and Administration			0	0	0	106,000	106,000	
TOTAL Construction Contracts			0	0	0	106,000	106,000	
TOTAL Supervision and Administration			0	0	0	106,000	106,000	
TOTAL RAILROAD CLOSURE Contract			160,144	39,512	206,951	852,766	1,259,373	
F NON FEDERAL COSTS								
F01 Lands and Damages								
F0102 Acquisition Costs								
F0102_01 Levee Raise - Acquisition Costs								

** PROJECT DIRECT SUMMARY - Level 6 **

		QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0102_0102	Permanent Easements								
F0102_0102 A	Berms-Stability & Seepage	32.81	AC	0	0	0	57,418	57,418	1750.00
F0102_0102 B	Pump Station	4.00	AC	0	0	0	7,000	7,000	1750.00
F0102_0102 C	Railroad Closure	9.60	AC	0	0	0	16,800	16,800	1750.00
F0102_0102 D	Drainage Ditch	34.20	AC	0	0	0	59,850	59,850	1750.00
TOTAL	Permanent Easements			0	0	0	141,068	141,068	
F0102_0103	Temporary Easements								
F0102_0103 A	Berms-Stability & Seepage	74.80	AC	0	0	0	13,090	13,090	175.00
F0102_0103 B	Pump Station	4.00	AC	0	0	0	700	700	175.00
F0102_0103 C	Railroad Closure	40.70	AC	0	0	0	7,123	7,123	175.00
F0102_0103 D	Borrow Area - "A"	186.40	AC	0	0	0	293,580	293,580	1575.00
F0102_0103 E	Borrow Area - "B"	260.30	AC	0	0	0	234,270	234,270	900.00
F0102_0103 F	Relief Wells	17.00	AC	0	0	0	2,975	2,975	175.00
F0102_0103 G	Drainage Ditch	31.81	AC	0	0	0	5,567	5,567	175.00
F0102_0103 H	Roads	38.50	AC	0	0	0	6,738	6,738	175.00
TOTAL	Temporary Easements			0	0	0	564,042	564,042	
F0102_0104	Severance Damages								
F0102_0104 A	Severance Damages - 10%			0	0	0	70,511	70,511	
TOTAL	Severance Damages			0	0	0	70,511	70,511	
F0102_0105	Acquisition Costs-Ownerships-102								
F0102_0105 A	Planning	102.00	EA	0	0	0	153,000	153,000	1500.00
F0102_0105 B	Acquisition	102.00	EA	0	0	0	561,000	561,000	5500.00
F0102_0105 C	Appraisal	102.00	EA	0	0	0	102,000	102,000	1000.00
TOTAL	Acquisition Costs-Ownerships-102			0	0	0	816,000	816,000	
F0102_0107	PL 91-646 Relocation Assistance								
F0102_0107 A	Title III Payments-Basic Project	102.00	EA	0	0	0	51,000	51,000	500.00
TOTAL	PL 91-646 Relocation Assistance			0	0	0	51,000	51,000	
TOTAL	Levee Raise - Acquisition Costs			0	0	0	1,642,620	1,642,620	
F0102_02	Induced Flooding-AcquisitionCost								

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0102_0202 Permanent Easements								
F0102_0202 E Flowage (Induced Flooding)-A	436.00	AC	0	0	0	109,000	109,000	250.00
F0102_0202 F Flowage (Induced Flooding)-B	4.00	AC	0	0	0	2,500	2,500	625.00
TOTAL Permanent Easements			0	0	0	111,500	111,500	
F0102_0204 Severance Damages								
F0102_0204 A Severance Damages - 10%			0	0	0	11,150	11,150	
TOTAL Severance Damages			0	0	0	11,150	11,150	
F0102_0206 Acquisition-Induced Flooding-216								
F0102_0206 A Induced Flooding-216 Tracts	216.00	EA	0	0	0	1,728,000	1,728,000	8000.00
TOTAL Acquisition-Induced Flooding-216			0	0	0	1,728,000	1,728,000	
F0102_0207 PL 91-646 Relocation Assistance								
F0102_0207 B Induced Flooding	216.00	EA	0	0	0	108,000	108,000	500.00
TOTAL PL 91-646 Relocation Assistance			0	0	0	108,000	108,000	
TOTAL Induced Flooding-AcquisitionCost			0	0	0	1,958,650	1,958,650	
F0102_03 Environmental Mitigation Lands								
F0102_0301 Environmental Mitigation-								
F0102_0301 A Environmental Mitigation-			0	0	0	538,000	538,000	
TOTAL Environmental Mitigation-			0	0	0	538,000	538,000	
TOTAL Environmental Mitigation Lands			0	0	0	538,000	538,000	
TOTAL Acquisition Costs			0	0	0	4,139,270	4,139,270	
TOTAL Lands and Damages			0	0	0	4,139,270	4,139,270	
F02 Relocations								
F0201 Embankment & Ditching								
F0201_01 Utilities								

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0201_0101 Electric Utility			0	0	0	52,600	52,600	
TOTAL Utilities			0	0	0	52,600	52,600	
F0201_02 Pipeline								
F0201_0201 Pipeline Crossing Extension			0	0	0	44,800	44,800	
TOTAL Pipeline			0	0	0	44,800	44,800	
TOTAL Embankment & Ditching			0	0	0	97,400	97,400	
F0202 North Railroad Closure Relocatio								
F0202_01 Railroad Relocation - SHOO-FLY								
F0202_0101 Railroad Relocation - SHOO-FLY			0	0	0	191,670	191,670	
TOTAL Railroad Relocation - SHOO-FLY			0	0	0	191,670	191,670	
F0202_02 BNSF cost for SHOO-FLY Relocatio								
F0202_0201 BNSF cost for SHOO-FLY Relocatio			0	0	0	70,000	70,000	
TOTAL BNSF cost for SHOO-FLY Relocatio			0	0	0	70,000	70,000	
TOTAL North Railroad Closure Relocatio			0	0	0	261,670	261,670	
TOTAL Relocations			0	0	0	359,070	359,070	
F30 Planning, Engineering, & Design								
F3001 Planning, Engineering, & Design								
F3001_01 Planning, Engineering, & Design								
F3001_0101 Relocations			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Design			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Design			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Design			0	0	0	65,000	65,000	
F31 Supervision and Administration								

** PROJECT DIRECT SUMMARY - Level 6 **

	QUANTY	UOM	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F3101 Supervision and Administration								
F3101_01 Supervision and Administration								
F3101_0101 Relocation-Embankment, Ditching			0	0	0	11,000	11,000	
F3101_0102 Relocations for Railroad Closure			0	0	0	36,000	36,000	
TOTAL Supervision and Administration			0	0	0	47,000	47,000	
TOTAL Supervision and Administration			0	0	0	47,000	47,000	
TOTAL Supervision and Administration			0	0	0	47,000	47,000	
TOTAL NON FEDERAL COSTS			0	0	0	4,610,340	4,610,340	
G FEDERAL COSTS-PART OF 30 ACCOUNT								
G30 Planning, Engineering & Design								
G3001 Planning, Engineering & Design								
G3001_01 Combined Design Deficiency			0	0	0	2,414,000	2,414,000	
TOTAL Planning, Engineering & Design			0	0	0	2,414,000	2,414,000	
TOTAL Planning, Engineering & Design			0	0	0	2,414,000	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACCOUNT			0	0	0	2,414,000	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00	EA	3769224	4903729	1,961,716	24,582,475	35,217,14435217144	

Field Office Overhead	1,222,676
SUBTOTAL	36,439,820
Home Office Overhead	1,172,657
SUBTOTAL	37,612,477
Profit	1,920,813
SUBTOTAL	39,533,290
Bond	131,460
TOTAL INCL INDIRECTS	39,664,750
Contingency	6,911,197
TOTAL INCL OWNER COSTS	46,575,947

A. RELIEF WELLS # 1 Contract

A11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A. RELIEF WELLS # 1 Contract										
A11. Levees										
A1101. Relief Wells										
A1101_02. Mob, Demob & Preparatory Work										
A1101_02 1. Mobilization and Demobilization										
USR PM Mobilization and Demobilizat					0.00	0.00	0.00	76060.00	76060.00	
ion	1.00	LS		0.00	0	0	0	76,060	76,060	76060
TOTAL Mobilization and Demobilizat					0	0	0	76,060	76,060	
TOTAL Mob, Demob & Preparatory Wor					0	0	0	76,060	76,060	
A1101_99. Associated Levee Items										
A1101_99 1. Relief Wells, Welled Reaches-74										
These wells don't need additional ROW for installation because the contractor could work off of the existing berm. These wells are needed for the deficiency study. These wells are also needed for the 100-yr feasibility study but because these new wells will be installed between existing relief wells, no change in the location of a well is necessary between the deficiency well or the 100-yr feasibility study well.										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	4440.00	LF		0.00	0	0	0	666,000	666,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	1110.00	LF		0.00	0	0	0	210,900	210,900	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	74.00	EA		0.00	0	0	0	250,120	250,120	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	5550.00	LF	XXQMO	5.00	94,408	107,817	138,750	0	340,975	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	148.00	HR	XTBCA	1.00	29,565	9,687	2,960	0	42,212	285.21
TOTAL Relief Wells, Welled Reaches	74.00	EA			123,973	117,504	141,710	1,127,020	1,510,207	20408

A. RELIEF WELLS # 1 Contract

A11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A1101_99 2. Seeding										
B MIL PM Mechanical Seeding, 450#/acre, Assume 0.2 acre of seeding per well. 74 wells x 0.2 = 14.8 acres of seeding	14.80	ACR	COELB66	0.18	227.94 3,374	90.70 1,342	820.00 12,136	0.00 0	1138.65 16,852	 1138.65
TOTAL Seeding	14.80	ACR			3,374	1,342	12,136	0	16,852	1138.65
TOTAL Associated Levee Items					127,347	118,846	153,846	1,127,020	1,527,059	
TOTAL Relief Wells	74.00	EA			127,347	118,846	153,846	1,203,080	1,603,119	21664
TOTAL Levees					127,347	118,846	153,846	1,203,080	1,603,119	
A30. Planning, Engineering and Design										
A3001. Planning, Engineering and Design										
A3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	60,000	60,000	
TOTAL Engineering During Construct					0	0	0	39,000	39,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	99,000	99,000	
A3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	65,000	65,000	
TOTAL Engineering During Construct					0	0	0	40,000	40,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	105,000	105,000	
A3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	3,500	3,500	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	8,500	8,500	

A. RELIEF WELLS # 1 Contract

A30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
A3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	11,000	11,000	
TOTAL Engineering During Construct					0	0	0	500	500	
TOTAL Engineering - ED-C Cost Esti					0	0	0	11,500	11,500	
A3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	6,000	6,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Project Management					0	0	0	11,000	11,000	
A3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	5,000	5,000	
TOTAL Engineering During Construct					0	0	0	2,000	2,000	
TOTAL CT-Contracts					0	0	0	7,000	7,000	
A3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL CO-C, AND CO-F					0	0	0	10,000	10,000	
TOTAL Planning, Engineering and De					0	0	0	252,000	252,000	
TOTAL Planning, Engineering and De					0	0	0	252,000	252,000	
A31. Supervision and Administration										
A3123. Construction Contracts										
A3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL Construction Contracts					0	0	0	241,000	241,000	
TOTAL Supervision and Administrati					0	0	0	241,000	241,000	
TOTAL RELIEF WELLS # 1 Contract					127,347	118,846	153,846	1,696,080	2,096,119	

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B. RELIEF WELLS # 2 Contract										
B11. Levees										
B1101. Relief Wells										
B1101_02. Mob, Demob & Preparatory Work										
B1101_02 1. Mobilization and Demobilization										
USR PM Mobilization and Demobilizat					0.00	0.00	0.00	434000.00	434000.00	
ion	1.00	LS		0.00	0	0	0	434,000	434,000	434000
TOTAL Mobilization and Demobilizat					0	0	0	434,000	434,000	
TOTAL Mob, Demob & Preparatory Wor					0	0	0	434,000	434,000	
B1101_99. Associated Levee Items										
B1101_99 1. Relief Wells for 7 hot spot area										
Total number of relief wells in contract No. 2 is 414. a. 7 hot spot area										
= 62 each, b. welled reaches = 98 each, c. Non-welled reaches = 254 each.										
Total Relief Wells = 414 each										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	3720.00	LF		0.00	0	0	0	558,000	558,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	930.00	LF		0.00	0	0	0	176,700	176,700	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous	62.00	EA		0.00	0	0	0	209,560	209,560	3380.00
ing										
with appurtenant items,including										
attached guard screen.										
("D" Type Outlet Works)										
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	4650.00	LF	XXQMO	5.00	79,099	90,333	116,250	0	285,682	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	124.00	HR	XTBCA	1.00	24,771	8,116	2,480	0	35,367	285.21
TOTAL Relief Wells for 7 hot spot	62.00	EA			103,869	98,449	118,730	944,260	1,265,309	20408

B. RELIEF WELLS # 2 Contract

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B1101_99 2. Relief Wells, Welded Reaches										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	5880.00	LF		0.00	0	0	0	882,000	882,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	1470.00	LF		0.00	0	0	0	279,300	279,300	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	98.00	EA		0.00	0	0	0	331,240	331,240	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	7350.00	LF	XXQMO	5.00	125,027	142,785	183,750	0	451,562	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	20.00	0.00	285.21	
	196.00	HR	XTBCA	1.00	39,154	12,828	3,920	0	55,902	285.21
TOTAL Relief Wells, Welded Reaches	98.00	EA			164,181	155,613	187,670	1,492,540	2,000,004	20408
B1101_99 3. Relief Wells, Non-Welled Reaches										
USR PM Well Screen & Gravel Pack					0.00	0.00	0.00	150.00	150.00	
	15240	LF		0.00	0	0	0	2,286,000	2,286,000	150.00
USR PM Riser Pipe & Blank Pipe					0.00	0.00	0.00	190.00	190.00	
	3810.00	LF		0.00	0	0	0	723,900	723,900	190.00
USR PM Outlet Works					0.00	0.00	0.00	3380.00	3380.00	
This item includes well hous ing with appurtenant items,including attached guard screen. ("D" Type Outlet Works)	254.00	EA		0.00	0	0	0	858,520	858,520	3380.00
B USR PM Drilling					17.01	19.43	25.00	0.00	61.44	
	19050	LF	XXQMO	5.00	324,050	370,075	476,250	0	1,170,375	61.44
M USR PM Relief Well Pumping Test					199.76	65.45	5.00	0.00	270.21	
	508.00	HR	XTBCA	1.00	101,480	33,249	2,540	0	137,269	270.21
TOTAL Relief Wells, Non-Welled Rea	254.00	EA			425,530	403,324	478,790	3,868,420	5,176,064	20378
TOTAL Modify Existing Relief Wells	5.00	EA			0	0	0	20,000	20,000	4000.00

B. RELIEF WELLS # 2 Contract

B11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B1101_99 5. Seeding										
B MIL PM Mechanical Seeding, 450#/acre, Assume 0.2 acre of seeding per relief well. 414 wells x 0.2 = 82.8 acres of seeding.	82.80	ACR	COELB66	0.18	227.94 18,874	90.70 7,510	820.00 67,896	0.00 0	1138.65 94,280	1138.65
TOTAL Seeding	82.80	ACR			18,874	7,510	67,896	0	94,280	1138.65
TOTAL Associated Levee Items					712,453	664,896	853,086	6,325,220	8,555,656	
TOTAL Relief Wells	414.00	EA			712,453	664,896	853,086	6,759,220	8,989,656	21714
B1102. Piezometers										
B1102_01. Piezometers										
B1102_01 1. Piezometers										
B TUN PM Install Piezometers					515.20	0.00	318.00	0.00	833.20	
	68.00	EA	EELEELEC2	0.20	35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Piezometers	68.00	EA			35,034	0	21,624	0	56,658	833.20
TOTAL Levees					747,487	664,896	874,710	6,759,220	9,046,313	
B30. Planning, Engineering and Design										
B3001. Planning, Engineering and Design										
B3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	80,000	80,000	
TOTAL Engineering During Construct					0	0	0	60,000	60,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	140,000	140,000	

B. RELIEF WELLS # 2 Contract

B30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	85,000	85,000	
TOTAL Engineering During Construct					0	0	0	80,000	80,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	165,000	165,000	
B3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	20,000	20,000	
B3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	16,000	16,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	26,000	26,000	
B3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	11,000	11,000	
TOTAL Engineering During Construct					0	0	0	25,000	25,000	
TOTAL Project Management					0	0	0	36,000	36,000	
B3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	15,000	15,000	
TOTAL CT-Contracts					0	0	0	25,000	25,000	
B3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	18,000	18,000	
TOTAL CO-C, AND CO-F					0	0	0	18,000	18,000	
TOTAL Planning, Engineering and De					0	0	0	430,000	430,000	
TOTAL Planning, Engineering and De					0	0	0	430,000	430,000	

B. RELIEF WELLS # 2 Contract

B31. Supervision and Administration	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
B31. Supervision and Administration										
B3123. Construction Contracts										
B3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	1,357,000	1,357,000	
TOTAL Supervision and Administrati					0	0	0	1,357,000	1,357,000	
TOTAL Construction Contracts					0	0	0	1,357,000	1,357,000	
TOTAL Supervision and Administrati					0	0	0	1,357,000	1,357,000	
TOTAL RELIEF WELLS # 2 Contract					747,487	664,896	874,710	8,546,220	10,833,313	

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C. EMBANKMENT & DITCHING Contract										
C11. Levees										
C1101. Levee Raise and Seepage Berms										
C1101_02. Mob, Demob & Preparatory Work										
THis item covers mob. Demob and preparatory work for levee raise & berms, access road on top of levee and drainage ditching, and highway 51 closure structure removal.										
C1101_02 1. Mobilization and Demobilization										
USR PM Mobilization and Demobilizat					0.00	0.00	0.00	200000.00	200000.00	
ion	1.00	LS		0.00	0	0	0	200,000	200,000	200000
TOTAL Mobilization and Demobilizat					0	0	0	200,000	200,000	
TOTAL Mob, Demob & Preparatory Wor					0	0	0	200,000	200,000	
C1101_04. Permanent Access Road										
C1101_04 1. Road on Levee Crown										
B USR PM Graded Crushed Agg Rdwy Base					5.39	3.96	4.00	0.00	13.35	
Crs	94200	TON	XSABA	55.00	507,992	372,947	376,800	0	1,257,740	13.35
TOTAL Road on Levee Crown					507,992	372,947	376,800	0	1,257,740	
TOTAL Permanent Access Road					507,992	372,947	376,800	0	1,257,740	
C1101_99. Associated Levee Items										
C1101_99 1. Embankment In Place										
USR PM Embankment In Place Material					1.30	2.22	0.00	0.00	3.52	
Assume the following;	1257200	CY	ZBBLEVEE	565.00	1630211	2789727	0	0	4,419,938	3.52
Quantity in place = 1,257,200cy										
Average haul dist.= 1 mile										
TOTAL Embankment In Place	1257200	CY			1630211	2789727	0	0	4,419,938	3.52

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C1101_99 2. Embankment - Variable Freeboard										
USR PM Embankment - Variable Freeboard Material Assume the following; Quantity in place = 200,000cy Average haul dist.= 1 mile	200000	CY	ZBBLEVEE	565.00	1.30 259,340	2.22 443,800	0.00 0	0.00 0	3.52 703,140	3.52
TOTAL Embankment - Variable Freebo	200000	CY			259,340	443,800	0	0	703,140	3.52
C1101_99 3. Landside Seepage Berms-Pervious										
USR PM Landside Seepage Berms-Pervious	145000	CY	ZBBLEVEE	565.00	1.30 188,022	2.22 321,755	0.00 0	0.00 0	3.52 509,777	3.52
TOTAL Landside Seepage Berms-Pervi	145000	CY			188,022	321,755	0	0	509,777	3.52
TOTAL Gravity Drain Extenstions					0	0	0	17,800	17,800	
C1101_99 5. Establishment of Turf										
M MIL PM Seeding, seeding	363.00	ACR	COELB66	0.24	169.74 61,617	67.54 24,519	790.00 286,770	0.00 0	1027.29 372,906	1027.29
TOTAL Establishment of Turf	363.00	ACR			61,617	24,519	286,770	0	372,906	1027.29
TOTAL Associated Levee Items					2139190	3579800	286,770	17,800	6,023,560	
TOTAL Levee Raise and Seepage Berm					2647182	3952748	663,570	217,800	7,481,300	
C1102. Drainage Ditching										
C1102_01. Jones Cutoff Drainage Area										
C1102_01 1. Ditch Excavation										
USR PM Ditch Excavation, Material used in the enbankment. This item covers cost to excavate and load on trucks. The hauling, spreading, and compaction cost is covered in embankment cost.	16644	CY	ZBBLEVEE	555.00	1.32 21,972	2.26 37,599	0.00 0	0.00 0	3.58 59,571	3.58
TOTAL Ditch Excavation	16644	CY			21,972	37,599	0	0	59,571	3.58

C. EMBANKMENT & DITCHING Contract

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C1102_01 2. Establishment of Turf										
M MIL PM Mechanical Seeding					169.74	67.54	790.00	0.00	1027.29	
	20.00	ACR	COELB66	0.24	3,395	1,351	15,800	0	20,546	1027.29
TOTAL Establishment of Turf	20.00	ACR			3,395	1,351	15,800	0	20,546	1027.29
C1102_01 3. 36" Dia. Corrugated Metal Pipe two each x 42 lf/ea = 84 lin ft										
MIL PM 36" dia, 12ga, CMP, bitum ct					16.63	5.42	38.40	0.00	60.45	
d, 2 ea x 42'=84 Lin Ft w/paved invert	84.00	LF	CLABB13	15.00	1,397	455	3,226	0	5,078	60.45
TOTAL 36" Dia. Corrugated Metal Pi	84.00	LF			1,397	455	3,226	0	5,078	60.45
TOTAL Jones Cutoff Drainage Area					26,763	39,405	19,026	0	85,194	
C1102_02. Cinque Holmes Drainage Area										
C1102_02 1. Ditch Excavation										
USR PM Ditch Excavation, Material u					1.32	2.26	0.00	0.00	3.58	
sed in the embankment. This item covers cost to excavate and load on trucks. Hauling, spreading and compaction covered in embankment item.	16528	CY	ZBBLEVEE	555.00	21,819	37,337	0	0	59,155	3.58
TOTAL Ditch Excavation	16528	CY			21,819	37,337	0	0	59,155	3.58
C1102_02 2. Establishment of Turf										
M MIL PM Seeding, seeding					169.74	67.54	790.00	0.00	1027.29	
	20.00	ACR	COELB66	0.24	3,395	1,351	15,800	0	20,546	1027.29
TOTAL Establishment of Turf	20.00	ACR			3,395	1,351	15,800	0	20,546	1027.29
C1102_02 3. 36" Dia. Corrugated Metal Pipe two each x 42 lf/ea = 84 lin ft										
MIL PM 36" dia, 12ga, CMP, bitum ct					16.63	5.42	38.40	0.00	60.45	
d, 2 ea x 42'=84 Lin Ft w/paved invert	84.00	LF	CLABB13	15.00	1,397	455	3,226	0	5,078	60.45

C. EMBANKMENT & DITCHING Contract

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL 36" Dia. Corrugated Metal Pi	84.00	LF			1,397	455	3,226	0	5,078	60.45
TOTAL Cinque Holmes Drainage Area					26,610	39,143	19,026	0	84,779	
C1102_03. Bois Brule Drainage Area										
C1102_03 1. Ditch Excavation										
USR PM Ditch Excavation, Material u					1.32	2.26	0.00	0.00	3.58	
sed in the embankment. This item covers cost to excavate and load on trucks. Hauling, spreading and compaction cost covered in the embankment item.	20720	CY	ZBBLEVEE	555.00	27,352	46,806	0	0	74,159	3.58
TOTAL Ditch Excavation	20720	CY			27,352	46,806	0	0	74,159	3.58
C1102_03 2. Establishment of Turf										
M MIL PM Seeding, seeding					169.74	67.54	790.00	0.00	1027.29	
	25.00	ACR	COELB66	0.24	4,244	1,689	19,750	0	25,682	1027.29
TOTAL Establishment of Turf	25.00	ACR			4,244	1,689	19,750	0	25,682	1027.29
C1102_03 3. 36" Dia. Corrugated Metal Pipe three each x 42 lf/ea = 126 lin ft										
MIL PM 36" dia, 12ga, CMP, bitum ct					16.63	5.42	38.40	0.00	60.45	
d, 3 ea x 42'=126 Lin Ft w/paved invert	126.00	LF	CLABB13	15.00	2,095	683	4,838	0	7,616	60.45
TOTAL 36" Dia. Corrugated Metal Pi	126.00	LF			2,095	683	4,838	0	7,616	60.45
TOTAL Bois Brule Drainage Area					33,691	49,178	24,588	0	107,458	
TOTAL Drainage Ditching					87,064	127,726	62,640	0	277,430	

C11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C1103. Highway 51 Closure Structure										
C1103_02. Demolish High. 51 Closure Struct										
TOTAL Remove Reinforced Concrete S	105.00	CY			0	0	0	22,050	22,050	210.00
TOTAL Excavation	50.00	CY			0	0	0	200	200	4.00
TOTAL Backfill to Grade	150.00	CY			0	0	0	1,005	1,005	6.70
TOTAL Disposal of Steel Panels					0	0	0	2,000	2,000	
TOTAL Demolish High. 51 Closure St					0	0	0	25,255	25,255	
TOTAL Highway 51 Closure Structure					0	0	0	25,255	25,255	
TOTAL Levees					2734247	4080474	726,210	243,055	7,783,985	
C30. Planning, Engineering and Design										
C3001. Planning, Engineering and Design										
C3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	300,000	300,000	
TOTAL Engineering During Construct					0	0	0	215,000	215,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	515,000	515,000	
C3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	120,000	120,000	
TOTAL Engineering During Construct					0	0	0	110,000	110,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	230,000	230,000	
C3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	15,000	15,000	
TOTAL Engineering During Construct					0	0	0	20,000	20,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	35,000	35,000	

C30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
C3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	20,000	20,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	30,000	30,000	
C3001_05. Project Management										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	25,000	25,000	
TOTAL Project Management					0	0	0	35,000	35,000	
C3001_06. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	15,000	15,000	
TOTAL Engineering During Construct					0	0	0	20,000	20,000	
TOTAL CT-Contracts					0	0	0	35,000	35,000	
C3001_07. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F					0	0	0	20,000	20,000	
TOTAL Planning, Engineering and De					0	0	0	900,000	900,000	
TOTAL Planning, Engineering and De					0	0	0	900,000	900,000	
C31. Supervision and Administration										
C3123. Construction Contracts										
C3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	1,168,000	1,168,000	
TOTAL Supervision and Administrati					0	0	0	1,168,000	1,168,000	
TOTAL Construction Contracts					0	0	0	1,168,000	1,168,000	
TOTAL Supervision and Administrati					0	0	0	1,168,000	1,168,000	
TOTAL EMBANKMENT & DITCHING Contra					2734247	4080474	726,210	2,311,055	9,851,985	

D13. Pumping Plant	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D. PUMP STATIONS Contract								
D13. Pumping Plant								
D1301. Missouri Chute Pump Station								
D1301_01. Pump Station								
TOTAL Pump Station - 48 cfs			0	0	0	800,000	800,000	
TOTAL Pump Station			0	0	0	800,000	800,000	
D1301_02. Raise Discharge Pipe								
TOTAL Raise Discharge Pipe-36" Dia	248.00 LF		0	0	0	16,534	16,534	66.67
TOTAL Raise Discharge Pipe			0	0	0	16,534	16,534	
D1301_03. Dresser Couplings								
TOTAL Dresser Couplings for Pipe	6.00 EA		0	0	0	16,002	16,002	2667.00
TOTAL Dresser Couplings			0	0	0	16,002	16,002	
D1301_04. Mob . Demob & Preparatory								
TOTAL Mob . Demob & Preparatory			0	0	0	25,000	25,000	
TOTAL Mob . Demob & Preparatory			0	0	0	25,000	25,000	
TOTAL Missouri Chute Pump Station			0	0	0	857,536	857,536	
D1302. Jones Cutoff Pump Station								
D1302_01. Pump Station								
TOTAL Pump Station - 57 cfs			0	0	0	800,000	800,000	
TOTAL Pump Station			0	0	0	800,000	800,000	
D1302_02. Raise Discharge Pipe								
TOTAL Raise Discharge Pipe-36" Dia	396.00 LF		0	0	0	26,401	26,401	66.67
TOTAL Raise Discharge Pipe			0	0	0	26,401	26,401	

D. PUMP STATIONS Contract

D13. Pumping Plant	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D1302_03. Dresser Couplings								
TOTAL Dresser Couplings for Pipe	12.00 EA		0	0	0	32,004	32,004	2667.00
TOTAL Dresser Couplings			0	0	0	32,004	32,004	
D1302_04. Mob. Demob. & Preparatory cost								
TOTAL Mob. Demob. & Preparatory co			0	0	0	25,000	25,000	
TOTAL Mob. Demob. & Preparatory co			0	0	0	25,000	25,000	
TOTAL Jones Cutoff Pump Station			0	0	0	883,405	883,405	
D1303. Cinque Hommes Pump Station								
D1303_01. Pump Station								
TOTAL Pump Station - 16 cfs			0	0	0	266,700	266,700	
TOTAL Pump Station			0	0	0	266,700	266,700	
D1303_02. Raise Discharge Pipe								
TOTAL Raise Discharge Pipe-36" Dia	391.00 LF		0	0	0	26,068	26,068	66.67
TOTAL Raise Discharge Pipe			0	0	0	26,068	26,068	
D1303_03. Dresser Couplings								
TOTAL Dresser Couplings for Pipe	12.00 EA		0	0	0	32,004	32,004	2667.00
TOTAL Dresser Couplings			0	0	0	32,004	32,004	
D1303_04. Mob. Demob. & Preparatory cost								
TOTAL Mob. Demob. & Preparatory co			0	0	0	13,300	13,300	
TOTAL Mob. Demob. & Preparatory co			0	0	0	13,300	13,300	
TOTAL Cinque Hommes Pump Station			0	0	0	338,072	338,072	

D. PUMP STATIONS Contract

D13. Pumping Plant	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D1304. Bois Brule Pump Station								
D1304_01. Pump Station								
TOTAL Pump Station - 41 cfs			0	0	0	800,000	800,000	
TOTAL Pump Station			0	0	0	800,000	800,000	
D1304_02. Mob. Demob. & Preparatory cost								
TOTAL Mob. Demob. & Preparatory co			0	0	0	18,000	18,000	
TOTAL Mob. Demob. & Preparatory co			0	0	0	18,000	18,000	
TOTAL Bois Brule Pump Station			0	0	0	818,000	818,000	
TOTAL Pumping Plant			0	0	0	2,897,013	2,897,013	
D30. Planning, Engineering and Design								
D3001. Planning, Engineering and Design								
D3001_01. Engineering - ED-DC Civil Design								
TOTAL Plans/Specification&Gen.Draw			0	0	0	50,000	50,000	
TOTAL Engineering During Construct			0	0	0	8,000	8,000	
TOTAL Engineering - ED-DC Civil De			0	0	0	58,000	58,000	
D3001_02. Engineering - ED-GF Geotech								
TOTAL Plans & Specifications			0	0	0	45,000	45,000	
TOTAL Engineering During Construct			0	0	0	15,000	15,000	
TOTAL Engineering - ED-GF Geotech			0	0	0	60,000	60,000	
D3001_03. Engineering - ED-HE Hydrologic								
TOTAL Plans & Specifications			0	0	0	10,000	10,000	
TOTAL Engineering During Construct			0	0	0	5,000	5,000	
TOTAL Engineering - ED-HE Hydrolog			0	0	0	15,000	15,000	

D. PUMP STATIONS Contract

D30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	20,000	20,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	30,000	30,000	
D3001_05. Engineering - ED-DA Structures										
TOTAL Plans & Specifications,Drawi					0	0	0	235,000	235,000	
TOTAL Engineering During Construct					0	0	0	9,000	9,000	
TOTAL Engineering - ED-DA Structur					0	0	0	244,000	244,000	
D3001_06. Engineering - ED-DM Mechanical										
TOTAL Modifiy Pump Discharge Pipe					0	0	0	18,000	18,000	
TOTAL Engineering During Const.-Pi					0	0	0	16,000	16,000	
TOTAL Pump Station Design-4 each					0	0	0	172,000	172,000	
TOTAL Eng during Const-4 Pump Stat					0	0	0	77,000	77,000	
TOTAL Engineering - ED-DM Mechanic					0	0	0	283,000	283,000	
D3001_07. Engineering - ED-DM Electrical										
TOTAL Plans & Specification-4 Stat					0	0	0	40,000	40,000	
TOTAL Engineering - ED-DM Electric					0	0	0	40,000	40,000	
D3001_08. Value Engineering										
TOTAL Value Engineering-Pump Stati					0	0	0	40,000	40,000	
TOTAL Value Engineering					0	0	0	40,000	40,000	
D3001_09. Project Management										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Project Management					0	0	0	15,000	15,000	

D. PUMP STATIONS Contract

D30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
D3001_10. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL CT-Contracts					0	0	0	15,000	15,000	
D3001_11. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F					0	0	0	20,000	20,000	
TOTAL Planning, Engineering and De					0	0	0	820,000	820,000	
TOTAL Planning, Engineering and De					0	0	0	820,000	820,000	
D31. Supervision and Administration										
D3123. Construction Contracts										
D3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	435,000	435,000	
TOTAL Supervision and Administrati					0	0	0	435,000	435,000	
TOTAL Construction Contracts					0	0	0	435,000	435,000	
TOTAL Supervision and Administrati					0	0	0	435,000	435,000	
TOTAL PUMP STATIONS Contract					0	0	0	4,152,013	4,152,013	

E11. Levees	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E. RAILROAD CLOSURE Contract								
E11. Levees								
E1101. North Railroad Closure-Replace								
E1101_01. Mob, Demob & Preparatory Work								
E1101_0101. Mobilization and Demobilization								
USR PM Mobilization and Demobilizat			0.00	0.00	0.00	50000.00	50000.00	
ion	1.00 LS	0.00	0	0	0	50,000	50,000	50000
TOTAL Mobilization and Demobilizat			0	0	0	50,000	50,000	
TOTAL Mob, Demob & Preparatory Wor			0	0	0	50,000	50,000	
E1101_02. Site Work								
E1101_0201. Clearing, Grubbing and Stripping								
MIL PM Clear & grub, cut & chip med			2854.93	1237.98	0.00	0.00	4092.91	
ium	3.00 ACR CODFB7	0.08	8,565	3,714	0	0	12,279	4092.91
trees, 10" dia								
TOTAL Clearing, Grubbing and Strip			8,565	3,714	0	0	12,279	
E1101_0202. Structural Excavation								
Assume excavated material to be stockpiled in the immediate area.								
L USR PM Exc & Load,4 CY Hyd Exc,Med			1.22	1.38	0.00	0.00	2.60	
Matl	1131.00 CY XXQHL	90.00	1,383	1,557	0	0	2,940	2.60
196 CY/Hr (150M3)								
CIV PM Excavating,bulk,235 cycles/h			0.24	0.35	0.00	0.00	0.60	
r,	1131.00 CY CODTB10M	235.00	277	400	0	0	677	0.60
dozer,150' push,mdm matl,open								
site,335HP								
TOTAL Structural Excavation	1131.00 CY		1,659	1,957	0	0	3,617	3.20
E1101_0203. Structural Backfill								
Assume embankment material to come from adjacent borrow area.								
CIV PM Excavating,bulk,235 cycles/h			0.24	0.35	0.00	0.00	0.60	
r,	779.00 CY CODTB10M	235.00	190	276	0	0	466	0.60
dozer,150' push,mdm matl,open								
site,335HP								

E. RAILROAD CLOSURE Contract

	E11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
MIL PM	Excavation, bulk, 4.5 cycle/					0.62	1.10	0.00	0.00	1.72	
	hr,	779.00	CY	CODSB33E	112.50	481	855	0	0	1,336	1.72
	push loaded self prop scraper, 25 BCY										
MIL PM	Spread/compact, 200 HP dozer					0.22	0.25	0.00	0.00	0.47	
	w/sheepsfoot roller, 6" lift , embankment	779.00	CY	COFCB32E	468.75	173	197	0	0	370	0.47
TOTAL	Structural Backfill	779.00	CY			845	1,327	0	0	2,172	2.79
	E1101_0204. Bedding Material										
B USR PM	Bedding Material					5.39	3.96	4.00	0.00	13.35	
		1700.00	TON	XSABA	55.00	9,168	6,730	6,800	0	22,698	13.35
TOTAL	Bedding Material	1700.00	TON			9,168	6,730	6,800	0	22,698	13.35
	E1101_0205. Riprap										
L USR PM	Riprap, Dumped from Truck					9.38	2.68	6.25	0.00	18.30	
		3500.00	TON	COETE	15.00	32,819	9,368	21,875	0	64,062	18.30
TOTAL	Riprap	3500.00	TON			32,819	9,368	21,875	0	64,062	18.30
	E1101_0206. Establishment of Turf										
M MIL PM	Seeding, athletic field mix,					169.74	67.54	800.00	0.00	1037.29	
	mechanical seeding, 450#/acre	10.00	ACR	COELB66	0.24	1,697	675	8,000	0	10,373	1037.29
TOTAL	Establishment of Turf					1,697	675	8,000	0	10,373	
	E1101_0207. Demolition of Existing Closure										
USR PM	Steel Removal & Disposal					0.00	0.00	0.00	1.04	1.04	
		7300.00	LB		0.00	0	0	0	7,592	7,592	1.04
USR PM	Concrete Demolition & Dispos					0.00	0.00	0.00	100.00	100.00	
	al	49.00	CY		0.00	0	0	0	4,900	4,900	100.00
TOTAL	Demolition of Existing Closu					0	0	0	12,492	12,492	

E. RAILROAD CLOSURE Contract

E11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
TOTAL Site Work					54,753	23,773	36,675	12,492	127,693	
E1101_03. Closure Structure-Pile Founded										
E1101_0301. Concrete Formwork										
MIL PM Forms in place, SOG, edge fo					3.27	0.00	0.74	0.00	4.01	
rms, wood, over 12", 4 use	1070.00	SF	ACARC1	43.75	3,499	0	792	0	4,291	4.01
M MIL PM Forms in place, grade beam, 2 use, plywood					2.99	0.00	0.70	0.00	3.69	
	540.00	SF	ACARC2	72.50	1,612	0	378	0	1,990	3.69
M MIL PM Forms in place, walls, job b					5.02	0.00	1.20	0.00	6.22	
uilt plywood, 8-16' high, 2 use	4710.00	SF	ACARC2	43.13	23,636	0	5,652	0	29,288	6.22
MIL PM Forms in place, column, pier/pilaster, below grade, plywood, 1 use					6.41	0.00	2.18	0.00	8.59	
	340.00	SF	ACARC2	33.75	2,180	0	741	0	2,921	8.59
TOTAL Concrete Formwork					30,927	0	7,563	0	38,490	
E1101_0302. Concrete Reinforcing Steel										
M MIL PM Reinforcing in place, walls, #3 to #7					500.22	0.00	560.00	0.00	1060.22	
	50.40	TON	SIWRRODM4	0.38	25,211	0	28,224	0	53,435	1060.22
TOTAL Concrete Reinforcing Steel	50.40	TON			25,211	0	28,224	0	53,435	1060.22
E1101_0303. Concrete-Cast in Place										
M MIL PM Placing conc, columns, square/round, 12" thick, w/c rane & bucket					55.85	17.84	65.00	0.00	138.69	
	480.00	CY	ULABC7	5.00	26,810	8,561	31,200	0	66,571	138.69
M RSM PM Concrete ready mix, regular weight, 3000 psi					0.00	0.00	65.00	0.00	65.00	
	480.00	CY	N/A	0.00	0	0	31,200	0	31,200	65.00
TOTAL Concrete-Cast in Place	480.00	CY			26,810	8,561	62,400	0	97,771	203.69

E11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E1101_0305. HP14 Pile Points										
B USR PM 14" (36cm) H-Section Std Poi					49.06	1.32	95.50	0.00	145.88	
nt	58.00	EA	SIWWA	1.20	2,845	77	5,539	0	8,461	145.88
Heavy Duty, Rolled Steel										
TOTAL HP14 Pile Points	58.00	EA			2,845	77	5,539	0	8,461	145.88
E1101_0306. PZ27 Steel Sheet Pile										
USR PM PZ27 Steel Sheet Piling					0.00	0.00	0.00	21.67	21.67	
	8813.00	SF		0.00	0	0	0	190,978	190,978	21.67
TOTAL PZ27 Steel Sheet Pile	8813.00	SF			0	0	0	190,978	190,978	21.67
E1101_0307. Steel H Pile, HP14x73-58 x42.75'										
M MIL PM Pile, steel, "H" sections, 5					4.67	2.86	23.45	0.00	30.99	
0'	2480.00	VLF	CPIDB19A	63.75	11,590	7,098	58,156	0	76,844	30.99
long, HP14 x 117										
L USR PM 14" (36cm) H-Section Driving					58.87	1.59	2715.80	0.00	2776.26	
Cap	2.00	EA	SIWWA	1.00	118	3	5,432	0	5,553	2776.26
Rolled Steel										
TOTAL Steel H Pile, HP14x73-58 x42	2480.00	LF			11,708	7,101	63,588	0	82,397	33.22
E1101_0308. Swing Gate & J-Seals										
USR PM Structural Steel - Gates					0.00	0.00	0.00	3.34	3.34	
	14460	LB		0.00	0	0	0	48,296	48,296	3.34
M MIL PM Waterstop, rubber, flat					2.00	0.00	11.40	0.00	13.40	
dumbbell, 3/8" thick, 6" wid	47.00	LF	ACARCARP1	18.13	94	0	536	0	630	13.40
e										
TOTAL Swing Gate & J-Seals	7.23	TON			94	0	536	48,296	48,926	6767.08
E1101_0309. Miscellaneous Embedded Metals										
B USR PM Misc Strl Shapes					2.35	0.00	0.98	0.00	3.33	
A-36 Structural Steel	1190.00	LB	SIWSB	50.00	2,802	0	1,166	0	3,968	3.33
TOTAL Miscellaneous Embedded Metal	0.60	TON			2,802	0	1,166	0	3,968	6614.02

E. RAILROAD CLOSURE Contract

E11. Levees	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E1101_0310. Painting										
CIV PM Struct steel projects, metal					0.13	0.00	0.07	0.00	0.20	
prep, brush-off blast	2250.00	SF	APTRPORD2	475.00	295	0	158	0	452	0.20
CIV PM Structural steel, 1 coat, pa					0.23	0.00	0.00	0.00	0.23	
int,	9000.00	SF	APTSPSST1	162.50	2,105	0	0	0	2,105	0.23
spray, heavy size, appl only										
CIV PM Ctg & paints, V-106D, dark r					0.00	0.00	0.13	0.00	0.13	
ed	2250.00	SF	N/A	0.00	0	0	293	0	293	0.13
oxide, vinyl paint										
CIV PM Ctg & paints, V-106D, dark r					0.00	0.00	0.13	0.00	0.13	
ed	2250.00	SF	N/A	0.00	0	0	293	0	293	0.13
oxide, w/ added abrsv, vinyl										
paint										
CIV PM Ctg & paints, V-766E, gray,					0.00	0.00	0.11	0.00	0.11	
vinyl paint	2250.00	SF	N/A	0.00	0	0	248	0	248	0.11
CIV PM Ctg & paints, V-766E, w/ add					0.00	0.00	0.12	0.00	0.12	
ed	2250.00	SF	N/A	0.00	0	0	270	0	270	0.12
abrsv, gray, vinyl paint										
TOTAL Painting	1460.00	SF			2,400	0	1,260	0	3,660	2.51
TOTAL Closure Structure-Pile Found					102,797	15,739	170,276	239,274	528,086	
E1101_04. Traffic Control										
E1101_0401. Flagmen										
MIL PM Outside Laborer					34.59	0.00	0.00	0.00	34.59	
	75.00	HR	X-LABORER	1.00	2,594	0	0	0	2,594	34.59
TOTAL Flagmen	2.00	EA			2,594	0	0	0	2,594	1297.13
TOTAL Traffic Control					2,594	0	0	0	2,594	
TOTAL North Railroad Closure-Repla					160,144	39,512	206,951	301,766	708,373	
TOTAL Levees					160,144	39,512	206,951	301,766	708,373	

E30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E30. Planning, Engineering and Design										
E3001. Planning, Engineering and Design										
E3001_01. Engineering - ED-DC Civil Design										
TOTAL Plans/Specification&Gen.Draw					0	0	0	60,000	60,000	
TOTAL Engineering During Construct					0	0	0	15,000	15,000	
TOTAL Engineering - ED-DC Civil De					0	0	0	75,000	75,000	
E3001_02. Engineering - ED-GF Geotech										
TOTAL Plans & Specifications					0	0	0	55,000	55,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-GF Geotech					0	0	0	65,000	65,000	
E3001_03. Engineering - ED-HE Hydrologic										
TOTAL Plans & Specifications					0	0	0	10,000	10,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Engineering - ED-HE Hydrolog					0	0	0	15,000	15,000	
E3001_04. Engineering - ED-C Cost Estimate										
TOTAL Plans & Specs. Bid Opening					0	0	0	20,000	20,000	
TOTAL Engineering During Construct					0	0	0	5,000	5,000	
TOTAL Engineering - ED-C Cost Esti					0	0	0	25,000	25,000	
E3001_05. Engineering - ED-DA Structures										
TOTAL Plans & Specifications					0	0	0	165,000	165,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL Engineering - ED-DA Structur					0	0	0	175,000	175,000	

E. RAILROAD CLOSURE Contract

E30. Planning, Engineering and Design	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
E3001_06. Project Management										
TOTAL Plans & Specifications					0	0	0	30,000	30,000	
TOTAL Engineering During Construct					0	0	0	15,000	15,000	
TOTAL Project Management					0	0	0	45,000	45,000	
E3001_07. CT-Contracts										
TOTAL Plans & Specifications					0	0	0	15,000	15,000	
TOTAL Engineering During Construct					0	0	0	10,000	10,000	
TOTAL CT-Contracts					0	0	0	25,000	25,000	
E3001_08. CO-C, AND CO-F										
TOTAL Plans & Specifications					0	0	0	20,000	20,000	
TOTAL CO-C, AND CO-F					0	0	0	20,000	20,000	
TOTAL Planning, Engineering and De					0	0	0	445,000	445,000	
TOTAL Planning, Engineering and De					0	0	0	445,000	445,000	
E31. Supervision and Administration										
E3123. Construction Contracts										
E3123_11. Supervision and Administration										
TOTAL Supervision and Administrati					0	0	0	106,000	106,000	
TOTAL Supervision and Administrati					0	0	0	106,000	106,000	
TOTAL Construction Contracts					0	0	0	106,000	106,000	
TOTAL Supervision and Administrati					0	0	0	106,000	106,000	
TOTAL RAILROAD CLOSURE Contract					160,144	39,512	206,951	852,766	1,259,373	

F. NON FEDERAL COSTS

F01. Lands and Damages	QUANTY	UOM	CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F. NON FEDERAL COSTS										
F01. Lands and Damages										
F0102. Acquisition Costs										
F0102_01. Levee Raise - Acquisition Costs										
F0102_0102. Permanent Easements										
TOTAL Berms-Stability & Seepage	32.81	AC			0	0	0	57,418	57,418	1750.00
TOTAL Pump Station	4.00	AC			0	0	0	7,000	7,000	1750.00
TOTAL Railroad Closure	9.60	AC			0	0	0	16,800	16,800	1750.00
TOTAL Drainage Ditch	34.20	AC			0	0	0	59,850	59,850	1750.00
TOTAL Permanent Easements					0	0	0	141,068	141,068	
F0102_0103. Temporary Easements										
TOTAL Berms-Stability & Seepage	74.80	AC			0	0	0	13,090	13,090	175.00
TOTAL Pump Station	4.00	AC			0	0	0	700	700	175.00
TOTAL Railroad Closure	40.70	AC			0	0	0	7,123	7,123	175.00
F0102_0103 D. Borrow Area - "A" Work Area for Construction: 60.2 Acres Landside (90% or 54.2 acres)										
TOTAL Borrow Area - "A"	186.40	AC			0	0	0	293,580	293,580	1575.00
F0102_0103 E. Borrow Area - "B" Work Area for Construction: 60.2 acres Riverside (10% or 6.0 acres)										
TOTAL Borrow Area - "B"	260.30	AC			0	0	0	234,270	234,270	900.00
TOTAL Relief Wells	17.00	AC			0	0	0	2,975	2,975	175.00
TOTAL Drainage Ditch	31.81	AC			0	0	0	5,567	5,567	175.00
TOTAL Roads	38.50	AC			0	0	0	6,738	6,738	175.00
TOTAL Temporary Easements					0	0	0	564,042	564,042	

F. NON FEDERAL COSTS

F01. Lands and Damages	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0102_0104. Severance Damages								
TOTAL Severance Damages - 10%			0	0	0	70,511	70,511	
TOTAL Severance Damages			0	0	0	70,511	70,511	
F0102_0105. Acquisition Costs-Ownerships-102								
F0102_0105 A. Planning								
	Planning cost at $ 1,000 per ownership, Number of ownerships = 45 each							
TOTAL Planning	102.00 EA		0	0	0	153,000	153,000	1500.00
F0102_0105 B. Acquisition								
	Acquisition cost at $ 5,500 per ownership, Number of ownerships = 45 each							
TOTAL Acquisition	102.00 EA		0	0	0	561,000	561,000	5500.00
F0102_0105 C. Appraisal								
	Appraisal cost at $ 1,500 per ownership, Number of ownerships = 45 each							
TOTAL Appraisal	102.00 EA		0	0	0	102,000	102,000	1000.00
TOTAL Acquisition Costs-Ownerships			0	0	0	816,000	816,000	
F0102_0107. PL 91-646 Relocation Assistance								
F0102_0107 A. Title III Payments-Basic Project								
	Relocation Assistance Public Law 91-646 102 ownerships at $ 500 per ownership.							
TOTAL Title III Payments-Basic Pro	102.00 EA		0	0	0	51,000	51,000	500.00
TOTAL PL 91-646 Relocation Assista			0	0	0	51,000	51,000	
TOTAL Levee Raise - Acquisition Co			0	0	0	1,642,620	1,642,620	
F0102_02. Induced Flooding-AcquisitionCost								
F0102_0202. Permanent Easements								
TOTAL Flowage (Induced Flooding)-A	436.00 AC		0	0	0	109,000	109,000	250.00
TOTAL Flowage (Induced Flooding)-B	4.00 AC		0	0	0	2,500	2,500	625.00
TOTAL Permanent Easements			0	0	0	111,500	111,500	

F. NON FEDERAL COSTS

F01. Lands and Damages	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0102_0204. Severance Damages								
TOTAL Severance Damages - 10%			0	0	0	11,150	11,150	
TOTAL Severance Damages			0	0	0	11,150	11,150	
F0102_0206. Acquisition-Induced Flooding-216								
TOTAL Induced Flooding-216 Tracts	216.00 EA		0	0	0	1,728,000	1,728,000	8000.00
TOTAL Acquisition-Induced Flooding			0	0	0	1,728,000	1,728,000	
F0102_0207. PL 91-646 Relocation Assistance								
F0102_0207 B. Induced Flooding payments. Relocation Assistance Public Law 91-646 216 tracts at $500 per each								
TOTAL Induced Flooding	216.00 EA		0	0	0	108,000	108,000	500.00
TOTAL PL 91-646 Relocation Assista			0	0	0	108,000	108,000	
TOTAL Induced Flooding-Acquisition			0	0	0	1,958,650	1,958,650	
F0102_03. Environmental Mitigation Lands								
F0102_0301. Environmental Mitigation- Payments for Easements and ROW								
TOTAL Environmental Mitigation-			0	0	0	538,000	538,000	
TOTAL Environmental Mitigation-			0	0	0	538,000	538,000	
TOTAL Environmental Mitigation Lan			0	0	0	538,000	538,000	
TOTAL Acquisition Costs			0	0	0	4,139,270	4,139,270	
TOTAL Lands and Damages			0	0	0	4,139,270	4,139,270	
F02. Relocations								
F0201. Embankment & Ditching								
F0201_01. Utilities								
F0201_0101. Electric Utility								
USR 12 Aerial Electric Crossings			0.00	0.00	0.00	2300.00	2300.00	
@ $2,300/each	12.00 EA	0.00	0	0	0	27,600	27,600	2300.00

F. NON FEDERAL COSTS

F02. Relocations	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
USR Aerial Electric near Levee			0.00	0.00	0.00	2000.00	2000.00	
Staion 20+00 - 40+00 @ $2,000 0 each	1.00 EA	0.00	0	0	0	2,000	2,000	2000.00
USR Aerial Electric near Levee			0.00	0.00	0.00	23000.00	23000.00	
Staion 1500+00 - 1540+00 @ $23,000 each	1.00 EA	0.00	0	0	0	23,000	23,000	23000
TOTAL Electric Utility			0	0	0	52,600	52,600	
TOTAL Utilities			0	0	0	52,600	52,600	

F0201_02. Pipeline

F0201_0201. Pipeline Crossing Extension

USR 20" Mobile crude pipeline			0.00	0.00	0.00	44800.00	44800.00	
crosses under levee at 1 location where the land side berm will be extended about 25 feet, so the steel pipe casing for the pipeline will need to be extended. Based on an estimate from Mobil Oil in 1998, this modification will cost $40,000. Update to Oct 2002 price level. $40,000 x 1.12 = $ 44,800	1.00 EA	0.00	0	0	0	44,800	44,800	44800
TOTAL Pipeline Crossing Extension			0	0	0	44,800	44,800	
TOTAL Pipeline			0	0	0	44,800	44,800	
TOTAL Embankment & Ditching			0	0	0	97,400	97,400	

F0202. North Railroad Closure Relocatio

F0202_01. Railroad Relocation - SHOO-FLY
The lump sum cost for the relocation SHOO-FLY is based on construction costs of the Middle Closure Structure on the Ste. Genevieve project.

TOTAL Railroad Relocation - SHOO-F			0	0	0	191,670	191,670	
TOTAL Railroad Relocation - SHOO-F			0	0	0	191,670	191,670	

F. NON FEDERAL COSTS

F02. Relocations	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
F0202_02. BNSF cost for SHOO-FLY Relocatio								
The cost of the BNSF work includes removing a length of rail and ties so the closure structure can be constructed, tying their mainline tracks and signalling system into the shoo-fly, reinstalling their rail and ties after the closure structure is built, reconnecting to the mainline tracks from the shoo-fly, a temporary crossing for our contractor, and engineering and admin costs.								
TOTAL BNSF cost for SHOO-FLY Reloc			0	0	0	70,000	70,000	
TOTAL BNSF cost for SHOO-FLY Reloc			0	0	0	70,000	70,000	
TOTAL North Railroad Closure Reloc			0	0	0	261,670	261,670	
TOTAL Relocations			0	0	0	359,070	359,070	
F30. Planning, Engineering, & Design								
F3001. Planning, Engineering, & Design								
F3001_01. Planning, Engineering, & Design								
TOTAL Relocations			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Des			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Des			0	0	0	65,000	65,000	
TOTAL Planning, Engineering, & Des			0	0	0	65,000	65,000	
F31. Supervision and Administration								
F3101. Supervision and Administration								
F3101_01. Supervision and Administration								
TOTAL Relocation-Embankment, Ditch			0	0	0	11,000	11,000	
TOTAL Relocations for Railroad Clo			0	0	0	36,000	36,000	
TOTAL Supervision and Administrati			0	0	0	47,000	47,000	
TOTAL Supervision and Administrati			0	0	0	47,000	47,000	
TOTAL Supervision and Administrati			0	0	0	47,000	47,000	
TOTAL NON FEDERAL COSTS			0	0	0	4,610,340	4,610,340	

G30. Planning, Engineering & Design	QUANTY UOM CREW ID	OUTPUT	LABOR EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
G. FEDERAL COSTS-PART OF 30 ACCOUNT							
G30. Planning, Engineering & Design							
G3001. Planning, Engineering & Design							
G3001_01. Combined Design Deficiency and Section 205 Project							
USR Sunk Costs-Design Deficiency Thru FY01	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	135000.00 135,000	135000.00 135,000	135000
USR Design Deficiency Report FY02 & FY03	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	90000.00 90,000	90000.00 90,000	90000
USR Define Induced Flooding Extent	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	140000.00 140,000	140000.00 140,000	140000
USR Project Man Plan/Quality Control	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	110000.00 110,000	110000.00 110,000	110000
USR Project Cooperation Agreement	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	86000.00 86,000	86000.00 86,000	86000
USR Soil Boring/Testing-All Features	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	581000.00 581,000	581000.00 581,000	581000
USR Surveys & Mapping-District	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	153000.00 153,000	153000.00 153,000	153000
USR Interior Drainage Analysis	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	30000.00 30,000	30000.00 30,000	30000
USR Pump Station OMRRR Manual	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	50000.00 50,000	50000.00 50,000	50000
USR ROW & Relocations Drawings	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	115000.00 115,000	115000.00 115,000	115000
USR Levee OMRRR Manual/as-builts	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	60000.00 60,000	60000.00 60,000	60000
USR Real Estate Fed Activities not including induced flooding	1.00 LS	0.00	0.00 0	0.00 0	0.00 0	140000.00 140,000	140000.00 140,000	140000

G. FEDERAL COSTS-PART OF 30 ACCOUNT

G30. Planning, Engineering & Design	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMN	MATERIAL	UNIT PRC	TOTAL COST	UNIT
USR Environmental-not including			0.00	0.00	0.00	65000.00	65000.00	
P&S	1.00 LS	0.00	0	0	0	65,000	65,000	65000
USR Regulatory-not including P&S			0.00	0.00	0.00	35000.00	35000.00	
	1.00 LS	0.00	0	0	0	35,000	35,000	35000
USR Project Management-Not inclu			0.00	0.00	0.00	565000.00	565000.00	
ding	1.00 LS	0.00	0	0	0	565,000	565,000	565000
combined report, PMP, QCP								
USR Economics combined report, P			0.00	0.00	0.00	59000.00	59000.00	
MP,	1.00 LS	0.00	0	0	0	59,000	59,000	59000
QCP								
TOTAL Combined Design Deficiency			0	0	0	2,414,000	2,414,000	
TOTAL Planning, Engineering & Desi			0	0	0	2,414,000	2,414,000	
TOTAL Planning, Engineering & Desi			0	0	0	2,414,000	2,414,000	
TOTAL FEDERAL COSTS-PART OF 30 ACC			0	0	0	2,414,000	2,414,000	
TOTAL BOIS BRULE-100 YEAR LEVEL OF	1.00 EA		3769224	4903729	1,961,716	24,582,475	35,217,14	435217144

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ACARC1	3 carpnters			PROD = 100%			CREW HOURS =		24
MIL	B-CARPNTERL	Carpenters	3.00	HR	36.16	3.00	108.49			108.49
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	34.59	1.00	34.59			34.59
	TOTAL					4.00	143.08	0.00	0.00	143.08
	ACARC2	5 carpnters			PROD = 100%			CREW HOURS =		127
MIL	B-CARPNTERF	Carpenters	1.00	HR	37.16	1.00	37.16			37.16
MIL	B-CARPNTERL	Carpenters	4.00	HR	36.16	4.00	144.66			144.66
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	34.59	1.00	34.59			34.59
	TOTAL					6.00	216.41	0.00	0.00	216.41
	ACARCARP1	1 carpnter			PROD = 100%			CREW HOURS =		3
MIL	B-CARPNTERL	Carpenters	1.00	HR	36.16	1.00	36.16			36.16
	TOTAL					1.00	36.16	0.00	0.00	36.16
	APTRPORD2	2 paintords			PROD = 100%			CREW HOURS =		5
MIL	B-PAINTORDL	Painters, Ordinary	2.00	HR	31.09	2.00	62.17			62.17
	TOTAL					2.00	62.17	0.00	0.00	62.17
	APTSPSST1	1 paintss			PROD = 100%			CREW HOURS =		55
MIL	B-PAINTSS L	Painters, Structural Steel	1.00	HR	38.02	1.00	38.02			38.02
	TOTAL					1.00	38.02	0.00	0.00	38.02
	CLABB13	5 laborers + 1 crane, hydr, trk mtd, 60 ton			PROD = 100%			CREW HOURS =		20
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	35.59	1.00	35.59			35.59
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	34.59	4.00	138.36			138.36
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	40.66	1.00	40.66			40.66
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	34.78	1.00	34.78			34.78
GEN	C80Z2280 E	CRANE, HYD, TRUCK MTD, 60 TON	1.00	HR	81.32			1.00	81.32	81.32
	TOTAL					7.00	249.39	1.00	81.32	330.71
	CODFB7	2 eqoprmed + 1 laoder, F/E, crawler, 2.60 CY			PROD = 100%			CREW HOURS =		40
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	35.59	1.00	35.59			35.59
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	34.59	4.00	138.36			138.36
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	40.17	1.00	40.17			40.17
GEN	B20Z0890 E	BRUSH CHIPPER, 12" (305 MM) CAP	1.00	HR	18.72			1.00	18.72	18.72
GEN	L35Z4260 E	LOADER, F/E, CRWLR, 2.60 CY	1.00	HR	71.45			1.00	71.45	71.45
GEN	C05Z1210 E	CHAIN SAW, 24"-43"	2.00	HR	1.34			2.00	2.68	2.68
	TOTAL					6.00	214.12	4.00	92.85	306.97

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	CODSB33E	1 eqoprmed + 1 scraper, self propelled, 21-31 CY			PROD = 100%				CREW HOURS =	7
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.30	HR	40.17	1.30	52.22			52.22
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50	HR	34.59	0.50	17.30			17.30
GEN	S15Z5980 E	SCRAPER, S/P, 21-31 CY	1.00	HR	98.56			1.00	98.56	98.56
GEN	T15Z6600 E	DOZER, CRWLR, 341-440 HP	0.30	HR	83.13			0.30	24.94	24.94
	TOTAL					1.80	69.52	1.30	123.50	193.01
	CODTB10M	1 eqoprmed + 1 dozer, crawler, 341-440 HP			PROD = 100%				CREW HOURS =	8
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	40.17	1.00	40.17			40.17
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50	HR	34.59	0.50	17.30			17.30
GEN	T15Z6600 E	DOZER, CRWLR, 341-440 HP	1.00	HR	83.13			1.00	83.13	83.13
	TOTAL					1.50	57.47	1.00	83.13	140.60
	COELB66	1 eqoprlt + 1 loader, BH, wheel, 0.80 CY F/E bkt			PROD = 100%				CREW HOURS =	2422
MIL	B-EQOPRLT L	Equip. Operators, Light	1.00	HR	39.89	1.00	39.89			39.89
GEN	L50Z4640 E	LOADER/BH, WH, 0.80 CY (0.6 M3)	1.00	HR	12.96			1.00	12.96	12.96
GEN	L15Z4040 E	DRY CHEMICAL SPREADER, 85 CF	1.00	HR	2.92			1.00	2.92	2.92
	TOTAL					1.00	39.89	2.00	15.87	55.76
	COETE	3 laborer + 1 12 Cy Dump Truck			PROD = 100%				CREW HOURS =	233
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	35.59	1.00	35.59			35.59
MIL	B-LABORER L	Laborers, (Semi-Skilled)	2.00	HR	34.59	2.00	69.18			69.18
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	35.88	1.00	35.88			35.88
MIL	T40XX010 E	REAR DUMP BODY,12 CY,(36,000 GV	1.00	HR	2.93			1.00	2.93	2.93
MIL	T50KE003 E	TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00	HR	37.22			1.00	37.22	37.22
	TOTAL					4.00	140.65	2.00	40.15	180.80
	COFCB32E	1 eqoprmed + 1 dozer, crawler, 181-250 HP, PS			PROD = 100%				CREW HOURS =	2
MIL	B-LABORER F	Laborers, (Semi-Skilled)	0.30	HR	35.59	0.30	10.68			10.68
MIL	B-LABORER L	Laborers, (Semi-Skilled)	0.50	HR	34.59	0.50	17.30			17.30
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	40.17	1.00	40.17			40.17
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	35.88	1.00	35.88			35.88
GEN	R40Z5670 E	ROLLER, VIB, ST, SHEEPSFT, TOWE	1.00	HR	21.35			1.00	21.35	21.35
GEN	T15Z6520 E	DOZER, CRAWLER, 181-250 HP	1.00	HR	55.76			1.00	55.76	55.76
GEN	T40Z7055 E	WATER TANK, 3000 GAL (11 355 L)	1.00	HR	4.09			1.00	4.09	4.09
GEN	T50Z7420 E	TRUCK, 40,000 - 45,000 (18 144	1.00	HR	37.22			1.00	37.22	37.22
	TOTAL					2.80	104.02	4.00	118.42	222.45
	CPIDB19A	5 piledrvrs + 1 crane, crawler,drag/clam, 75 ton			PROD = 100%				CREW HOURS =	39
MIL	B-PILEDRVRF	Pile Drivers	1.00	HR	37.16	1.00	37.16			37.16
MIL	B-PILEDRVRL	Pile Drivers	4.00	HR	36.16	4.00	144.66			144.66
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	2.00	HR	40.66	2.00	81.32			81.32
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	34.78	1.00	34.78			34.78
GEN	C85Z2400 E	CRANE, CRWLR, DRAG/CLAM, 3.0CY	1.00	HR	135.30			1.00	135.30	135.30
GEN	P10Z4840 E	PILE LEADS, 8"X 26"(203-660 MM)	1.00	HR	5.95			1.00	5.95	5.95
GEN	A15Z0180 E	AIR COMPRESSOR, 1200CFM (34CMM)	1.00	HR	40.11			1.00	40.11	40.11

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
GEN	A20Z0490	E AIR HOSE,3.0"(76MM) X 100'(31M)	1.00	HR	1.10			1.00	1.10	1.10
	TOTAL					8.00	297.92	4.00	182.46	480.38
	EELEELEC2	2 electrns			PROD = 100%			CREW HOURS =		340
MIL	B-ELECTRN	L Electricians	2.00	HR	51.52	2.00	103.04			103.04
	TOTAL					2.00	103.04	0.00	0.00	103.04
	SIWRRODM4	4 rodmen			PROD = 100%			CREW HOURS =		134
MIL	B-RODMAN	L Rodmen, (Reinforcing)	4.00	HR	46.90	4.00	187.58			187.58
	TOTAL					4.00	187.58	0.00	0.00	187.58
	SIWSB	2 strsteel			PROD = 100%			CREW HOURS =		24
MIL	B-STRSTEELL	Structural Steel Workers	2.00	HR	46.90	2.00	93.79			93.79
MIL	B-STRSTEELF	Structural Steel Workers	0.50	HR	47.90	0.50	23.95			23.95
	TOTAL					2.50	117.74	0.00	0.00	117.74
	SIWWA	1 welders + 1 300 Amp Welding Machine			PROD = 100%			CREW HOURS =		50
MIL	B-WELDERS	L Welders, Structural Steel	1.00	HR	46.90	1.00	46.90			46.90
MIL	B-WELDERS	F Welders, Structural Steel	0.25	HR	47.90	0.25	11.97			11.97
MIL	W35XX009	E WELDER, 300 AMP, SKID,ELEC DRIV	1.00	HR	1.59			1.00	1.59	1.59
	TOTAL					1.25	58.87	1.00	1.59	60.46
	ULABC7	6 laborers + 1 crane, hydr, trk mtd, 60 ton			PROD = 100%			CREW HOURS =		96
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00	HR	35.59	1.00	35.59			35.59
MIL	B-LABORER	L Laborers, (Semi-Skilled)	5.00	HR	34.59	5.00	172.95			172.95
MIL	B-CEMTFINRL	Cement Finishers	1.00	HR	30.56	1.00	30.56			30.56
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	40.17	1.00	40.17			40.17
GEN	XMEZ9520	E VIBRATOR, CONCRETE	2.00	HR	3.70			2.00	7.40	7.40
GEN	B30Z1050	E BUCKET, CONCRETE, 1.0 CY	1.00	HR	0.46			1.00	0.46	0.46
GEN	C80Z2280	E CRANE, HYD, TRUCK MTD, 60 TON	1.00	HR	81.32			1.00	81.32	81.32
	TOTAL					8.00	279.27	4.00	89.18	368.45
*	XSABA	3 eqoprmed + 1 Grader, 2 Rollers, 3 Trucks			PROD = 100%			CREW HOURS =		1744
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	3.00	HR	34.59	3.00	103.77			103.77
MIL	X-EQOPRMEDL	Outside Equip. Operators, Mediu	2.00	HR	40.17	2.00	80.34			80.34
MIL	X-TRKDVRLTL	Outside Truck Drivers, Light	2.00	HR	35.66	2.00	71.32			71.32
MIL	G15CA003	E GRADER,MOTOR, ARTIC, CAT 12-G	1.00	HR	32.89			1.00	32.89	32.89
MIL	T60KI002	E TRK,WTR,OF-HY, 6000GAL,W/CAT621	1.00	HR	61.38			1.00	61.38	61.38
MIL	A10ET001	E CHIPSPREADER,S/P, 10'W, MECH	1.00	HR	20.70			1.00	20.70	20.70
GEN	L35Z4240	E LOADER, F/E, CRWLR, 1.50 CY	1.00	HR	32.84			1.00	32.84	32.84
GEN	T15Z6570	E DOZER, CRWLR, 300-340 HP	1.00	HR	69.94			1.00	69.94	69.94
MIL	X-EQOPRMEDF	Outside Equip. Operators, Mediu	1.00	HR	41.17	1.00	41.17			41.17
	TOTAL					8.00	296.60	5.00	217.75	514.35

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	XTBCA	3 laborer + 1 Water Truck, Backhoe, Compactor			PROD = 100%				CREW HOURS =	976
MIL	C10WC003	E COMPACTOR, RAMMER, 13"X11" SHOE	2.00	HR	2.46			2.00	4.91	4.91
MIL	L50CA003	E LDR,BH,WH, 1.38CY FE BKT, 30"DI	1.00	HR	19.78			1.00	19.78	19.78
MIL	T40XX033	E WATER TANK, 3000 GAL (ADD TRK	1.00	HR	3.54			1.00	3.54	3.54
MIL	T50KE003	E TRK,HWY, 46,000 GVW, 6X4, 3 AXL	1.00	HR	37.22			1.00	37.22	37.22
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	3.00	HR	34.59	3.00	103.77			103.77
MIL	X-EQOPRLT	L Outside Equip. Operators, Light	1.00	HR	39.89	1.00	39.89			39.89
MIL	X-EQOPRLT	F Outside Equip. Operators, Light	0.50	HR	40.89	0.50	20.45			20.45
MIL	X-TRKDVRLT	L Outside Truck Drivers, Light	1.00	HR	35.66	1.00	35.66			35.66
	TOTAL					5.50	199.76	5.00	65.45	265.21
*	XXQHL	1 eqoprhvy + 1 4.5 Cy Hydr. Excavator, Cwlr			PROD = 100%				CREW HOURS =	13
GEN	H25Z3225	E HYD EXCV, CRAWLER, 4.50 CY	1.00	HR	123.93			1.00	123.93	123.93
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	1.00	HR	34.59	1.00	34.59			34.59
MIL	X-EQOPRHVY	L Outside Equip. Operators, Heavy	1.00	HR	40.66	1.00	40.66			40.66
MIL	X-EQOPROIL	L Outside Equip. Operators, Oiler	1.00	HR	34.78	1.00	34.78			34.78
	TOTAL					3.00	110.03	1.00	123.93	233.96
*	XXQMO	1 eqoprmed + 1 Rotary Drill, 250 Hp			PROD = 100%				CREW HOURS =	7320
GEN	D35Z2970	E DRILL, ROTARY-BLASTHOLE, 7"- 9"	1.00	HR	97.13			1.00	97.13	97.13
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	1.00	HR	34.59	1.00	34.59			34.59
MIL	X-EQOPRMED	L Outside Equip. Operators, Mediu	1.00	HR	40.17	1.00	40.17			40.17
MIL	X-EQOPRMED	F Outside Equip. Operators, Mediu	0.25	HR	41.17	0.25	10.29			10.29
	TOTAL					2.25	85.05	1.00	97.13	182.19
	ZBBLEVEE	Embankment			PROD = 0.00%				CREW HOURS =	2933
EP	R30CA005	E SOIL COMP,SHPSFT,S/P 35T, 88"W	2.00	HR	86.49			2.00	172.98	172.98
MAP	S20CA003	E SCRAPER,TAND, 21-31CY, 37.5T PS	6.00	HR	130.44			6.00	782.62	782.62
EP	T15CA008	E DOZER,CWLR, D6M XL PS,W/BLADE	1.00	HR	45.67			1.00	45.67	45.67
MAP	T15CA016	E DOZER,CWLR, D-8R PS,W/BLADE	1.00	HR	60.94			1.00	60.94	60.94
MAP	T10CA017	E BLADE, UNIVERSAL, HYDR, D-8	1.00	HR	8.67			1.00	8.67	8.67
MAP	T15CA017	E DOZER,CWLR, D-9R PS,W/BLADE	1.00	HR	83.13			1.00	83.13	83.13
MAP	T10CA022	E BLADE, UNIVERSAL, HYDR, D-9	1.00	HR	12.50			1.00	12.50	12.50
EP	T60KI003	E TRK,WTR,OF-HY, 8000GAL,W/CAT631	1.00	HR	87.22			1.00	87.22	87.22
MIL	X-EQOPRHVY	L Outside Equip. Operators, Heavy	12.00	HR	40.66	12.00	487.92			487.92
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	4.00	HR	34.59	4.00	138.36			138.36
MIL	X-TRKDVRHV	L Outside Truck Drivers, Heavy	2.00	HR	35.88	2.00	71.76			71.76
MIL	X-LABORER	L Laborer Foreman	1.00	HR	34.59	1.00	34.59			34.59
	TOTAL					19.00	732.63	14.00	1253.74	1986.37

** LABOR BACKUP **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-CARPNTER	Carpenters	22.46	0.0%	40.0%	4.72	0.00	36.16	HR	04/10/02	22.87	710
MIL	B-CEMTFINR	Cement Finishers	17.40	0.0%	40.0%	6.20	0.00	30.56	HR	04/10/02	20.34	96
MIL	B-ELECTRN	Electricians	26.65	0.0%	40.0%	14.21	0.00	51.52	HR	04/10/02	27.92	680
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	20.75	0.0%	40.0%	11.61	0.00	40.66	HR	04/10/02	23.41	97
MIL	B-EQOPRLT	Equip. Operators, Light	20.20	0.0%	40.0%	11.61	0.00	39.89	HR	04/10/02	15.97	2422
MIL	B-EQOPRMED	Equip. Operators, Medium	20.40	0.0%	40.0%	11.61	0.00	40.17	HR	04/10/02	15.97	155
MIL	B-EQOPROIL	Equip. Operators, Oilers	16.55	0.0%	40.0%	11.61	0.00	34.78	HR	04/10/02	15.97	59
MIL	B-LABORER	Laborers, (Semi-Skilled)	20.35	0.0%	40.0%	6.10	0.00	34.59	HR	04/10/02	12.50	1734
MIL	B-PAINTORD	Painters, Ordinary	17.94	0.0%	40.0%	5.97	0.00	31.09	HR	04/10/02	12.96	9
MIL	B-PAINTSS	Painters, Structural Steel	22.89	0.0%	40.0%	5.97	0.00	38.02	HR	04/10/02	15.95	55
MIL	B-PILEDRVR	Pile Drivers	22.46	0.0%	40.0%	4.72	0.00	36.16	HR	04/10/02	25.72	195
MIL	B-RODMAN	Ironworker	25.34	0.0%	40.0%	11.42	0.00	46.90	HR	04/10/02	27.36	538
MIL	B-STRSTEEL	Structural Steel Workers	25.34	0.0%	40.0%	11.42	0.00	46.90	HR	04/10/02	24.06	60
MIL	B-TRKDVRHV	Truck Drivers, Heavy	21.88	0.0%	40.0%	5.25	0.00	35.88	HR	04/10/02	11.56	235
MIL	B-WELDERS	Welders, Structural Steel	25.34	0.0%	40.0%	11.42	0.00	46.90	HR	04/10/02	31.09	63
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	20.75	0.0%	40.0%	11.61	0.00	40.66	HR	04/10/02	23.41	35207
MIL	X-EQOPRLT	Outside Equip. Operators, Light	20.20	0.0%	40.0%	11.61	0.00	39.89	HR	04/10/02	15.96	1464
MIL	X-EQOPRMED	Outside Equip. Operators, Medium	20.40	0.0%	40.0%	11.61	0.00	40.17	HR	04/23/02	21.21	14381
MIL	X-EQOPROIL	Outside Equip. Oilers	16.55	0.0%	40.0%	11.61	0.00	34.78	HR	04/10/02	17.10	13
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	20.35	0.0%	40.0%	6.10	0.00	34.59	HR	04/10/02	9.72	30231
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	21.88	0.0%	40.0%	5.25	0.00	35.88	HR	04/10/02	19.23	5866
MIL	X-TRKDVRLT	Outside Truck Drivers, Light	21.72	0.0%	40.0%	5.25	0.00	35.66	HR	04/10/02	17.09	4463

** EQUIPMENT BACKUP **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
MAP	A10ET001	CHIP SPREADER,S/P, 10' W, MECH	6.68	1.81	3.54	0.98	0.12	0.02	7.55	20.70 HR	1744
GEN	A15Z0180	AIR COMPRESSOR,1,200CFM, 100 PSI	9.58	2.86	12.56	4.18	0.15	0.02	10.76	40.11 HR	39
GEN	A20Z0490	AIR HOSE,3.0"X 100'L (76MMX 31M)	0.37	0.04					0.69	1.10 HR	39
GEN	B20Z0890	BRUSH CHIPPER, 12"(305MM)DIA LOG	2.05	0.46	9.74	3.68	0.06	0.01	2.72	18.72 HR	40
GEN	B30Z1050	BUCKET, CONCRETE, 1.0CY (0.8M3)	0.20	0.05					0.20	0.46 HR	96
GEN	C05Z1210	CHAINSAW, 24" - 42" LONG BAR	0.12	0.01	0.57	0.21			0.42	1.34 HR	80
MAP	C10WC003	COMPACTOR, RAMMER, 11"X13" SHOE	0.67	0.10	0.40	0.11			1.18	2.46 HR	1952
GEN	C80Z2280	CRANE, HYD, TRUCK MTD, 65T	28.15	10.71	10.63	3.30	0.92	0.15	27.47	81.32 HR	116
GEN	C85Z2400	DRAGLINE/CLAMSHELL,CRWLR, 3.0CY	46.12	17.36	8.63	2.20			60.99	135.30 HR	39
GEN	D35Z2970	DRILL, ROTARY-BLASTHOLE, 7"-9"	26.05	9.53	16.22	7.20			38.13	97.13 HR	7320
EP	G15CA003	GRADER,MOTOR, ARTIC, CAT 12-H	10.60	4.34	3.99	1.60	0.47	0.08	11.82	32.89 HR	1744
GEN	H25Z3225	HYD EXCV, CRAWLER, 160,000LBS,	36.46	15.33	12.99	3.32			55.83	123.93 HR	13
GEN	L15Z4040	SPREADER, DRY CHEMICAL 85CF	1.38	0.16			0.03	0.00	1.34	2.92 HR	2422
GEN	L35Z4240	LOADER, F/E, CRWLR, 1.50CY	8.93	1.96	2.98	1.32			17.65	32.84 HR	1744
GEN	L35Z4260	LOADER, F/E, CRWLR, 2.60CY	19.95	4.39	5.30	2.35			39.45	71.45 HR	40
EP	L50CA003	LDR,BH,WH, 1.38CY FE BKT, 30"DIP	6.08	1.84	2.70	1.02	0.46	0.08	7.60	19.78 HR	976
GEN	L50Z4640	LOADER/BCK-HOE,WH, 0.80CY(0.6M3)	3.73	1.17	1.82	0.69	0.72	0.12	4.70	12.96 HR	2422
GEN	P10Z4840	PILE LEADS, SWING, 26"W X 8"D	2.23	0.51					3.22	5.95 HR	39
EP	R30CA005	SOIL COMP,SHPSFT,S/P 35T, 88"W	30.60	8.22	9.56	2.65			35.45	86.49 HR	5866
GEN	R40Z5670	ROLLER, VIB, SD, TOWED 25.5T	7.75	1.70	2.12	0.80			8.98	21.35 HR	2
GEN	S15Z5980	SCRAPER, SP, 21-31CY (16-24M3)	30.52	12.69	12.83	4.84	8.33	1.39	27.96	98.56 HR	7
MAP	S20CA003	SCRAPER,TAND, 21-31CY, 37.5T PS	38.91	16.03	20.61	6.41	11.05	1.84	35.60	130.44 HR	17597
MAP	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.50	0.94		0.13			4.10	8.67 HR	2933
MAP	T10CA022	BLADE, UNIVERSAL, HYDR, D-9	5.04	1.35		0.19			5.91	12.50 HR	2933
EP	T15CA008	DOZER,CWLR, D6M XL PS,W/BLADE	12.33	3.64	4.64	1.96			23.11	45.67 HR	2933
MAP	T15CA016	DOZER,CWLR, D-8R PS,W/BLADE	16.21	7.51	10.10	3.36			23.75	60.94 HR	2933
MAP	T15CA017	DOZER,CWLR, D-9R PS,W/BLADE	22.29	10.33	13.41	4.47			32.64	83.13 HR	2933
GEN	T15Z6520	DOZER, CRAWLER, 181-250HP	15.42	7.15	7.95	2.65			22.59	55.76 HR	2
GEN	T15Z6570	DOZER, CRAWLER, 300-340HP	19.06	8.83	10.60	3.53			27.92	69.94 HR	1744
GEN	T15Z6600	DOZER, CRAWLER, 341-440HP	22.29	10.33	13.41	4.47			32.64	83.13 HR	10
GEN	T40Z7055	WATER TANK, 3,000 GAL (11,356L)	1.95	0.43					1.72	4.09 HR	2
MAP	T50KE003	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	10.79	2.44	10.04	3.34	0.97	0.16	9.48	37.22 HR	1209
GEN	T50Z7420	TRUCK, HWY 45,000 (20,412KG)GVW	10.79	2.44	10.04	3.34	0.97	0.16	9.48	37.22 HR	2
MAP	T60KI002	TRK,WTR,OF-HY, 6000GAL,W/CAT621E	18.24	6.16	10.02	3.78	3.45	0.57	19.16	61.38 HR	1744
EP	T60KI003	TRK,WTR,OF-HY, 8000GAL,W/CAT631E	26.31	8.86	13.66	5.16	4.83	0.80	27.61	87.22 HR	2933
GEN	XMEZ9520	CONC VIBRATOR, 2.5" (63.5MM) DIA	1.04	0.16	0.69	0.48			1.33	3.70 HR	192

No errors detected...

* * * END OF ERROR REPORT * * *

OPERATION, MAINTENANCE & REPLACEMENT COST

Project: ***BOIS BRULE FEASIBILITY STUDY***
MISSOURI

50 Year Deficiency Project

DATE: 25 JULY 2002

Price Level: 01 October 2002

	FREQUENCY	QUANTITY	UNIT	UNIT COST	COST
OPERATION:					
PUMP STATION OPERATING COST:					
Missouri Chute Pump Station, 25 cfs	*Annual*	*1*	*EACH*	*14,430.00*	*14,430.00*
Cinque Hommes Pump Station, 10 cfs	*Annual*	*1*	*EACH*	*1,776.00*	*1,776.00*
Jones Cutoff Pump Station, 30 cfs	*Annual*	*1*	*EACH*	*5,328.00*	*5,328.00*
MAINTENANCE:					
Relief Well Inspection and Cleanout	*10 Years*	*284*	*EACH*	*500.00*	*142,000.00*
PUMP STATION MAINTENANCE COST:					
Missouri Chute Pump Station, 25 cfs	*Annual*	*1*	*EACH*	*2,000.00*	*2,000.00*
Cinque Hommes Pump Station, 10 cfs	*Annual*	*1*	*EACH*	*2,000.00*	*2,000.00*
Jones Cutoff Pump Station, 30 cfs	*Annual*	*1*	*EACH*	*2,000.00*	*2,000.00*
REPLACEMENT COST					
PUMPS & ELECTRICAL					
Missouri Chute Pump Station, 25 cfs	*25 Years*	*LUMP*	*SUM*		*250,000.00*
Cinque Hommes Pump Station, 10 cfs	*25 Years*	*LUMP*	*SUM*		*85,000.00*
Jones Cutoff Pump Station, 30 cfs	*25 Years*	*LUMP*	*SUM*		*250,000.00*
PUMP STATION STRUCTURAL					
Missouri Chute Pump Station, 25 cfs	*50 Years*	*LUMP*	*SUM*		*250,000.00*
Cinque Hommes Pump Station, 10 cfs	*50 Years*	*LUMP*	*SUM*		*85,000.00*
Jones Cutoff Pump Station, 30 cfs	*50 Years*	*LUMP*	*SUM*		*250,000.00*
Relief Well Rehabilitation	*25 Years*	*284*	*EACH*	*2,500.00*	*710,000.00*

OPERATION, MAINTENANCE & REPLACEMENT COST

Project: ***BOIS BRULE FEASIBILITY STUDY***
MISSOURI

100 Year Combined Project

DATE: 23 MAY 2002

Price Level: 01 October 2002

	FREQUENCY	QUANTITY	UNIT	UNIT COST	COST
OPERATION:					
PUMP STATION OPERATING COST:					
Bois Brule Pump Station, 41 cfs	*Annual*	*1*	*EACH*	*8,332.00*	*8,332.00*
Missouri Chute Pump Station, 48 cfs	*Annual*	*1*	*EACH*	*26,960.00*	*26,960.00*
Cinque Hommes Pump Station, 16 cfs	*Annual*	*1*	*EACH*	*2,808.00*	*2,808.00*
Jones Cutoff Pump Station, 57 cfs	*Annual*	*1*	*EACH*	*10,012.00*	*10,012.00*
MAINTENANCE:					
Relief Well Inspection and Cleanout	*10 Years*	*488*	*EACH*	*500.00*	*244,000.00*
PUMP STATION MAINTENANCE COST:					
Bois Brule Pump Station, 41 cfs	*Annual*	*1*	*EACH*	*2,500.00*	*2,500.00*
Missouri Chute Pump Station, 48 cfs	*Annual*	*1*	*EACH*	*2,500.00*	*2,500.00*
Cinque Hommes Pump Station, 16 cfs	*Annual*	*1*	*EACH*	*2,500.00*	*2,500.00*
Jones Cutoff Pump Station, 57 cfs	*Annual*	*1*	*EACH*	*2,500.00*	*2,500.00*
REPLACEMENT COST					
PUMPS & ELECTRICAL					
Bois Brule Pump Station, 41 cfs	*25 Years*	*LUMP*	*SUM*		*480,000.00*
Missouri Chute Pump Station, 48 cfs	*25 Years*	*LUMP*	*SUM*		*480,000.00*
Cinque Hommes Pump Station, 16 cfs	*25 Years*	*LUMP*	*SUM*		*160,000.00*
Jones Cutoff Pump Station, 57 cfs	*25 Years*	*LUMP*	*SUM*		*480,000.00*
PUMP STATION STRUCTURAL					
Bois Brule Pump Station, 41 cfs	*50 Years*	*LUMP*	*SUM*		*480,000.00*
Missouri Chute Pump Station, 48 cfs	*50 Years*	*LUMP*	*SUM*		*480,000.00*
Cinque Hommes Pump Station, 16 cfs	*50 Years*	*LUMP*	*SUM*		*160,000.00*
Jones Cutoff Pump Station, 57 cfs	*50 Years*	*LUMP*	*SUM*		*480,000.00*
Relief Well Rehabilitation	*25 Years*	*488*	*EACH*	*2,500.00*	*1,220,000.00*

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX G

ECONOMIC CONSIDERATIONS

APPENDIX G -ECONOMIC CONSIDERATIONS

Introduction

This appendix addresses the National Economic Development (NED) contributions of potential alternatives designed to improve the flood control performance of the Bois Brule Levee and Drainage District, predominantly in Perry County, Missouri with a small portion in Randolph County, Illinois. NED contributions are defined as increases in the net value of the national output of goods and services, expressed in monetary units.

Some important assumptions employed in the NED evaluation of potential alternatives for the Bois Brule Levee are:

- All costs and benefits are expressed in October 2002 price levels.
- The project life is estimated to be 50 years with the appropriate operation, maintenance, and replacements.
- The project interest rate is 6.125 percent.

Without Project Flood Damages And Losses

Flood damages experienced in the Bois Brule project area include damages to commercial and industrial structures and their contents; damages to the community’s infrastructure; flood damage to crop lands and losses resulting from disruption of traffic during periods of flooding.

Structural damages in the study area are mostly attributable to the two industrial facilities located within the levee district. Because of the unique characteristics of these facilities, existing condition structure damages were determined through interviews with representatives of the Saberliner and Gilster-Mary Lee companies. Other structures are scattered throughout the floodplain with the town of McBride containing numerous commercial structures. Damages for these structures were obtained using traditional depth-damage analysis and are contained within the structure damage tables.

Tables G-1 displays existing condition structure damages and G-2 and G-3 display structural damages for the 50- and 100-year projects respectively.

TABLE G-1

BOIS BRULE D&LD
EXISTING CONDITION STRUCTURE DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	STRUCTURE DAMAGE	CONTENT DAMAGE	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.0	1.0000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
2.0	0.5000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
10.0	0.1000	379.3	0.00	$ 3,273,000	$ 1,232,000	$ 4,505,000	$ 0	$ 0
10.1	0.0990	379.3	0.15	$ 3,273,000	$ 1,232,000	$ 4,505,000	$ 675,750	$ 335
20.0	0.0500	383.0	0.45	$11,939,000	$16,983,000	$28,922,000	$13,014,900	$ 335,489
25.0	0.0400	384.6	0.58	$15,686,000	$23,795,000	$39,481,000	$22,898,980	$ 179,569
41.0	0.0244	387.0	0.85	$20,032,000	$27,875,000	$47,907,000	$40,720,950	$ 496,546
55.0	0.0182	388.3	1.00	$22,125,000	$30,170,000	$52,295,000	$52,295,000	$ 288,741
75.0	0.0133	389.8	1.00	$25,341,000	$33,189,000	$58,530,000	$58,530,000	$ 268,667
100.0	0.0100	390.7	1.00	$25,836,000	$33,658,000	$59,494,000	$59,494,000	$ 196,707
200.0	0.0050	391.5	1.00	$29,167,000	$37,509,000	$66,676,000	$66,676,000	$ 315,425
500.0	0.0020	392.7	1.00	$29,167,000	$37,509,000	$66,676,000	$66,676,000	$ 200,028
				TOTAL AVERAGE ANNUAL STRUCTURE DAMAGE				$2,281,507

TABLE G-2

BOIS BRULE D&LD
WITH 50 YEAR PROJECT CONDITION STRUCTURE DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	STRUCTURE DAMAGE	CONTENT DAMAGE	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1	1.0000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
2	0.5000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
10	0.1000	379.3	0.00	$ 3,273,000	$ 1,232,000	$ 4,505,000	$ 0	$ 0
20	0.0500	383.0	0.00	$11,939,000	$16,983,000	$28,922,000	$ 0	$ 0
25	0.0400	384.6	0.00	$15,686,000	$23,795,000	$39,481,000	$ 0	$ 0
50	0.0200	387.9	0.00	$20,917,000	$29,234,000	$50,151,000	$ 0	$ 0
51	0.0196	387.9	0.85	$20,932,000	$29,234,000	$50,166,000	$42,641,100	$ 8,361
55	0.0182	388.3	1.00	$22,125,000	$30,170,000	$52,295,000	$52,295,000	$ 67,691
75	0.0133	389.8	1.00	$25,341,000	$33,189,000	$58,530,000	$58,530,000	$ 268,667
100	0.0100	390.7	1.00	$25,836,000	$33,658,000	$59,494,000	$59,494,000	$ 196,707
200	0.0050	391.5	1.00	$29,170,000	$37,509,000	$66,679,000	$66,679,000	$ 315,433
500	0.0020	392.7	1.00	$29,167,000	$37,509,000	$66,676,000	$66,676,000	$ 200,033
				TOTAL AVERAGE ANNUAL STRUCTURE DAMAGE				$1,056,892

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-3

BOIS BRULE D&LD
WITH 100 YEAR PROJECT CONDITION STRUCTURE DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	STRUCTURE DAMAGE	CONTENT DAMAGE	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.0	1.0000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
2.0	0.5000	XXX.X	0.00	$ 0	$ 0	$ 0	$ 0	$ 0
10.0	0.1000	379.3	0.00	$ 2,626,000	$ 1,037,000	$ 3,660,000	$ 0	$ 0
20.0	0.0500	383.0	0.00	$11,289,000	$16,777,000	$28,066,000	$ 0	$ 0
25.0	0.0400	384.6	0.00	$14,993,000	$23,587,000	$38,580,000	$ 0	$ 0
50.0	0.0200	387.9	0.00	$20,195,000	$29,021,000	$49,216,000	$ 0	$ 0
75.0	0.0133	389.8	0.00	$24,628,000	$32,975,000	$57,603,000	$ 0	$ 0
100.0	0.0100	390.7	0.00	$25,836,000	$33,658,000	$59,494,000	$ 0	$ 0
100.1	0.0100	390.7	1.00	$25,836,000	$33,658,000	$59,494,000	$59,494,000	$ 297
200.0	0.0050	391.5	1.00	$29,170,000	$37,509,000	$66,679,000	$66,679,000	$314,802
500.0	0.0020	392.7	1.00	$29,167,000	$37,509,000	$66,676,000	$66,676,000	$200,033

TOTAL AVERAGE ANNUAL STRUCTURE DAMAGE $ 515,132

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

Agricultural Damages

Crop damages for the project area were calculated by applying a dollar damage rate of $231.44 per peak flood acre (derived from the CACFDAS agricultural flood damage calculation program) to the average number of crop acres flooded per year under existing and potential project conditions. These damages are displayed in Tables G-4 through G-6.

Traffic Lost Time And Mileage Losses

This category of damages and benefits is based upon vehicles being forced to take alternate routes because of road closures due to high water. Lost time damages are based upon the type of travel, the amount of time spent traveling the best alternate route and the median family income derived from census information for the county containing the study area. Mileage losses are derived by applying the government mileage rate to the distance of the best alternate route. Because the existing Highway 51 bridge currently does not go over the top of the levee, a closure structure must be engaged any time flood events meet or exceed the 20-year frequency event. Without a bridge replacement, time and travel loss benefits would be reduced under the with-project condition, but if the bridge were raised, full benefits would accrue to the project. MODOT has indicated that the earliest time they would raise the bridge would be in the year 2012 which is five years beyond the base year of the project. Because of this, lost time and travel damages were calculated using data for the without-bridge condition for the first five years of the analysis and the with-bridge condition for the last 45 years of the project life. Existing travel and time losses without the bridge are displayed in Table G-7; with 50-year-project conditions without the bridge are displayed in Table G-8 and Table G-9 contains the same information for the 100-year combined project. Tables G-10 through G-12 contain corresponding information for the with-bridge conditions.

Because the study area contains the only access point across the Mississippi River between St. Louis and Cape Girardeau, it is important for transportation, not only for the study area, but also for the entire region on both sides of the Mississippi. Workers commute back and forth and the study area also contains two major industries, which must ship and receive goods over the Highway 51 bridge. Additionally, TG Industries, which is located outside the floodplain, but is dependent upon the Highway 51 bridge, is a supplier for the Toyota plant in Lexington, Kentucky. When the bridge is closed, shipment to the Toyota plant is more expensive and perhaps more importantly, it takes longer to deliver the parts.

Location and Development Benefits

The study area contains approximately 400 acres near the airport, which can be developed under the with-combined-project condition. This area contains much of the necessary infrastructure for development, including sewers and utilities. The development benefit is equal to the value of the land under the with-project condition minus the value of the land under the without-project condition and additional infrastructure costs. Consequently, the development benefit is equal to $103,600 for the project area.

TABLE G-4

BOIS BRULE D&LD
EXISTING CONDITION CROP DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	CROP ACRES FLOODED	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.0	1.0000	XXX.X	0.00	0	$ 0	$ 0	$ 0
2.0	0.5000	XXX.X	0.00	0	$ 0	$ 0	$ 0
10.0	0.1000	379.3	0.00	0	$ 0	$ 0	$ 0
10.1	0.0990	379.3	0.15	23,854	$5,518,384	$ 827,758	$ 410
20.0	0.0500	383.0	0.45	23,854	$5,518,384	$2,483,273	$ 81,137
25.0	0.0400	384.6	0.58	23,854	$5,518,384	$3,200,663	$ 28,420
41.0	0.0244	387.0	0.85	23,854	$5,518,384	$4,690,627	$ 91,861
55.0	0.0182	388.3	1.00	23,854	$5,518,384	$5,518,384	$ 95,117
75.0	0.0133	389.8	1.00	23,854	$5,518,384	$5,518,384	$ 26,756
100.0	0.0100	390.7	1.00	23,854	$5,518,384	$5,518,384	$ 18,395
200.0	0.0050	391.5	1.00	23,854	$5,518,384	$5,518,384	$ 27,592
500.0	0.0020	392.7	1.00	23,854	$5,518,384	$5,518,384	$ 16,555
				TOTAL AVERAGE ANNUAL CROP DAMAGE			$ 369,686

ACRES FLOODED TIMES $231.34 DAMAGE PER ACRE

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-5

BOIS BRULE D&LD
50-YEAR PROJECT CONDITION CROP DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	CROP ACRES FLOODED	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.0	1.0000	XXX.X	0.00	0	$ 0	$ 0	$ 0
2.0	0.5000	XXX.X	0.00	0	$ 0	$ 0	$ 0
10.0	0.1000	379.3	0.00	0	$ 0	$ 0	$ 0
20.0	0.0500	383.0	0.00	0	$ 0	$ 0	$ 0
25.0	0.0400	384.6	0.00	0	$ 0	$ 0	$ 0
50.0	0.0200	387.9	0.00	0	$ 0	$ 0	$ 0
51.0	0.0196	387.9	1.00	23,854	$5,518,384	$5,518,384	$ 1,082
75.0	0.0133	389.8	1.00	23,854	$5,518,384	$5,518,384	$34,625
100.0	0.0100	390.7	1.00	23,854	$5,518,384	$5,518,384	$18,395
200.0	0.0050	391.5	1.00	23,854	$5,518,384	$5,518,384	$27,592
500.0	0.0020	392.7	1.00	23,854	$5,518,384	$5,518,384	$16,555
				TOTAL AVERAGE ANNUAL CROP DAMAGE			$98,249

ACRES FLOODED TIMES $231.34 DAMAGE PER ACRE

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-6

BOIS BRULE D&LD
WITH 100-YEAR PROJECT CONDITION CROP DAMAGES

RETURN INTERVAL YRS.	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	CROP ACRES FLOODED	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.0	1.0000	XXX.X	0.00	0	$ 0	$ 0	$ 0
2.0	0.5000	XXX.X	0.00	0	$ 0	$ 0	$ 0
10.0	0.1000	379.3	0.00	0	$ 0	$ 0	$ 0
20.0	0.0500	383.0	0.00	23,854	$5,518,384	$ 0	$ 0
25.0	0.0400	384.6	0.00	23,854	$5,518,384	$ 0	$ 0
50.0	0.0200	387.9	0.00	23,854	$5,518,384	$ 0	$ 0
75.0	0.0133	389.8	0.00	23,854	$5,518,384	$ 0	$ 0
100.0	0.0100	390.7	0.00	23,854	$5,518,384	$ 0	$ 0
100.1	0.0100	390.7	1.00	23,854	$5,518,384	$5,518,384	$ 28
200.0	0.0050	391.5	1.00	23,854	$5,518,384	$5,518,384	$27,537
500.0	0.0020	392.7	1.00	23,854	$5,518,384	$5,518,384	$16,555

ACRES FLOODED TIMES $231.34 DAMAGE PER ACRE

TOTAL AVERAGE ANNUAL CROP DAMAGE $44,120

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-7

BOIS BRULE D&LD

EXISTING CONDITION VALUE OF LOST TIME & MILEAGE COST

WITHOUT BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$10,969,170	$ 0	$ 0
10.00000	0.1000	379.30	0.150	$10,969,170	$ 1,645,376	$ 0
20.00000	0.0500	383.00	1.000	$21,504,777	$21,504,777	$ 578,754
50.00000	0.0200	387.90	1.000	$20,811,074	$20,811,074	$ 634,738
75.00000	0.0133	389.80	1.000	$28,615,227	$28,615,227	$ 164,754
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$ 120,675
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$ 291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$ 218,516
				TOTAL AVERAGE ANNUAL VALUE OF LOST TIME		$2,009,009

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-8

BOIS BRULE D&LD
WITH 50-YR PROJECT CONDITION VALUE OF LOST TIME & MILEAGE COST
WITHOUT BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$ 0	$ 0	$ 0
10.00000	0.1000	379.30	0.150	$ 0	$ 0	$ 0
20.00000	0.0500	383.00	1.000	$21,504,777	$21,504,777	$578,754
50.00000	0.0200	387.90	1.000	$20,811,074	$20,811,074	$634,738
75.00000	0.0133	389.80	1.000	$28,615,227	$28,615,227	$164,754
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$120,675
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$218,516
				TOTAL AVERAGE ANNUAL VALUE OF LOST TIME		$1,967,875

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-9

BOIS BRULE D&LD
WITH 100-YR COMBINED PROJECT CONDITION VALUE OF LOST TIME & MILEAGE COST
WITHOUT BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$ 0	$ 0	$ 0
10.00000	0.1000	379.30	0.000	$ 0	$ 0	$ 0
20.00000	0.0500	383.00	1.000	$21,504,777	$21,504,777	$578,754
50.00000	0.0200	387.90	1.000	$20,811,074	$20,811,074	$634,738
75.00000	0.0133	389.80	1.000	$28,615,227	$28,615,227	$164,754
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$120,675
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$218,516
				TOTAL AVERAGE ANNUAL VALUE OF LOST TIME		$1,967,875

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS
DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-10

BOIS BRULE D&LD
EXISTING CONDITION VALUE OF LOST TIME & MILEAGE COST
WITH BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$10,969,170	$ 0	$ 0
10.00000	0.1000	379.30	0.150	$10,969,170	$ 1,645,376	$ 0
25.00000	0.0400	384.60	0.200	$21,504,777	$ 4,300,955	$578,754
50.00000	0.0200	387.90	1.000	$20,811,074	$20,811,074	$634,738
75.00000	0.0133	389.80	1.000	$28,615,227	$28,615,227	$164,754
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$120,675
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$218,516

TOTAL AVERAGE ANNUAL VALUE OF LOST TIME $1,225,028

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-11

BOIS BRULE D&LD

WITH 50-YR PROJECT CONDITION VALUE OF LOST TIME & MILEAGE COST

WITH BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$ 0	$ 0	N/A
10.00000	0.1000	379.30	0.000	$ 0	$ 0	$ 0
25.00000	0.0400	384.60	0.000	$ 0	$ 0	$ 0
50.00000	0.0200	387.90	0.000	$20,811,074	$20,811,074	$208,111
75.00000	0.0133	389.80	0.000	$28,615,227	$28,615,227	$164,754
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$120,675
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$218,516
				TOTAL AVERAGE ANNUAL VALUE OF LOST TIME		$1,003,629

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS

DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

TABLE G-12

BOIS BRULE D&LD
WITH 100-YR PROJECT CONDITION VALUE OF LOST TIME & MILEAGE COST
WITH BRIDGE REPLACEMENT

RETURN INTERVAL	RECURRENCE FREQUENCY	ELEVATION	PROBABILITY OF FLOODING	INUNDATION DAMAGES	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
1.00000	1.0000	XXX.XX	0.000	$ 0	$ 0	$ 0
2.00000	0.5000	XXX.XX	0.000	$ 0	$ 0	$ 0
9.99999	0.1000	379.30	0.000	$ 0	$ 0	N/A
10.00000	0.1000	379.30	0.000	$ 0	$ 0	$ 0
25.00000	0.0400	384.60	0.000	$ 0	$ 0	$ 0
50.00000	0.0200	387.90	0.000	$ 0	$ 0	$ 0
75.00000	0.0133	389.80	0.000	$ 0	$ 0	$ 0
100.00000	0.0100	390.70	1.000	$43,789,969	$43,789,969	$ 72,983
200.00000	0.0050	391.50	1.000	$72,838,760	$72,838,760	$291,572
500.00000	0.0020	392.70	1.000	$72,838,760	$72,838,760	$218,516
			TOTAL AVERAGE ANNUAL VALUE OF LOST TIME			$583,071

VALUE OF LOST TIME = $191,300 TIMES # OF DAYS
DATA REFLECTS PFP/PNP SEEPAGE GRADIENT METHOD

Benefit-Cost Analysis

Tables G-13 and G-14 display first cost information for the 50-Year and combined projects respectively. Average annual costs include first costs and corresponding interest during construction, which are amortized over the 50-year project life. Table G-15 combines the annualized first costs with annual operation, maintenance, and replacement, as well as annual costs necessary to raise the Highway 51 bridge, to determine the total average annual costs for the three project plans. These costs are then compared with the various benefit categories to calculate net benefits and benefit-cost-ratios.*

* Costs and benefits of the Section 205 alternative were derived by calculating the difference between the combined project and the design deficiency alternatives.

TABLE G-13

BOIS BRULE D&LD
50-YEAR PROJECT COST ANALYSIS

Project Cost Estimate Bois Brule – 50-Year Alternative			Cost	Future Cost
Construction Cost	$19,240,000	Year 1	$ 6,413,000	$ 7,441,000
Int. During Const.	$ 1,819,000	Year 2	$ 6,413,000	$ 7,011,000
Total PV Cost	$21,059,000	Year 3	$ 6,413,000	$ 6,606,000
		TOTAL	$19,239,000	$21,058,000
Avg. Ann. Cost	$ 1,359,400	IDC =	$ 1,819,000	

TABLE G-14

BOIS BRULE D&LD
COMBINED PROJECT FIRST COST ANALYSIS

Project Cost Estimate Bois Brule - 100-Year Alternative			Cost	Future Cost
Construction Cost	$51,000,000	Year 1	$17,000,000	$19,724,000
Int. During Const.	$ 4,823,000	Year 2	$17,000,000	$18,586,000
Total PV Cost	$55,823,000	Year 3	$17,000,000	$17,513,000
		TOTAL	$51,000,000	$55,823,000
Avg. Ann. Cost	$3,603,600	IDC =	$ 4,823,000	

TABLE G-15

BOIS BRULE D&LD

Benefit – Cost Analysis

	50-Yr Design Deficiency	Sect. 209 Plan	Combined Plan
PROJECT COST	$19,240,000	$31,760,000	$51,000,000
INTEREST DURING CONSTRUCTION	$ 1,819,000	$ 3,004,000	$ 4,823,000
TOTAL FIRST COSTS	$21,059,000	$34,764,209	$55,823,000
AVERAGE ANNUAL COST	$ 1,359,400	$ 2,244,200	$ 3,603,600
Assoc. Cost (Bridge Replacement)	$ 124,700	$ 124,700	$ 249,400
O&M/Replacement	$ 61,500	$ 95,800	$ 157,300
TOTAL AVERAGE ANNUAL COST	$1,545,600	$2,464,700	$4,010,300

	DAMAGES			BENEFITS		
	Existing Damages	50-Yr	100-Yr	50-Yr Design	Sect. 205 Plan	Combined Plan
STRUCTURES	$2,231,700	$1,040,300	$ 507,600	$1,224,600	$ 541,800	$1,766,400
TRAFFIC	$1,438,000	$1,265,000	$ 958,000	$ 173,000	$ 307,000	$ 480,000
CROP	$ 369,700	$ 98,200	$ 44,100	$ 271,500	$ 54,100	$ 325,600
LOCATION			$ 103,600	N/A	$ 103,600	$ 103,600
TOTAL AVERAGE ANNUAL BENEFITS				$1,669,100	$1,006,500	$2,675,600
BENEFIT/COST RATIO				1.08	0.41	0.67
EXCESS BENEFITS OVER COST				123,500	-1,458,200	-1,334,700

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX H

FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Marion Illinois Suboffice (ES)
8588 Route 148
Marion, IL 62959
(618) 997-3344

October 15, 1997

Colonel Thomas J. Hodgini

U.S. Army Corps of Engineers
1222 Spruce Street
St. Louis, Missouri 63103-2833

ATTN: Mr. Lyn Neher, CELMS-PD-A

Dear Colonel Hodgini:

This letter constitutes our Draft Fish and Wildlife Coordination Act Report (DFWCAR) for the Bois Brule Levee and Drainage District, Levee Raise Project, located in Perry County, Missouri, and Randolph County, Illinois. This report is intended to provide compliance with Subsection 2(b) of the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act of 1973, as amended.

This report describes existing fish and wildlife resources in the project area and adjacent areas subject to potential impact by structural development and identifies associated resource problems with emphasis on those related to or likely to be affected by water and land resource development. The report describes both positive and negative impacts to fish and wildlife associated the proposed plan. It also includes measures which should be included as an integral part of the project to mitigate project impacts and enhance the area for indigenous fish and wildlife species.

INTRODUCTION

The Bois Brule Levee and Drainage District is located in Perry County, Missouri, and Randolph County, Illinois, on the right bank of the Mississippi River between approximate River Miles 110.0 and 91.0. The levee is 33.1 miles in length and protects approximately 26,060 acres which is predominantly agricultural land. However, it also includes two corporate entities and the township of McBride, Missouri. The old river channel borders the district on the northwest. The Mississippi River is located both north and east of the district and Bois Brule Creek and Cinque Holmes Creek form the southern and western boundaries.

Colonel Thomas J. Hodgini

This feasibility study of improvements for the Bois Brule Levee and Drainage District was authorized by the Flood Control Act of 1948 under provisions of Section 205 of Public Law 80-858. The project incudes raising the levee, adding and/or rehabilitating existing relief wells, raising road crossings, and improving closure structures to provide added protection for the district. Four levee height alternatives are being considered. These include protection from the 75, 90, 100 and 200 year floods. Levee expansion is proposed to be landward of the existing levee.

Material for the levee is proposed to be excavated from three interior borrow areas and nine borrow sites located riverward of the levee. Borrow material from interior locations will be excavated adjacent to former borrow sites and from agricultural fields. Borrow sites located riverward of the levee are also agricultural fields currently in corn and soybean production.

DESCRIPTION OF THE PROJECT AREA

Approximately 26,000 acres located with the drainage district are in highly productive, intensive agricultural production which includes corn, wheat and soybeans. The area has a ridge and swale topography which is typical of Mississippi River bottomland areas. Relatively few remnants of formerly abundant floodplain forests are found within the levees. Those remaining occur along ditches and within lower swales.

Abundant agricultural lands also occur riverward of the levee. However, in this area floodplain forest is more common and occurs along the old river channel and the Mississippi River. These forest are dominated by silver maple, cottonwood and willow trees with limited numbers of other species.

FISH AND WILDLIFE RESOURCES

Wetland and forest wildlife habitat is generally scarce within the leveed area. Wooded areas occur in small tracts and along drainage ditches. Many of the trees in these areas died as a result of the Great Flood of 1993. Wetland and aquatic areas occur near the levee in former borrow sites, along various ditches running through the district and in low swales. These areas provide seasonal habitat for migratory birds including waterfowl, herons, egrets and shorebirds. The former borrow sites also provide habitat for various species of fish.

Wetland and forest wildlife habitat is generally more common riverward of the levee, but does not occur in great abundance. The forested areas were also affected by the Great Flood of 1993, but continue to provide important habitat for migratory birds. Various sloughs, swales and ditches also provide habitat for waterfowl, herons, egrets and shorebirds. The old river channel and the Mississippi River are important habitats for a variety of riverine fish. In particular, the

aquatic habitat around the Kaskaskia Bend area provides important habitat for the federally endangered pallid sturgeon (Scaphirhynchus albus).

RESOURCE PROBLEMS AND OPPORTUNITIES

Scarcity of habitat is the most important problem facing fish and wildlife in the Bois Brule Drainage and Levee District. Much of the vegetation has been cleared and tillage occurs up to the edge of the ditches. Many of these areas are sparsely vegetated and thus have relatively low carrying capacity. The revegetation of buffer areas along ditches and swales with food and cover producing plants would increase their carrying capacity for wildlife.

Good water quality is a prerequisite to maintaining healthy fish populations. More emphasis should be placed on prevention of point and non-point sources of pollution from agricultural lands in the project area. An intensive soil conservation program is needed to prevent further degradation of streams and ditches from siltation, sedimentation, pesticides and fertilizers.

FISH AND WILDLIFE IMPACTS AND MITIGATION

The landward expansion of the Bois Brule levee is expected to impact a small amount of wetland habitat. This will primarily consist of former borrow sites and small fragments of floodplain forest. A mitigation plan should be developed to address these impacts. Emergent wetlands should be replaced at a 1.5 to 1.0 ratio and forested wetlands should be replaced at a 2.0 to 1.0 ratio. Emergent wetlands may be allowed to naturally regenerate and can be developed utilizing the proposed borrow sites. Native tree species, including hard mast producing trees, should be planted to compensate for forested wetland impacts. These may also be developed around proposed borrow sites.

Many of the proposed borrow sites located riverward of the levee are expected to be farmed wetlands. These borrow sites should be developed in a manner that will increase their wetland benefits and provide higher value aquatic habitat for fish and wildlife. These sites could be developed in two different ways in order to maximize their benefits. Firstly, some sites could be excavated in a stair step pattern to a depth no greater than 6 feet. As such, these will develop wetland characteristics valuable to many species of wildlife. Secondly, some sites could be excavated to a depth of 20 feet and have a continuous slope which is easily stabilized. These will also develop wetland characteristics in the shallow water areas, but will also provide deep water aquatic habitat for fish.

Borrow pits located riverward of the levee should be constructed to have a connection to the river. This would allow fish spawned in the borrow pits to exit back to the river as spring floods recede. These sites should provide important backwater habitat, which is a resource that has declined drastically in the middle Mississippi River.

THREATENED AND ENDANGERED SPECIES

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Fish and Wildlife Service (Service) information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are furnishing you the following list of species that have ranges that include the concerned area:

Classification	Common Name	Scientific Name	Habitat
Endangered	Indiana bat	*Myotis sodalis*	Caves, mines; small stream corridors with well developed riparian woods; upland forests
Endangered	Pallid sturgeon	*Scaphirhynchus albus*	Rivers
Threatened	Bald eagle	*Haliaeetus leucocephalus*	Breeds and winters along large rivers and reservoirs
Threatened	Small whorled pogonia	*Isotria medeoloicles*	Dry woodland
Threatened	Decurrent false aster	*Boltonia decurrens*	Disturbed alluvial soils

There is no designated critical habitat in the project area at this time.

The Indiana bat utilizes trees with rough or exfoliating bark to roost and to form maternity colonies. It does not appear that habitat suitable for this species will be adversely affected by the proposed project. Should it become necessary to remove trees which provide suitable habitat, this work should be conducted between September 1 and April 31.

A bald eagle nest is located upstream of the project area. This nest was established in 1995 and was active for a period of time this year. The proposed project is located well away from the nest and should have no adverse effect on nesting activity. Dredging for sand from the Mississippi River has not been proposed as a part of project construction. In addition, suitable habitat for the small whorled pogonia and decurrent false aster does not appear to be present. Therefore, based upon available information at this time, the Service would concur that the proposed action is not likely to adversely affect any known federally listed threatened or endangered species. This precludes the need for further action on this project as required under Section 7 of the

Endangered Species Act of 1973, as amended. Should the project be modified or new information indicate endangered species may be affected, consultation should be initiated.

A number state listed threatened, rare and endangered species are listed as occurring in Perry County. Missouri and Randolph County, Illinois. The Missouri Department of Conservation and the Illinois Department of Natural Resources should be contacted regarding possible impacts to these species.

CONCLUSIONS AND RECOMMENDATIONS

The proposed project construction should have minimal impact on fish and wildlife resources in the project area. The proper development of the proposed borrow sites should maximize project benefits for fish and wildlife resources. However, if implemented, the increased flood protection within the district is likely to lead to increased economic development which are likely to adversely affect fish and wildlife resources in the project area. In addition, the continued isolation of the Mississippi River from the floodplain will serve to further adversely affect this important riverine resource and the fish and wildlife species which depend upon it.

The proposed project along with the recommended mitigation measures would meet basic Service mitigation goals. However, the following conservation measures should be included as an integral part of the project to enhance the project area for fish and wildlife.

1. Islands should be created in suitable borrow sites to provide a nesting area for waterfowl which is protected from terrestrial predators.

2. A 50-foot buffer area should be maintained around each borrow area to provide some protection of the aquatic habitats from agricultural runoff and to provide a source of cover for wildlife.

Thank you for the opportunity to provide this report. Please contact this office at 618/997-3344 should you have any questions.

Sincerely,

Joyce A. Collins

Joyce A. Collins
Assistant Field Supervisor

cc: IDNR (Schanzle, Kruse, Lauzon, Atwood)
MoDOC (Farabee, Haas, Fig-), USEPA (Mulder)

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX I

ENDANGERED SPECIES COORDINATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Marion Illinois Suboffice (ES)
8588 Route 148
Marion, IL 62959
(618) 997-3344

April 23, 1997

Mr. Daniel V. Ragland
St. Louis District
U.S. Army Corps of Engineers
1222 Spruce Street
St. Louis, Missouri 03103-283

ATTN: Ms. Sherrie Zenk-Reed, CELMS-PD-AE

Dear Mr. Ragland:

To facilitate compliance with Section 7 of the Endangered Species Act of 1973, as amended, we have been requested to determine whether any species that are federally listed or proposed to be listed as endangered or threatened may be present in the vicinity of the Bois Brule'Levee and Drainage District located in Perry County, Missouri, and Randolph County, Illinois. This information is requested to assist in the preparation of a draft Environmental Assessment for the Bois Brule Levee Raise Feasibility Study. Therefore, we are providing you the following list of species *which* have ranges that include the project area:

Classification	Common Name	Scientific Name	Habitat
Endangered	Pallid sturgeon	Scaphirhynchus *albus*	Rivers
Endangered	Indiana bat	Myotis *sodalis*	Caves, mines; small stream corridors with well developed riparian woods; upland forests
Threatened	Bald eagle	Haliaeetus leucocephalus	Breeds and winters along major rivers and large reservoirs
Threatened	Small whorled pogonia	Isotria medeoloides	Dry woodland
Threatened	Decurrent false aster	Boltonia decurrens	Disturbed alluvial soils

There is no designated critical habitat in the project area at this time.

The pallid sturgeon has been caught in the Mississippi River in the vicinity of Chester, Illinois. This endangered fish is wide-ranging and is thought to occur throughout the Middle Mississippi River. A bald eagle nest is located upstream of the project area on Kaskaskia Island and is thought to be active this year. Protection zones should be established around this nest to avoid disturbances.

The population of small whorled pogonia is located in the Mississippi River bluffs in Randolph County. The Indiana bat and decurrent false aster are not known to occur in the project area. However, suitable habitat for these species may be present.

Thank you for the opportunity to provide this list.

Sincerely,

Joyce A. Collins
Acting Assistant Field Supervisor

cc: MoDOC (Farabee)
IDNR (Glosser)
USFWS-CMFO

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 • Missouri Relay Center: 1-800-735-2966 (TDD)

JERRY M. CONLEY, *Director*

April 24, 1997

Mr. Daniel V. Ragland
Chief, Environmental Planning Branch
St. Louis District, Corps of Engineers
1222 Spruce Street
St. Louis, Missouri 63103-2833

Re: Bois Brule Levee Raise

Dear Mr. Ragland: Dan

Thank you for your letter of March 31, 1977 regarding threatened and endangered species within the proposed project area.

Department staff examined map and computer files for federal and state rare, threatened and endangered species and determined that sensitive species or communities are known to occur on the surrounding area. Please refer to the enclosed Heritage Database report for details.

This report reflects information currently in our database. It is provided for planning purposes only and should not be regarded as a definitive statement on the presence or absence of rare/endangered species or high-quality natural communities. Additional on-site inspections may be needed to verify the presence or absence of such species or communities.

Thank you for the opportunity to review and comment.

Sincerely,

GARY T. CHRISTOFF
ENVIRONMENTAL POLICY COORDINATOR

GTC:cgl
Enclosure

COMMISSION

ANITA B. GORMAN
Kansas City

RANDY HERZOG
St. Joseph

JOHN POWELL
Rolla

RONALD J. STITES
Plattsburg

ARMY CORPS OF ENGINEERS
BOIS BRULE LEVEE RAISE FEASIBILITY STUDY
PERRY COUNTY, MISSOURI

The following species and/or natural communities are *known* from the vicinity of the project site:

Scientific Name	Common Name	Fed Status	State Status	Date	Town/Range	Sec	Managed Area
ALOSA ALABAMAE	ALABAMA SHAD		R	1981	036N012E	23	
SCAPHIRHYNCHUS ALBUS	PALLID STURGEON	LE	E	1981	037N011E	3	

The following Managed Areas are located in the vicinity of the project site:

Managed Area	Owner	Town/Range	Sec
RED ROCK LANDING CONSERVATION AREA	MDC	035N012E11	SECS 12, 13

Additional *information* for planning purposes:

Pallid sturgeons are big river fish that may range widely in the Mississippi River and Missouri River system. Because the preferred habitat and range of the species are unknown, any project that modifies big river habitat or impacts water quality should consider the possible impact to pallid sturgeon populations.

FEDERAL STATUS - The federal status is derived from the provisions of the federal Endangered Species Act, which is administered by the U.S. Fish and Wildlife Service. The Endangered Species Act provides federal protection for plants and animals listed as Endangered or Threatened. E = Endangered T = Threatened A,B,C = Candidate for Federal Listing.

MISSOURI STATUS - The state status is determined by the Department of Conservation under Constitutional authority. Rule 3CSR10-4.111 of the Wildlife Code of Missouri and certain state statutes apply to state listed species. E = Endangered R = Rare SU = Status Undetermined WL = Watch List EXT = Extirpated XTN = Extinct.

Great blue heron rookeries, natural communities and geologic features may also occur on this printout. The status given these elements is provided for informational purposes only. C = Common, - = No status. These elements are not necessarily afforded protection through endangered species law or statute.

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 • Missouri Relay Center: 1-800-735-2966 (TDD)

JERRY M. CONLEY, *Director*

April 24, 1997

Mr. Daniel V. Ragland
Chief, Environmental Planning Branch
St. Louis District, Corps of Engineers
1222 Spruce Street
St. Louis, Missouri 63103-2833

Re: Bois Brule Levee Raise

Dear Mr. Ra6land: Dan

Thank y(fu for your letter of March 31, 1977 regarding threatened and endangered species within the proposed project area.

Department staff examined map and computer files for federal and state rare, threatened and endangered species and determined that sensitive species or communities are known to occur on the surrounding area. Please refer to the enclosed Heritage Database report for details.

This report reflects information currently in our database. It is provided for planning purposes only and should not be regarded as a definitive statement on the presence or absence of rare/endangered species or high-quality natural communities. Additional on-site inspections may be needed to verify the presence or absence of such species or communities.

Thank you for the opportunity to review and comment.

Siryserely,

ARY/JT. CHRISTOFF
NVIPONMENTAL POLICY COORDINATOR

GTC:cgl
Enclosure

COMMISSION

ANITA B. GORMAN
Kansas City

RANDY HERZOG
St. Joseph

JOHN POWELL
Rolla

RONALD J. STITES
Plattsburg

I 5

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX J

CLEAN WATER ACT EVALUATION

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX K

SECTION 404 PUBLIC NOTICE AND
SECTION 404 AUTHORIZATION

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX L

FARMLAND CONVERSION IMPACTS

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

REPLY TO
ATTENTION OF:
Environmental Planning Branch
Planning Division

6 MAY 1998

5/11/98

From:

Mr. J. Dan Childress
Eminence Soil Survey Office
Natural Resources Conservation Service
HCR-1, Box 185
Eminence, Missouri 65466

Dear Mr. Childress:

Re:

The St. Louis District, U.S. Army Corps of Engineers, is preparing a feasibility study for the Bois Brule Levee Raise Project. The majority of the Bois Brule Levee and Drainage District is located in Perry County, Missouri, with a small portion in Randolph County, Illinois. The project includes raising the levee, adding and/or rehabilitating existing relief wells, raising road crossings, and improving closure structures to provide added protection for the district.

We are currently preparing an Environmental Assessment (EA). As part of the EA, an AD-1006 Farmland Conversion Impact Rating Form needs to be completed. Enclosed is a form for the project with parts 1 and 2 filled in. I have included a series of plates that show where the borrow sites are located and a table listing the borrow sites and their respective size. Besides the 372.5 acres of borrow sites, an additional 40 acres will be impacted by the new levee right-of-way.

Questions and comments should be directed to Mr. Lynn Neher, at (314) 331-8880.

Sincerely,

Lynn N Neher

To:

for Daniel V. Ragland
Chief, Environmental Planning
Branch

Enclosures

Printed on Recycled Paper

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: 5 May 1998
Name Of Project: Bois Brule Levee Raise Project	Federal Agency Involved: US Army Corps of Engineers
Proposed Land Use: Borrow Sites and Levee right-of-way	County And State: Perry County, MO
PART II *(To be completed by SCS)*	Date Request Received By SCS: 5-11-98

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply — do not complete additional parts of this form).* Yes ☒ No ☐

Acres Irrigated: | Average Farm Size:

Major Crop(s)	Farmable Land In Govt. Jurisdiction	Amount Of Farmland As Defined in FPPA
CORN SOYBEANS WHEAT	Acres: 301,310 % 97.3	Acres: 174,110 % 56.2
Name Of Land Evaluation System Used: LESA	Name Of Local Site Assessment System: —	Date Land Evaluation Returned By SCS: 5-11-98

PART III *(To be completed by Federal Agency)*	Alternative Site Rating: Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	412.5			
B. Total Acres To Be Converted Indirectly	0			
C. Total Acres In Site	26,000			
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	312.0			
B. Total Acres Statewide And Local Important Farmland	—			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.18			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	9.2			
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	89			

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	20			
4. Protection Provided By State And Local Government	20	20			
5. Distance From Urban Builtup Area	—	—			
6. Distance To Urban Support Services	—	—			
7. Size Of Present Farm Unit Compared To Average	10	5			
8. Creation Of Nonfarmable Farmland	25	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	10			
11. Effects Of Conversion On Farm Support Services	25	0			
12. Compatibility With Existing Agricultural Use	10	0		—	
TOTAL SITE ASSESSMENT POINTS	160	85			
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	89			
Total Site Assessment *(From Part VI above or a local site assessment)*	160	85			
TOTAL POINTS *(Total of above 2 lines)*	260	174			

Site Selected: A | Date Of Selection: 5-18-98 | Was A Local Site Assessment Used? Yes ☐ No ☒

Reason For Selection:

The project involves using soil suitable for levee construction that will help to prevent ag land from being flooded. The majority of the area protected by the levee system is prime farmland. The choice of borrow sites placed a majority of them outside of the levee, which are areas most likely to flood.

(See Instructions on reverse side)

Form AD-1006 (10-83)

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Soil Conservation Service (SCS) local field office and retain copy D for their files. (Note: SCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the SCS State Conservationist in each state).

Step 3 – SCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step 4 – In cases where farmland covered by the FPPA will be converted by the proposed project, SCS field offices will complete Parts II, IV and V of the form.

Step 5 – SCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for SCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in §658.5(b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points", where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points: and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

DRAFT

COMBINED DESIGN DEFICIENCY AND DETAILED PROJECT REPORT
BOIS BRULE LEVEE AND DRAINAGE DISTRICT, MISSOURI

APPENDIX M

PUBLIC INVOLVEMENT AND CORRESPONDENCE