
Three Rivers Southeast Arkansas Study

Appendix C: Engineering

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1.0 THREE RIVERS SOUTHEAST ARKANSAS

Introduction

The Three Rivers Study, which encompasses the confluence of the Arkansas and White rivers with the Mississippi River in southeast Arkansas, is being conducted by the U. S. Army Corps of Engineers (USACE) to study the McClellan-Kerr Arkansas River Navigation System (MKARNS) in an effort to seek a long-term sustainable navigation system that promotes the continued safe and reliable economic use of the MKARNS.

There is a risk of breach of the existing containment structures near the entrance channel to the MKARNS on the White River. During high water events, water backing up the Mississippi can create significant head differentials between the Arkansas and the White rivers. The existing containment structures are subject to damaging overtopping, flanking and seepage that could result in a catastrophic breach. The uninhibited development of a breach, or cutoff, has the potential to create various navigation hazards, increase the need for dredging, and adversely impact an estimated 200 acres of bottomland hardwood forest in the isthmus between the Arkansas and White rivers.

Stage of Planning Process

This is a feasibility study. A planning Charette was conducted in September 2015, and an Alternatives Milestone Meeting was completed in December 2015. The study is in the Alternative Formulation and Analysis Phase. Utilizing a reasonable level of detail, the PDT has analyzed, compared, and evaluated the array of alternatives to identify a Tentatively Selected Plan.

Study Authority

Section 216, Flood Control Act of 1970 (Public Law 91-611) authorizes a feasibility study due to examine significantly changed physical and economic conditions in the Three Rivers study area. The study will evaluate and recommend modifications for long-term sustainable navigation on the MKARNS. Section 216 of the Flood Control Act of 1970 (Public Law 91-611) states:

"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."

Non-Federal Sponsor

The Arkansas Waterways Commission is the non-federal sponsor for the Three Rivers Southeast Arkansas Study. An amended feasibility cost-sharing agreement was executed in June 2015.

Purpose

Based on the Section 216 authority, the study is investigating alternatives that would minimize the risk of cut off development, including reducing the cost of maintenance associated with preventing cutoff development, while minimizing impacts to the surrounding ecosystem.

1. GENERAL

The project area being studied consists of a region where the White River, Arkansas River, Mississippi River and the McClellan-Kerr Arkansas River Navigation System (MKARNS) all interact during flood events to cause it to be a very dynamic area. When the Mississippi River is at flood stage it backs up the White River and eventually reaches a level where the White River's flow cannot stay within the banks. When this occurs it flows overland towards the Arkansas River, causing erosion to occur on a massive scale. Over time multiple headcuts have formed and were ultimately closed by the Corps of Engineers before significant damage could occur. The Owens Lake Structure, The Lagrues Lake Structure, the Melinda Structure, the Historic Cutoff Closure Structure, the Jim (John) Smith Structure and the Soil Cement Structure are just some of the facilities that USACE has built over the years in an attempt to control where and how water flows within the area. On a less frequent basis the Arkansas River can also flow towards the White River when it is experiencing a flooding condition. If the White River were to create a new channel to the Arkansas River, navigation utilizing the MKARNS would be disrupted. This is especially true of the barge shipping industry that uses the MKARNS to ship billions of dollars of commodities.

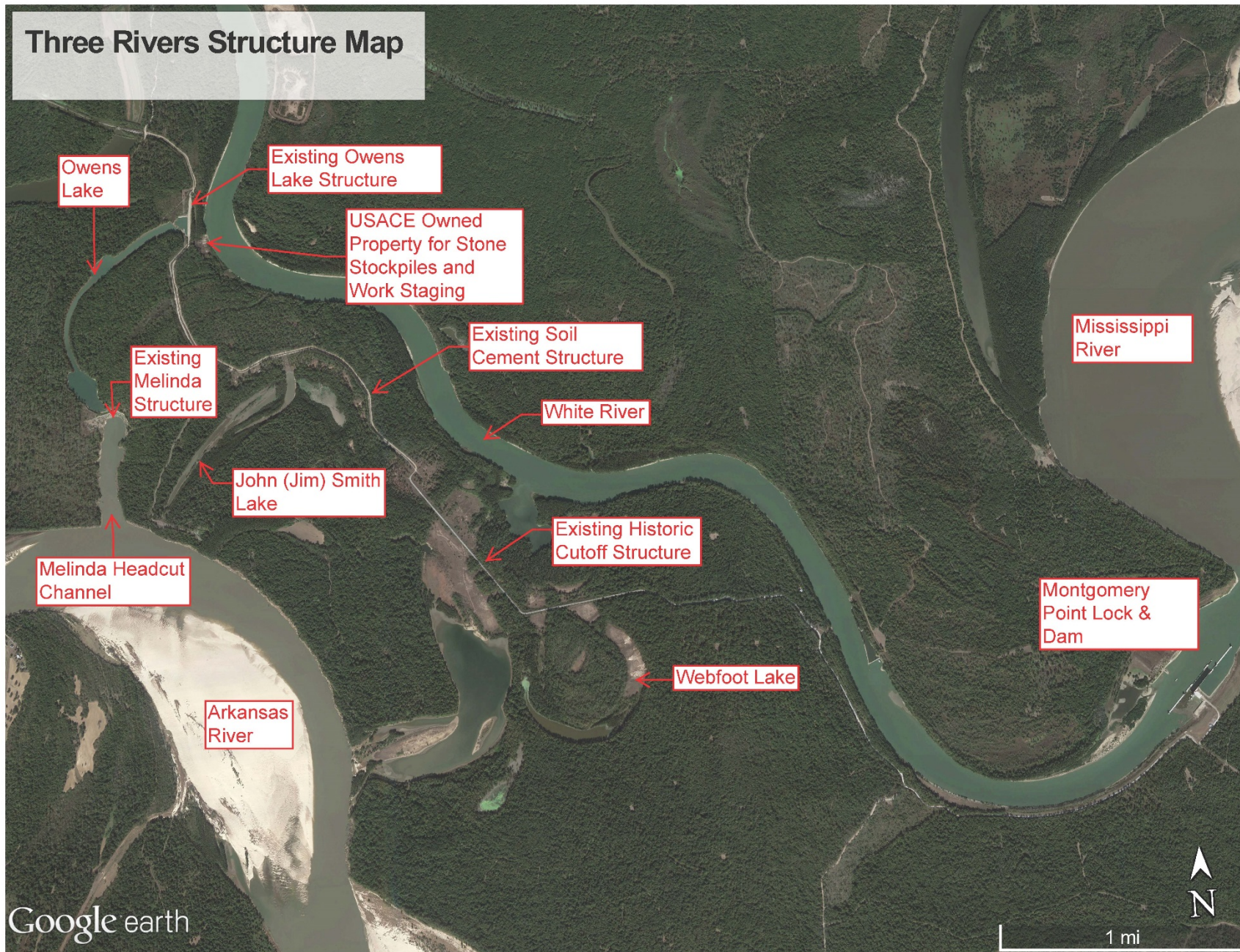
The goals of this project are to reduce the potential risk of a catastrophic breach, to insure that navigation can continue on the MKARNS and that environmental impact is limited. The means for achieving each of these goals is to reduce the damaging velocity heads which are causing the erosive forces creating new channels between the White River and the Arkansas River. This in turn will prevent disruption of river navigation and prevent destruction of the surrounding woodland areas. In order to do this, construction of various structures will need to be completed.

The engineering designs to follow were prepared to provide structures that are resilient enough to withstand the hydraulic forces that the Three Rivers system is capable of producing. Should damage occur to the structures, repairs can be easily performed with conventional construction equipment and the various stone material's. It is the intent of this study that future repairs would be expedited utilizing stone materials that have been stockpiled on USACE owned property located southeast of the existing Owens Lake Structure.

All the proposed structures will be hardened utilizing stone that has been delivered to the project site by the Sponsors shippers, utilizing the MKARNS.

On the next page is the Three Rivers Structure Map. It will provide the reader of this document the location of the existing structures located within the project area that will be impacted by the proposed projects to be discussed later in the Engineering Appendix.

Three Rivers Structure Map



Google earth

1 mi

2. HYDROLOGY AND HYDRAULICS (H&H)

H&H personnel performed numerous computer models to come up with the Alternatives that have been designed for this appendix. The complete H&H analysis is covered in a separate appendix and will provide a full explanation of the modeling that was performed.

The team investigated climate change impacts per “Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects” was issued in Engineering and Construction Bulletin (ECB) 2014-10. The proposed construction improvements are located at an elevation greater than 100 feet above Mean Sea Level and will not be impacted by sea level change. Change in climate is not expected to significantly alter the hydrologic analysis for the region and as a result was not specifically modeled for in the project. No climate change impacts have been included in the study.

3. SURVEYING, MAPPING AND OTHER GEOSPATIAL DATA REQUIREMENTS

Where available, LIDAR and hydrographic topographic data were used in the preparation of the designs described in this section. It should be noted that the available Lidar data was limited in some areas due to high water conditions at the time the Lidar data was obtained. During the Preconstruction, Engineering and Design (PED) phase, a comprehensive topographic and hydrographic survey will be required in order to develop the formal plans and specifications for construction. This proposed survey will identify topographic features, boundary lines, easements, structures, roads and utility lines, etc.

The available LIDAR and hydrographic topographic data was used within the Bentley INROADS software program to create 3D surface models of the structures to be constructed. This in turn was used to create volumes, measure distances and areas for the creation of the quantities used in the preparation of the cost estimates. These surfaces can create contour data as a byproduct of the computation process but contours are not needed to create quantities, the volume quantities were obtained from comparing the existing and proposed surfaces. The data used provided a realistic basis for the quantities used in the cost estimates.

4. GEOTECHNICAL

Sufficient geotechnical information is known about the areas where the proposed structures are to be constructed. The construction of the stone containment structure will be done solely by placement on-top of the ground surface without excavation being performed or required. The soils under the stone containment structure consist of silty-clay topsoil overlaying sandy materials. These soils have proved to be very stable under flood and construction activities. The existing Historic Cutoff structure as its name implies, is a structure that was built to close the cutoff or bypass that allowed water to flow between the White River and the Arkansas River during a flood event. See the “Three Rivers Structure Map” above for the location of the Historic Cutoff. It is a manmade structure and was constructed utilizing dredged material from the White

River. The composition of the dredged material was generally sandy with some clays and silts included. This was visually witnessed during its placement by USACE personnel. As such we do not believe that formal geotechnical testing was warranted for this study and the associated cost was therefore saved.

Prior to Preconstruction, Engineering and Design (PED) work, it is recommended that soil borings be taken in the Historic Cutoff to confirm the presence of the sandy soils and for the sheet pile design.

Stone material for the project's various construction activities is readily available from multiple quarries and can be barged directly to a USACE owned staging area adjacent to the Owens Lake Structure.

Additional Geotechnical information for the project area, including earthquake information, can be found in the draft "Arkansas-White River Cutoff Study" dated November 2007.

5. ENVIRONMENTAL ENGINEERING

The Three Rivers Study revealed some ancillary environmental benefits. They include the reduction in the isthmus velocities that promote erosion, preservation of the bottom land hardwood forest's hydrologic condition and re-connection of the Owens Lake oxbow that had been severed by the existing Melinda Structure. The existing Melinda Structure is located two-thirds of the way between the White River and Arkansas River and separates Owens Lake from the Melinda Headcut Channel. The existing Melinda Structure is constructed mainly of a soil cement mixture, with subsequent repairs utilizing concrete. The demolition of the existing Melinda Structure and the disposal of the debris in the 90 foot deep hole in the channel to the south of the structure will create a roughened bottom habit that will be beneficial for fish. See paragraph 6.1.2C for additional information. No other specific environmental features have been included in this study. For further background information see Appendix B – Hydrologic and Hydraulic Analysis and Appendix D - Environmental.

During the study's preliminary design process, we considered using dredged materials from the MKARNS for portions of the containment structure. However, a design that would be considered resilient enough for the rivers hydraulic flows was not identified. This decision was reinforced by the damage that occurred to the Jim (John) Smith Structure in occurred in February of 2005. The structure was built with a geotube core overlain with soil and vegetation. See Figure 1-13 in the "Arkansas-White River Cutoff Study", dated November 2007. It was therefore decided to utilize natural quarried stone for the containment structure. Stone is readily available for the project, it is durable and can be quickly modified or repaired if the need should occur.

6. CIVIL DESIGN

6.1.1 No Action Plan

Other than normal Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) requirements, the No Action Plan does not have any planned major changes to the existing structures maintaining the navigation system. Since 2014, two sinkholes have formed in the existing Historic Cutoff structure which requires remediation to insure that the structure does not fail in the future. While there may be other methods, this study only considered two methods for repairing the sinkholes. The first is to continue filling them with a mixture of earth and stone as they occur, with the potential risk for a damaging breach still present. This is the method currently being used by USACE Operations personal for sinkhole repairs. The second method and the one recommended for this feasibility study is the installation of a sheet pile cutoff wall. The wall would be 5625 feet long and extend from an elevation of 170 at the top of the sheet pile wall to an elevation of 100 at the bottom. The alignment for the sheet piling will follow the top of the existing Historic Cutoff Structure and be located at least 30 feet from the existing soil cement structure located on its top. This is to avoid the existing underground powerline and fiber optic cable that runs on either side of the soil cement structure. We consider the use of sheet piling to be a conservative and the most realistic method for repairing the sinkholes. For the No Action Plan, the final decision as to the type of repair method to be utilized for the sinkholes will require additional geotechnical study in the future. This falls within the Operation, Maintenance, Repair, Replacement & Rehabilitation (O,M,R,R&R) requirements for the existing Historic Cutoff Structure.

In addition, the draft “Arkansas-White River Cutoff Study”, dated November 2007 outlined additional structures that were to be constructed in the future as required to maintain the navigation system.

6.1.2 Alternative 1 – Stone Containment Structure at Elevation 157 and Re-opening of the Historic Cutoff (Tentatively Selected Plan (TSP))

This alternative is the Tentatively Selected Plan (TSP) and consists of four major elements:

- A. The construction of a Stone Containment Structure at an elevation of 157 feet above sea level. The proposed alignment is shown on sheet C-101 in Attachment A. The structure will be constructed of Little Rock District, Grade B stone. The stone gradation of which is also included in Attachment B. The structure will have a 20 foot wide top and 1:5 side slopes. Numerous alternative design materials were considered for the Containment Structure but only stone was determined to have the resiliency and ease of repair necessary for flowing water. See the table of alternative designs considered and not used. Although the all soil cement structure would be resilient, it was removed from consideration because the cost of repairs are high as USACE has experienced in the past. Due to the

remote location of the site, the use of stone provides the most hydraulically resilient structure, with the easiest ability to be maintained.

Alternative Designs Considered & Not Used	Resiliency
1 Ton retaining wall block core, 1:10 sand slopes & stone cap	No
Stone core w/1:1.5 slopes, 1:10 sand slopes & stone cap	No
Precast concrete core wall, 1:10 sand slopes & stone cap	No
Poured concrete wall core, 1:10 sand slopes & stone cap	No
Soil cement core, 1:10 sand slopes & stone cap	No
Soil cement structure in its entirety.	Yes
Sheet pile core, 1:10 sand slopes & stone cap	No

- B. The existing soil cement/concrete Owens Lake Structure will be revised to include a flow equalization structure consisting of a reinforced concrete arch bridge span similar to Contech's Con/Span O-Series. The inclusion of the arch will allow for flow between the White River and Owens Lake to allow the water levels to equalize at the same time without the damaging erosive forces which occur when water flows over the Owens Lake Structure. The arch shall have a rise of 6 feet and a span of 25 feet. After installation of the arch, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the Owens Lake Structure. See sheet C-502.
- C. The existing Melinda Structure will be demolished. Material disposal will be by pushing the soil cement/concrete debris into the adjacent scour hole located to the south of the structure which is about 90 feet in depth. The removal of the Melinda Structure will allow for a uniform rise in water levels in Owens Lake

and the Melinda Channel headcut without the risk of damage caused by high head differential flows over the Melinda Structure.

- D. The Historic Cutoff structure will be lowered to a final top of stone elevation of 145. See sheet C-501. For purposes of this feasibility study a 1000 foot wide opening is being used with 1:3 side slopes. During the Preconstruction, Engineering & Design (PED) phase of the project, the opening width must be optimized by the Hydrology & Hydraulics section (H&H). The materials excavated from the Historic Cutoff structure will be placed southwesterly of the proposed opening to create a new backwater embankment that is not directly impacted by the river flows. The excavated area will be protected by a 5 foot layer of R7400 on top of a 1 foot layer of R90 stone. The inlet and outlet end of the structure shall have stone placed upon the existing slope until the existing elevation of 135 is met. At this point a 20 foot wide by 20 foot deep section of stone toe protection trench filled with R7400 stone shall be placed running the full width of the inlet and outlet ends. Both the R7400 and R90 stone gradations are from the Vicksburg District. The R7400 gradation is shown in Attachment A. One existing underground powerline and underground fiber optic line are located in the project area and will need to be relocated as part of the New Historic Cutoff construction. Across the excavated area a 24 foot wide by 2 foot thick layer of concrete shall be placed with a top elevation of 145 and 1:10 end slopes as the road transitions to match the existing road. This road will allow for continued road access to the Montgomery Point Lock and Dam located 3-miles east of the Historic Cutoff. Across the center of the excavated area, a steel sheet pile shall be installed with a top elevation of 140 and a bottom elevation of 110 for a length of 1500 feet. All disturbed areas will be seeded with a flood resistant, deep rooting seed mixture suitable for growing in sandy conditions. During the Preconstruction, Engineering & Design (PED) phase, a geotechnical study should be performed to determine the best way to control sinkhole issues.

6.1.3 Alternative 2 – Multiple Openings

There will be three structures constructed as part of the Multiple Openings alternative and two existing structures will be modified.

- A. The Historic Cutoff structure will be lowered to a final top of stone elevation of 145. For purposes of this feasibility study a 2500 foot wide opening is being used with 1:10 side slopes. The materials excavated from the Historic Cutoff structure will be placed southwesterly of the proposed opening to create a new backwater embankment that is not directly impacted by the river flows. The excavated area

will be protected by a 5 foot layer of R7400 stone on top of a 1 foot layer of R90 stone. The inlet and outlet end of the structure shall have stone placed upon the existing slope until the existing elevation of 135 is met. At this point a 20 foot wide by 20 foot deep section of stone toe protection trench filled with R7400 stone shall be placed and shall run the full width of the inlet and outlet ends. Both the R7400 and R90 stone gradations are from the Vicksburg District. The R7400 gradation is shown in Attachment A. An existing underground powerline and underground fiber optic line are located in the project area and will need to be relocated as part of the New Historic Cutoff construction. Across the excavated area a 24 foot wide, 2 foot thick layer of concrete shall be placed with a top elevation of 145, to allow for continued road access to the Montgomery Point Lock and Dam located 3 miles east of the Historic Cutoff. Across the center of the excavated area, steel sheet pile shall be installed with a top elevation of 140 and a bottom elevation of 110 for a total length of 2700 feet. All disturbed areas will be seeded with a flood resistant, deep rooting seed mixture suitable for growing in sandy conditions. During the Preliminary, Engineering and Design (PED) phase, a geotechnical study should be performed to determine the best way to control sinkholes issues.

- B. The existing soil cement/concrete Owens Lake Structure is at an elevation of 145. As part of the multiple openings alternative, the structure would be reconstructed by removing a 400 foot section of the soil cement/concrete until the weir is at an elevation of 132. Both ends of the weir would be constructed with a minimum 1:10 slope to allow for vehicular traffic to utilize the structure. For purposes of this report it was assumed that the demolished materials would be repurposed for erosion protection on the Owens Lake side (west side) of the structure.
- C. A new 350 foot long stone structure will be constructed in Owens Lake halfway between the Owens Lake Structure and the Melinda Structure. It shall be constructed entirely of stone with a finished elevation of 135. The basic design shall follow the "Stone Containment Structure" shown on sheet C-501 in Attachment A with the exception that each end shall have 100 foot long stone keys in each embankment to protect against flanking. A new 1975 foot long by 30 foot wide access road will need to be cleared of trees and stumps to provide access to the site. No aggregate surfacing is proposed at this time.
- D. The existing soil cement/concrete Melinda Structure is at an elevation of 142. As part of the multiple openings alternative, the structure would be reconstructed by removing a 900 foot section of the soil cement/concrete until the weir is at an

elevation of 132. Both ends of the weir would be constructed with a minimum 1:10 slope to allow for vehicular traffic to utilize the structure. For purposes of this report it was assumed that the demolished materials would be repurposed for erosion protection on the Melinda Headcut channel side (south side) of the structure.

- E. A new 600 foot long stone structure will be constructed south of the Melinda Structure near the entrance to the Arkansas River. It shall be constructed entirely of stone with a finished elevation of 129. The basic design shall follow the “Stone Containment Structure” shown on sheet C-501 in Attachment A with the exception that each end shall have 100 foot long stone keys in each embankment to protect against flanking. A new 30 foot wide access road will need to be cleared of trees and stumps to provide access to the site. No aggregate surfacing is proposed at this time.

6.1.4 Environmental Alternatives

Four environmental alternatives were considered to provide fish passage for Lagrues Lake and Owens Lake. Preliminary designs and cost estimates were prepared for them, but were not included in this study. USACE was unable to find a Sponsor for the environmental alternatives, therefore the alternative was dropped from further consideration in the feasibility study.

- A. The existing road crossing at the north end of Lagrues Lake will have a flow equalization structure consisting of a reinforced concrete arch bridge span similar to Contech’s Con/Span O-Series. The inclusion of the arch will allow for flow between the White River and Lagrues Lake to allow for the passage of fish between them for longer periods of time. The arch shall have a rise of 6 feet and a span of 25 feet. The arch will need to be placed upon a concrete footing system set upon piling due to the soft soils anticipated. After installation of the arch, backfilling of the surrounding trench will be done using existing onsite soils and capped by a 12 inch aggregate surface course to restore the road to its existing condition. As part of the construction, the existing buried fiber optic cable will need to be relocated. We believe 300 feet of cable will be impacted. Electric power is overhead in this area.
- B. The existing soil cement/concrete Owens Lake Structure, located at the westerly end of Owens Lake, will be revised to include a flow equalization structure consisting of a reinforced concrete arch bridge span similar to Contech’s Con/Span O-Series. The inclusion of the arch will allow for flow between the White River and Owens Lake to allow for the passage of fish between them for longer periods of time. The arch shall have a rise of 6 feet and a span of 25 feet. The arch will be placed upon the existing soil cement which will act as the

footing system. After installation of the arch, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the Owens Lake Structure. No utilities are expected to be impacted.

- C. The existing soil cement containment structure at the easterly end of Owens Lake will be revised to include a flow equalization structure consisting of a reinforced concrete arch bridge span similar to Contech's Con/Span O-Series. The inclusion of the arch will allow for flow between the White River and Owens Lake to allow for the passage of fish between them for longer periods of time. The arch shall have a rise of 6 feet and a span of 25 feet. The arch will need to be placed upon a concrete footing system. After installation of the arch, backfilling of the surrounding trench will be done with concrete to restore the structural integrity of the existing soil cement containment structure. As part of the construction, both the existing fiber optic cable and underground powerline will need to be relocated. We believe 300 feet of fiber optic cable and potentially up to 2400 feet of underground power will be impacted.

Running parallel to the soil cement structure is a gravel road used by logging trucks. This gravel road lies within property currently owned by USACE. Due to elevation differences, the north end of the arch will need to be excavated to allow for water to pass thru easier. This area includes the gravel road which will need to be lowered and restored. Restoration will be by the placement of a 200 foot long, 30 foot wide and 2 foot thick concrete road crossing. In order to control erosion, Class B stone will be placed within the excavated area as needed.

- D. The existing Lagrues Lake soil cement/rip-rap structure will be demolished in its entirety. The rip-rap that has been placed on-top of the easterly end of the structure, will be removed and stockpiled for future use within the USACE property on the east end of the structure. Where practical, the soil cement shall be broken up and stockpiled adjacent to the rip-rap, otherwise it will be disposed of within the lake and used for bank protection. Where required, sand will be brought in to fill any large voids and to allow for natural revegetation. Disturbed areas will be revegetated upon completion. No utilities are expected to be impacted.

7. STRUCTURAL REQUIREMENTS

The existing Historic Cutoff has been experiencing small sinkholes during high head conditions that could cause a path for subsurface flows to breach the structure. To combat this risk, a steel sheet pile wall system will need to be designed for the No Action Alternative and Alternatives 1 and 2. For the No Action Alternative the top of the sheet pile will be at an elevation of 170 and the bottom at an elevation of 100. The total length of sheet pile to be installed for the No Action

Alternative is 5625 feet. For Alternative 1 the top of the sheet pile will be at an elevation of 140 and the bottom at an elevation of 110. Total length of sheet pile to be installed for Alternative 1 is 1500 feet. For Alternative 2 the top of the sheet pile will be at an elevation of 140 and the bottom at an elevation of 110. Total length of sheet pile to be installed for Alternative 2 is 2700 feet. For purposes of this feasibility study, an uncoated 27-inch wide steel sheet pile with a profile section of PZ26 was utilized.

8. ELECTRICAL AND MECHANICAL REQUIREMENTS

There are no mechanical features in this project.

For both Alternatives 1 and 2, an underground electrical powerline owned and operated by C&L Electric Cooperative Corporation at the Historic Cutoff has one pole within the area to be excavated. These poles will need to be replaced with longer ones to account for the lower ground elevation and to keep the electric connections above the water level. The wiring serving the poles is currently installed underground and is approximately 4800 feet between the next two poles located outside of the Historic Cutoffs project work. Design and construction of the electrical modifications would be performed by C&L Electric Cooperative Corporation with USACE reimbursing them for their work.

In addition, USACE owns an underground fiber optic communication cable serving the Montgomery Point Lock & Dam runs thru this same area and must be lowered after the excavation has been completed. Consideration should be given for the installation of the fiber optic cable within a PVC conduit installed adjacent to the sheet piling to provide protection from future damage and to allow for easier access if maintenance should be required. The anticipated length of fiber optic cable to be relocated is 2000 feet for Alternative 1 and 3000 feet for Alternative 2.

Electrical taking notes and drawings for the fiber optic cable show the general locations installed and are provided in Attachment C.

9. HAZARDOUS AND TOXIC MATERIALS

There will be no hazardous or toxic materials utilized in this project, nor are any expected to be encountered during its construction. A formal Hazardous, Toxic and Radioactive Waste (HTRW) survey is therefore not proposed for this project.

10. CONSTRUCTION PROCEDURES AND WATER CONTROL PLAN

As the Arkansas, White and Mississippi Rivers experience flood events, they will cause the cessation of all construction activities in the Three Rivers Study area. Careful planning and monitoring of river and weather conditions will be required in order for the construction equipment and associated manpower to be evacuated to higher ground prior to a flood event. Due to the volume of water moving through the study area during a flood event, a physical water control plan for the

construction site is therefore not feasible. However, localized erosion control measures should be implemented for the construction at the Historic Cutoff.

The construction schedule for the project should take into account mobilization and demobilization of construction equipment and personnel during flood events.

11. INITIAL RESERVOIR FILLING AND SURVEILLANCE PLAN

There are no reservoirs within the project area that would require a Reservoir Filling and Surveillance Plan.

12. FLOOD EMERGENCY PLANS FOR AREAS DOWNSTREAM AND UPSTREAM OF CORPS DAMS

There are no dams within the project area that would require a Flood Emergency Plan.

13. ENVIRONMENTAL OBJECTIVE AND REQUIREMENTS

The intent of the study's construction activities is to reduce the flood waters erosive forces which could potentially cause the White and Arkansas Rivers to merge. To accomplish this, Alternative 1 (the TSP) will require the installation of three new structures and the abandonment of one existing structure. Only the new Stone Containment Structure will require additional real estate. This real estate will be limited to the footprint covered by the structure and approximately 20 feet either side for future maintenance access. The other structures will be constructed within property owned by the Government or within the existing river floodways. The preliminary civil design described in Section 6 will become the basis for the final design.

14. RESERVOIR CLEANING

None required.

15. OPERATION AND MAINTENANCE

The project does not require physical operation of any of the features to be implemented. They are totally passive in nature and have no moving parts. As flooding occurs in the Three Rivers area, some stone will be shifted due to the force of the flood waters. In addition, vegetative debris could potentially begin to block the Owens Lake Equalization Structure. The expected maintenance required to maintain these structures would include the replacement of stone in areas where the thickness has been reduced and the removal of the vegetative debris blocking the Owens Lake Equalization Structure. All these repairs can be accomplished with the use of backhoes to place the stone and trucks to haul it.

16. ACCESS ROADS

Access to the project areas will use the existing roads and structures serving the Three Rivers Study area. The existing roads consist of aggregate stabilized surfaces capable of handling heavy

equipment loads. Recently these roads have been used for hauling timber, concrete and stone for structure repairs. The surface of the existing structures that would be used consists of soil cement or concrete. Only Alternative 2 requires additional access roads to be provided. They will be 30 feet wide and will not have an aggregate surface course. It is intended that the construction equipment blade and compact them so they are smooth and stable, in order to allow the off road trucks to deliver the stone for the two structures construction. Upon completion they would be reshaped and seeded.

It should be noted that portions of the access road will become inundated when the White River exceeds elevation 140. Also, there are some weight restrictions on the existing soil cement structure and the Wild Goose Bayou Bridge. A low water crossing will be required adjacent to the bridge for vehicles that exceed the bridge's weight restrictions.

During the Preconstruction, Engineering and Design (PED) phase, the access roads should be re-evaluated to verify that no improvements are required since the preparation of this study. The Contractor will be required to maintain all new and existing access roads used during the projects construction.

Access to the project area will also be available from the White River, especially for the delivery of stone materials.

17. CORROSION MITIGATION

The only metallic item in the project that could be subject to corrosion, is the steel sheet piling. The Historic Cutoff was built with sandy soils which allow for better aeration and faster evaporation rates which facilitates a faster evaporation process after water has been introduced to the soil. With these site conditions, corrosion is not expected to impact the steel sheet piling. However, during design a water and soil analysis should be performed to determine the groundwater level, resistivity and pH at the site. Other material options that could be considered if the water and soil analysis indicates corrosivity to steel include the use of vinyl sheet piling, concrete cutoff walls, slurry walls or soil mixing techniques.

18. PROJECT SECURITY

No project security is required, since the location of the construction is very remote and does not involve Government facilities that would require security to be present. During construction, the Contractor will be responsible for the protection of his equipment and personnel.

19. COST ESTIMATES

Cost estimates were prepared for the various alternatives and are included in Appendix F – “Cost Estimate”.

20. SCHEDULE FOR DESIGN AND CONSTRUCTION

The schedule for the tentatively selected plan is located within Appendix F – “Cost Estimate”.

21. SPECIAL STUDIES

None required.

22. PLATES, FIGURES AND DRAWINGS

Plates, Figures and Drawings have been included in Attachment A of the “Engineering Appendix”. They include: plan views of the Stone Containment Structure and the Historic Cutoff channel, typical cross sections of the containment structure, Historic Cutoff and the Owens lake Equalization Structure.

23. DATA MANAGEMENT

During the feasibility study, electronic data was compiled and maintained in project folders for each discipline involved on the server. This data is backed up regularly by USACE’s data manager (ACE-IT). The project’s information will be available for the next phase of the project.

24. USE OF METRIC SYSTEM MEASUREMENTS

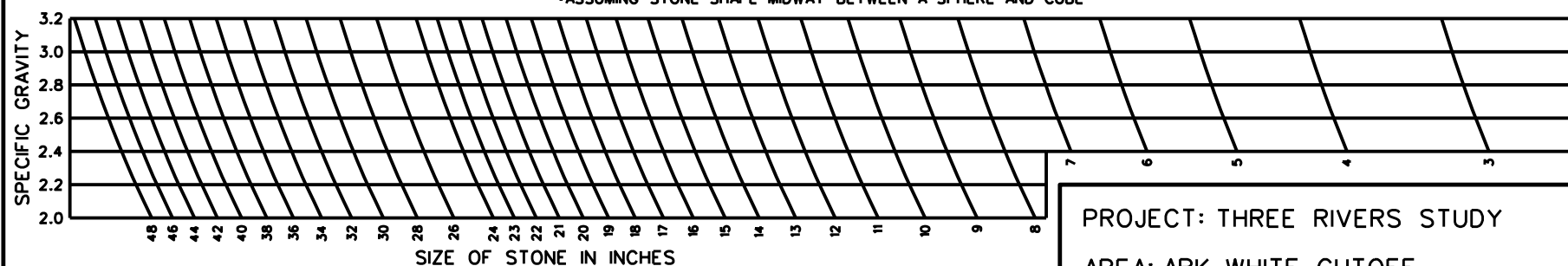
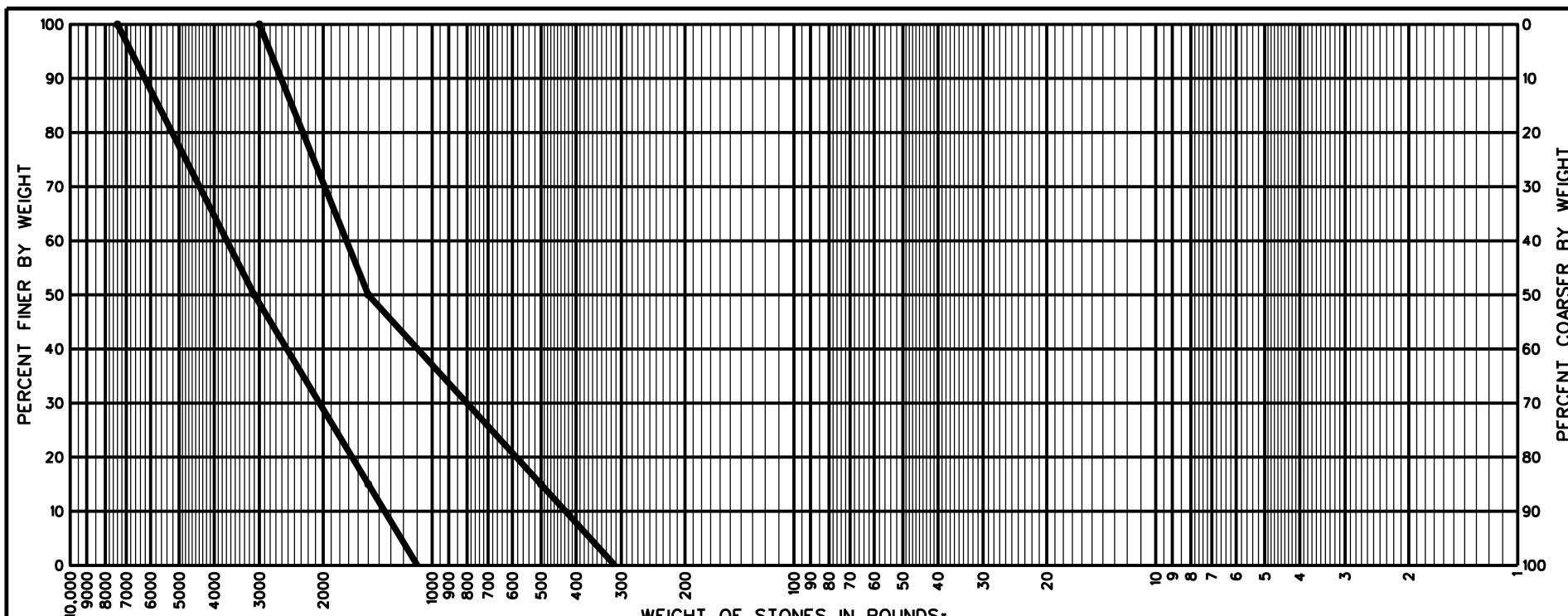
The Sponsor has not specifically requested that the project be designed in English units. However, the river mapping system and property surveys were all done originally in English units. Converting these survey drawings from English to Metric would have created additional work effort and potential translation errors which could affect the design team’s efforts resulting in delays to the schedule and additional costs to prepare the study.

25. REPORT ON DESIGN AND CONSTRUCTION DEFICIENCIES IN THE DALE BUMPERS WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

During the Alternatives Milestone Meeting held on December 15, 2015, the project team was requested to review the report “Correct Design and Construction Deficiencies of Mitigation Structures”, dated April 1991 for the Dale Bumpers White River National Wildlife Refuge. On October 11, 2016 a site visit was made to review the problems that said report had identified. The inspection report is located within Attachment B of the “Engineering Appendix”. The Army Corps of Engineers completed the required mitigation structures per the agreement for the construction of the MKARNS channel. The same agreement passed the responsibility for operation and maintenance of the mitigation structures to the US Fish and Wildlife Service (USFWS). At the time of the inspection, no design or construction deficiencies were identified. The issues the USFWS was experiencing at the refuge were the result of facilities meeting their useful life or were impacted by water movement between the green tree reservoirs or flooding from the river. The responsibility for correcting the damages associated with the age of the structure’s materials and the river is therefore the responsibility of the USFWS.

26. ATTACHMENT A

Plates, Figures and Drawings



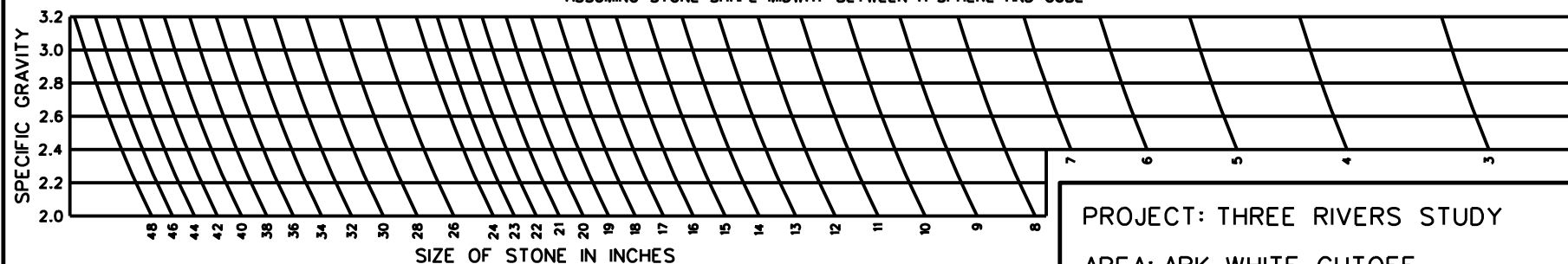
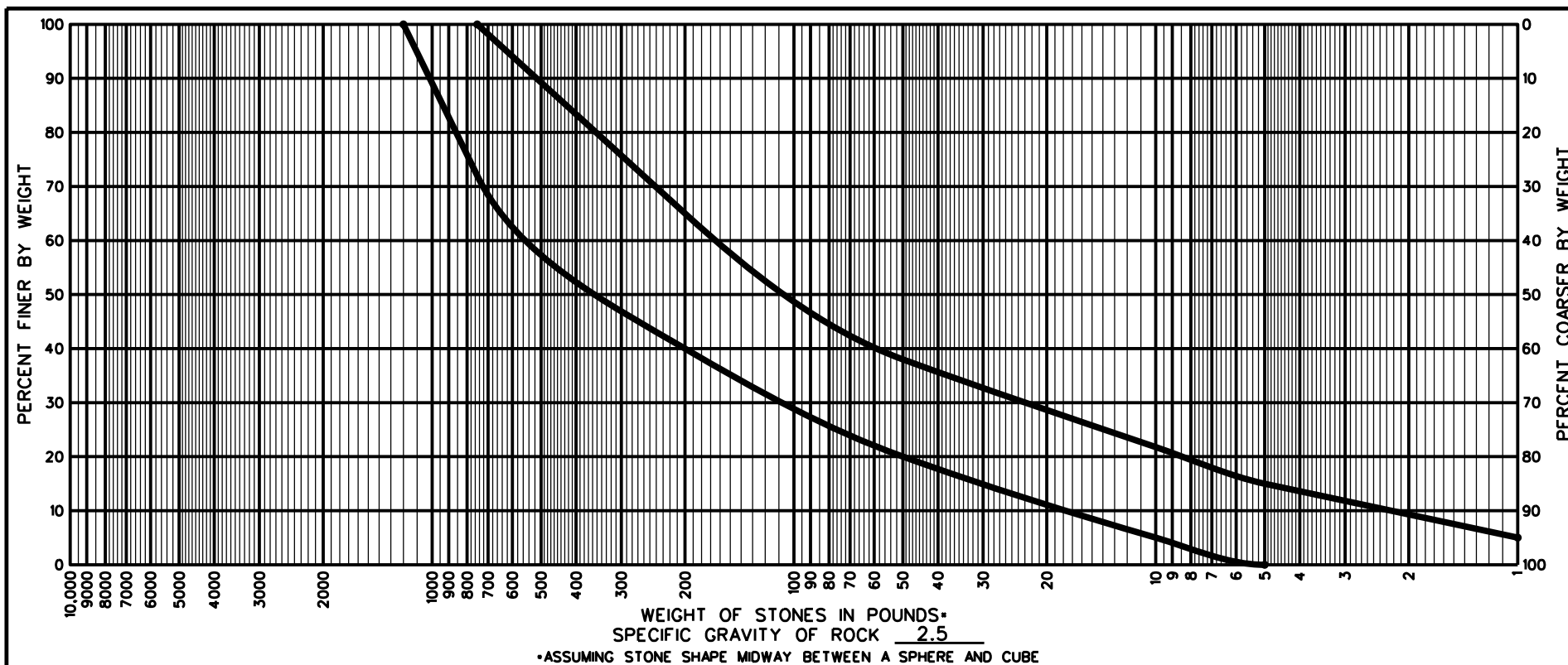
R7400 STANDARD RIPRAP

PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES



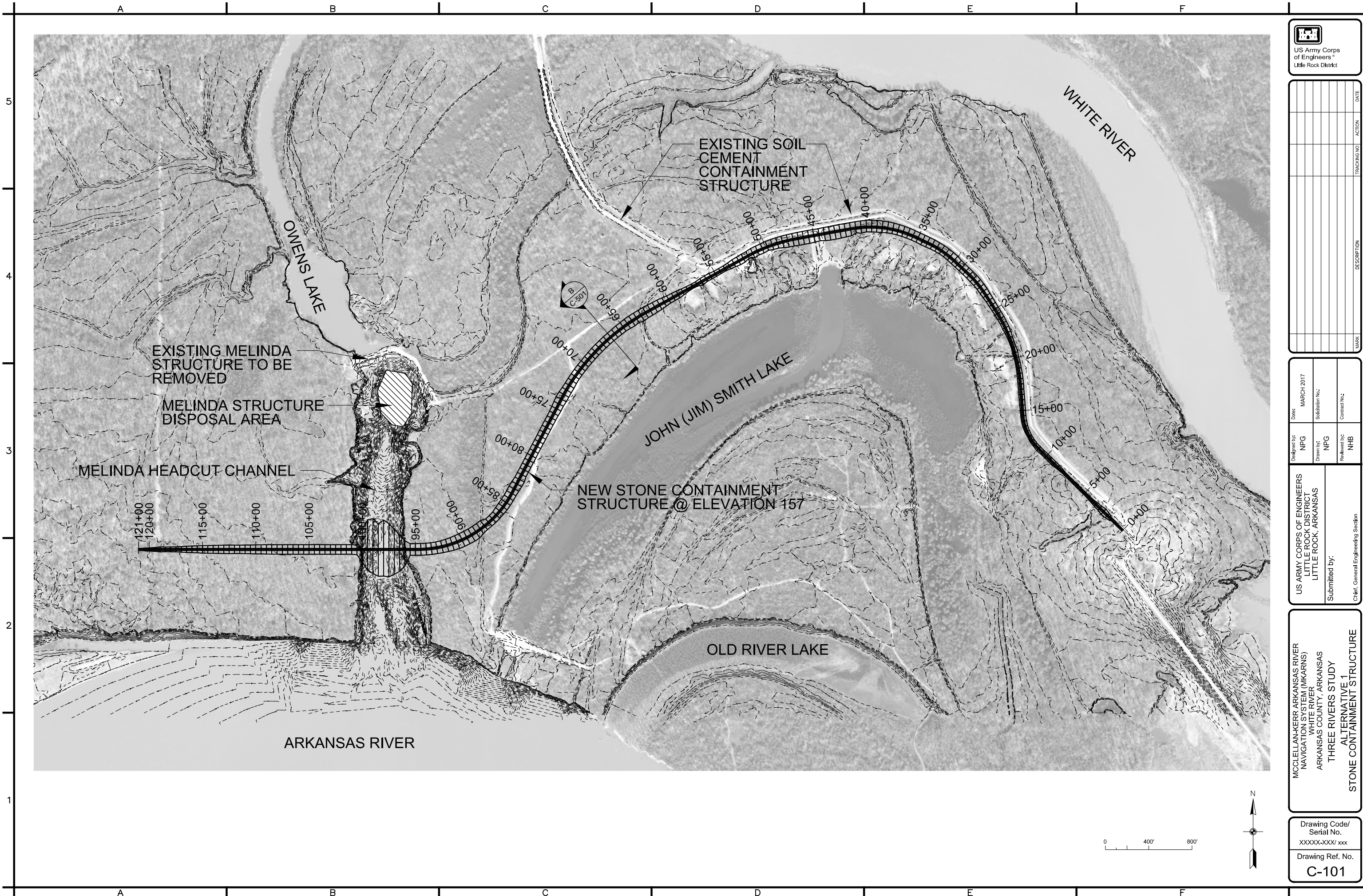
GRADED STONE B RIPRAP

PROJECT: THREE RIVERS STUDY

AREA: ARK-WHITE CUTOFF
ARKANSAS COUNTY, AR

DATE: NOVEMBER 2016

GRADATION CURVES



US Army Corps
of Engineers
Little Rock District

MARK	DESCRIPTION	TRACKING NO.	ACTION	DATE

Designed by: NPG	Date: MARCH 2017
Drawn by: NPG	Solidation No.:
Reviewed by: NHB	Contract No.:

Submitted by:
Chief, General Engineering Section

McCLELLAN-KERR ARKANSAS RIVER
NAVIGATION SYSTEM (MKANS)
WHITE RIVER
ARKANSAS COUNTY, ARKANSAS
THREE RIVERS STUDY
ALTERNATIVE 1
STONE CONTAINMENT STRUCTURE

Drawing Code/
Serial No.
XXXXX-XXX/ xxx
Drawing Ref. No.
C-101

\$\$\$\$\$SYTIME\$\$\$\$\$
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\$\$\$\$\$USERNAME\$\$\$\$\$

27. ATTACHMENT B

**Report on Design and Construction Deficiencies in the Dale Bumpers White River
National Wildlife Refuge, Arkansas**



Reply to
Attention of:

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
P.O. BOX 867
LITTLE ROCK, ARKANSAS 72203-0867
www.swl.usace.army.mil

CESWL-EC-DG

October 11, 2016

MEMORANDUM FOR RECORD

SUBJECT: Site Visit to Inspect MKARNS Construction Deficiencies of Mitigation Structures
Dale Bumpers White River National Wildlife Refuge (WRNWR), Arkansas

On this date a site visit was made to the WRNWR, specifically that area located north of the MKARNS channel and west of the White River. Present during the site visit were the USACE employees Norman Gartner, David "Craig" Hillburn and Cherrie-Lee Phillp and US Fish and Wildlife Service (USFWS) employees Charles "Bo" Sloan, Arthur "Jay" Hitchcock, and Jason Phillips. The Letter Report entitled "Correct Design and Construction Deficiencies of Mitigation Structures" dated April 1991 identified the mitigation structures that were to be corrected. This report is included for reference at the rear of this memorandum. It should be noted that since the 1991 report was completed, USACE has not performed any corrective action to these structures. During the December 15, 2015, Alternatives Milestone Meeting (AMM), USACE Headquarters requested that this report be revisited and the mitigation structures be re-inspected to see if additional damage has occurred. Below are the results of the site visit to the damaged mitigation structures and to other areas within the WRNWR that the USFWS requested to be looked at. Specific locations area identified on the attached Location Map.

Mitigation Deficiencies from 1991 Report

Area 1

A. Twin 60 inch Sluice Gate Control Structure.

The north slide gate has been replaced by Ducks Unlimited under contract with the USFWS. A "Hydrogate", Model IB5, with a 4:1 lift ratio was used to replace the original sluice gate. See Figure 1.

The south slide gate is still the original one installed. It has been partially disassembled and is currently inoperable. See Figures 2 and 3. In addition, the gate's guide brackets are not anchored to the concrete wall due to corrosion of the existing anchor bolts. See Figure 4. An attempt to re-anchor the guide brackets was never completed.

For the south slide gate, the concrete is pitted and at some locations adjacent to the stop log channels has broken away. In addition, the steel guide channels for the stop logs has

corroded and is partially missing. See Figure 5. Vegetative and earthen debris has partially blocked the use of the gates. See Figures 5 and 6.

The settlement and resulting cracking identified in the above referenced report was not immediately visible during this inspection.

Recommendation: The south slide gate should be repaired or replaced to restore its operability. Where missing, the steel guide channel and concrete should be repaired. Both slide gates should be re-anchored to the concrete wall. All vegetative and earthen debris should be removed to insure successful operation of the entire structure as designed.

B. 36 inch CMP Culvert

The 36 inch CMP culvert located north of the sluice gate was replaced by Ducks Unlimited in 2003 under contract with the USFWS. The pipe is now a 5 foot diameter steel pipe with a sluice gate.

Recommendation: No further action is required.

C. 36 inch CMP Culvert (Not part of original deficiencies.)

The 36 inch CMP culvert located 4780 feet east of the sluice gate has been lined with a ½ inch polyethylene liner that was pulled thru the pipe with no other work being performed on the pipe. The installation of the liner was done by slicing slits in the end to facilitate pulling it thru the CMP. The liner was not pulled all the way thru the pipe so the slits still remain inside the pipe. The ends of the pipe seem to have a direct connection to the ground surface because some settlement has occurred on the surface, possibly due to soil migration into the pipe. The upstream end also has sediment deposition which should be removed. Who installed the liner is unknown.

Recommendation: With the exception of the end areas, the liner does seem to be functioning, however USACE's preferred method of repair would have been to use the SnapTite liner system and grout the annular space that remains to restore the pipes structural integrity and prevent soil intrusion. The USFWS should periodically inspect the liner to insure further failure has not occurred. Other than removal of the sediment deposit at the upstream end of the pipe, no further action is recommended.

D. 36 inch CMP Culvert (Not part of original deficiencies.)

The 36 inch CMP culvert located 5440 feet east of the sluice gate has been lined with a ½ inch polyethylene liner that was pulled thru the pipe with no other work being performed on the pipe. The installation of the liner was done by slicing slits in the end to facilitate pulling it thru the CMP. The liner was not pulled all the way thru the pipe and remains inside the pipe. The liners ends also have poor adhesion at the top. See Figure 7. The upstream end of the pipe seems to have a direct connection to the ground level because some settlement has occurred on the surface, possibly due to soil migration into the pipe. The upstream end also has sediment deposition which should be removed. See Figure 8. Who installed the liner is unknown.

Recommendation: With the exception of the end areas, the liner does seem to be functioning, however USACE's preferred method of repair would have been to use the SnapTite liner system and grout the annular space that remains to restore the pipes structural integrity and prevent soil intrusion. The USFWS should periodically inspect the liner to insure further failure has not occurred. Other than removal of the sediment deposit at the upstream end of the pipe, no further action is recommended.

Area 2

This area was not inspected because the Deficiencies Report identified that there was "No economical justifiable repair to recommend".

Area 3

The 36" CMP was not visible during this site visit. It can only be assumed that it has been filled in or removed as previously recommended in the Deficiencies Report. The levee in this area was also in good structural shape.

Recommendation: No further action is required.

Area 4

As mentioned in the Deficiencies Report the culvert has been replaced by the USFWS with a 36" CMP. The outlet looked like it had been armored with a combination of stone and concrete. See Figure 9. The existing levee looked in good shape and did not appear to require widening or additional stone protection. The drainage from the culvert does not go directly to the river but turns southerly and follows an old channel between the levee and the river. This channel has experienced some erosion in localized areas that are not very big. The USFWS has indicated that the sluice gate and culvert are not currently being used and that their preference would be to block them. These issues appear to fall within the Operation and Maintenance obligations of the USFWS.

Recommendation: No further action is required.

New Erosion Area (Not part of original deficiencies.)

Approximately 6250 feet north of Area 4, the White River's embankment is within 50 feet of Levee A. At the time of the inspection, it was impossible to tell how active the river erosion process is in the area. Aerial photos reviewed back to 1994 on Google Earth did not show a very active erosion process. It is therefore impossible to determine if the levee is in imminent risk or whether the river will move away from this area.

Recommendation: Perform annual inspections of this area to determine if the river is continuing to erode the embankment. To do this establish fixed points to measure from towards the river and create a database to determine how fast the erosion is occurring. If erosion is determined to be a problem, approximately 3000 feet of stone bank protection

may be required to protect the embankment area. The final design of any stone bank protection required would be determined in the future.

Area 5

The White River has destroyed approximately 1300 feet of Levee "A" used as mitigation for the MKARNS project. The USFWS has built a new levee west of the White River. Starting approximately 8200 feet east of Area 1 and extending north until it intersects with Levee "A". Constructing this new levee was the recommendation in the Deficiencies Report. This new levee has removed approximately 175 acres of land from the "green tree reservoir" that the levee was to create for mitigation. Since this new levee has been constructed, the need for restoring the destroyed portion of Levee "A" is uncertain. In addition, a 60 inch CMP culvert located 8150 feet east of Area 1's sluice gate, has been constructed by Ducks Unlimited under contract with the USFWS.

Recommendation: No further action is required.

Dry Lake Structure (Not part of original deficiencies.)

During the site visit the USFWS requested that the Dry Lake Gate Structure be looked at. Figures 10 – 16 provide representative views of the structure. A visual inspection indicated the structure was in good shape. Some minor repairs are required. They include rehabilitating and adding a protective coating to the trash racks to repair the holes which have appeared over time. The second would be to replace the missing covers over the grating. See Figure 14. The structure's outlet pipe is served by two CMP of unknown size. No physical damage was witnessed, but due to their age it is believed they are approaching their useful life and should be considered for lining sometime in the near future.

Conclusion

Per the 1964 permit, a copy of which is included in the attached deficiency report, USACE was to design and construct the mitigation structures while the USFWS was to operate and maintain them. At the time of the inspection, no design or construction deficiencies were identified. In addition, the problems being experienced by the USFWS appear to be normal maintenance issues. Many of the issues the USFWS is experiencing are the result of facilities meeting their useful life or were physically impacted by water movement between the green tree reservoirs or flooding from the river. The responsibility for correcting the damages associated with the age of the structure's materials and the river is therefore the responsibility of the USFWS.

There were 41 photos taken of the different areas and placed in the following folder: "L:\ENG Shared\DESIGN\PROJECTS\CIVIL WORKS CORPS\Three Rivers Study\Photos\MKARNS Deficiencies". Representative photos of various items found have been attached as figures at the rear of this report.

Norman Gartner, P.E.
USACE General Engineering Section
CESWL-EC-DG



Figure 1 - Area 1, New Gate Mechanism installed by USFWS in 2003.



Figure 2 - Area 1, Existing Gate Mechanism (Note that it has been disassembled.)



Figure 3 - Area 1, Existing Gate Mechanism (Note that it has been disassembled.)



Figure 4 - Area 1 - Existing southern slide gate. Note that the anchor bolts are not connected.



Figure 5 - Area 1, Debris and missing guide frame and concrete spalling. North side of the southern 60" concrete pipes inlet.



Figure 6 - Area 1, Debris and guide frame. South side of the southern 60" concrete pipes inlet.



Figure 7 - Existing 36" CMP, 5440 feet east of Area 1. Typical liner installation. Note the poor liner adhesion at the pipes entrance.



Figure 8 - Existing 36" CMP inlet 5440 feet east of Area 1. Typical guide installation. Note sediment on upstream side.



Figure 9 - Area 4, Outlet end of 36" CMP replaced by the USFWS.



Figure 10 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 11 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 12 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 13 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 14 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 15 - Dry Lake Structure. (Not part of original mitigation deficiencies.)



Figure 16 - Dry Lake Structure Outlet. (Not part of original mitigation deficiencies.)

USFWS LOCATION MAP

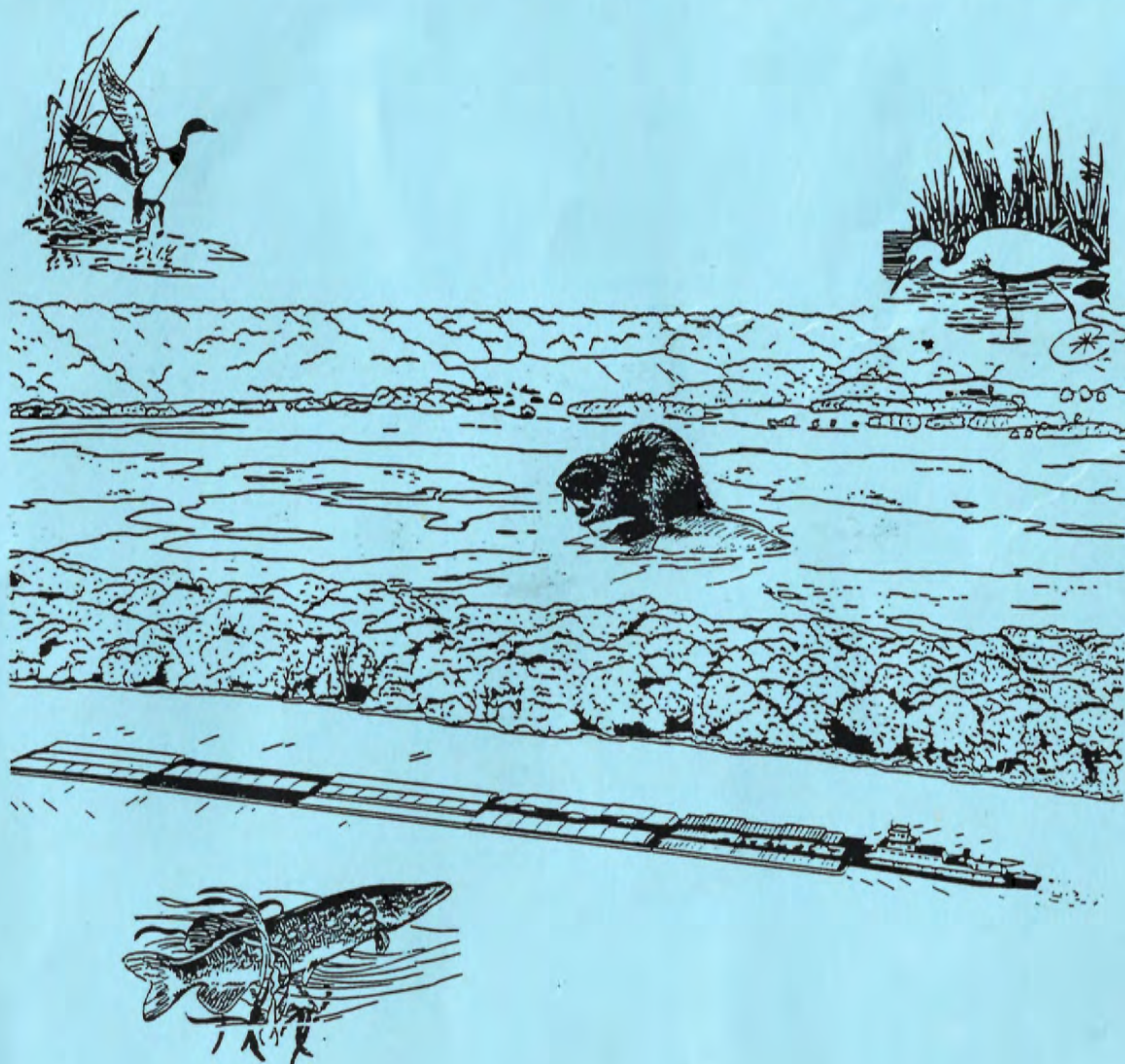




US Army Corps
of Engineers
Little Rock District

WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

CORRECT DESIGN AND CONSTRUCTION DEFICIENCIES OF MITIGATION STRUCTURES



LETTER REPORT
APRIL 1991

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- B. List of Project Deficiencies
- C. Cost Estimate Summary

Letter Report
Rehabilitation of Deteriorating Structures
White River National Wildlife Refuge

1. Background. Construction of the Arkansas Post Canal as a part of the McClellan-Kerr Arkansas River Navigation System was started during the early 1960's. A portion of the canal was constructed through the White River National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service (hereinafter referred to as "the Service"). Under the terms of a permit with the Service dated 2 January 1964 (Appendix A), the Corps was required to construct a containment levee system with gate structures (Plates 1-4) as mitigation measures.

2. Description of Original Project. The project consists of a system of levees that form three shallow greentree reservoirs with nine drainage structures providing water management. The purpose of the project was to develop and manage waterfowl resources on approximately 2,540 acres of refuge lands located north of the Arkansas Post Canal. The project was provided as mitigation for the loss of canal right-of-way (534 acres) and the "loss" of 568 acres of refuge land that was isolated south of the canal.

3. Description and History of Deficiencies. Areas 1-5 in this report correspond with those in previous correspondence and memorandums for record and are shown on Plate 2. Appendix B provides a detailed chronological listing of project problems and deficiencies.

A. Structural Deficiencies. Design and construction deficiencies in Area 1 were cited in a 1989 district memorandum as reasons for the following problems:

(1) Settlement of the 60" twin sluice gate structure in Levee B has caused cracking of the headwall. Poor concrete contributed to spalling at the gate support bracket. These problems caused the binding of one gate and breaking of its gate support bracket anchor bolt in 1984.

(2) The 36" slide gate located about 100 feet north of the twin 60" structure has failed. The gate reportedly "popped off" and has been missing since 1978.

B. Hydraulic Deficiencies. Levee A has been partially destroyed by the action of White River headcutting in Areas 3, 4, and 5 reportedly due to channelization of the White River below the Arkansas Post Canal. In 1967 the Service requested that the Corps take immediate measures to provide bank stabilization for those portions of the River subject to greatly increased erosion. This was not done.

(1) Area 2: Although this area has experienced significant erosion by the White River, the Service has indicated that it would not be feasible to perform all repairs that would be required.

(2) Area 3: A portion of the original section of Levee A in Area 3 and the 36" gate structure were lost due to the action of bank caving and was later rebuilt by the Service some distance inland from the White River. The new levee and gate structure became damaged by the action of floodwaters overtopping the sheet pile headwalls and eroding behind the sheet piles. This erosion was subsequently arrested by the installation of sheet pile wingwalls and stone slope protection. Although the gate structure was saved, the levee crown had eroded from 10 feet to approximately 5 feet in width, preventing occasional vehicle travel along the levee by the Service for inspections. (The Service has requested that a 100-foot section of levee in this area be reconstructed to the full 10-foot crown width and that slope protection be provided to extend longevity. Additionally, the Service no longer has a need to operate the 36" gate structure, and requests that it be removed from the levee or that the 36" corrugated metal pipe (cmp) be plugged with concrete.

(3) Area 4: The Service installed two concrete spillways in 1981 and placed rip rap along the levee for erosion protection. The Service also replaced a deteriorated 36" cmp gate structure with an 18" concrete pipe. The Service requests that stone protection be placed on the slopes around each end of the 18" pipe to prevent additional erosion.

(4) Area 5: The Service has estimated the loss of approximately 900 feet of Levee A due to the action of the White River. This has eliminated the Levee A road connecting with Wild Goose Landing. To keep from losing all of the use of Reservoir A, the Service installed a new section of levee with gate structure in a slough inland from the White River. The Service requests that the levee be rebuilt farther inland, perhaps utilizing this Service section of levee. The estimated length is 1,500 lineal feet.

4. History of Repairs by Local Interests. It appears that the Service has adequately attempted to maintain the subject structures since they were constructed.

A. Service memo, 27 April 1987, stated that "In the ensuing 20 years since construction, the Service has performed operation and maintenance (O&M) for all the completed mitigation features. The O&M activities to date have consisted primarily of adding gravel to the levees, minor repair of the levees or access roads, and other similar actions. ".... the costs of these activities represent a sizeable portion of the annual budget of White River NWR."

B. On 8 February 1991, the refuge manager stated that since the completion of the mitigation structures, the Service had expended over \$50,000 on maintenance.

5. History of Project Alterations by Local Interests Since Project Completion.

A. The Service had to replace the deteriorated 36" cmp in Area 1. The existing pipe and downstream headwall were both removed. As an economy measure, rip rap protection was provided in lieu of replacing the headwall.

B. When Levee A at Prosperous Bayou (Area 3) was lost, the Service moved inland to build a new temporary levee and protected it and the rebuilt gate structure with sheet pile headwalls. Later, after the levee became eroded, the Service placed rip rap on the White River face of the levee.

C. After the original 36" cmp gate structure in Area 4 had deteriorated, the Service, due to fiscal restraints, replaced it with an unregulated 18" concrete pipe placed higher up near the top of the levee.

D. After Levee A in Area 5 was lost, the Service constructed a temporary levee and gate structure inland in the southernmost slough.

6. Proposed Corrective Measures. The proposed methods of correcting design and construction deficiencies are shown on Plates 2 through 4. The corrective measures are described below:

A. Area 1: Bring the existing sluice gates and slide gate to operable condition as described below and as shown.

(1) Repair 60" sluice gate: Remove and reinstall floorstand; adjust existing guides; clean and paint two 60" gates, stems and floorstands; and, clean concrete on top of wall and patch spalls with grout.

(2) Repair 36" slide gate: Install complete 36" slide gate on existing structure.

B. Area 2: None.

C. Area 3: Abandon the existing gate structure (plug with concrete), restore the levee crown width, and provide stone slope protection as shown.

(1) Widen a 100-foot length of levee along the same alignment to original width, that is, with a 10-foot crown width and specified side slopes. Provide quarry run stone on the slopes to resist erosion.

(2) Since the gate structure and culvert are no longer used for reservoir A level control, the culvert will be plugged with concrete and abandoned in place.

D. Area 4: Provide erosion protection along the levee and beyond each end of the 18" pipe in Levee A. See Plate 4.

E. Area 5: Construct a 1,500-foot section of Levee A farther inland from the White River as shown on Plates 2 and 4.

7. Alternative Corrective Measures Considered.

A. Area 3: Abandon existing gate structure, culvert, and sheet pile headwalls. Alternatives considered included:

(1) Seal both ends of pipe with a metal plate. This would leave a potential failure zone in the embankment and was therefore considered unacceptable.

(2) Remove the gate structure and culvert from the embankment and rebuild the levee. This was considered to be too expensive.

(3) Plug the culvert with concrete and abandon in place. This alternate was selected as being the most economical satisfactory fix.

B. Areas 1,2,4 & 5: No practical alternatives were identified for consideration.

8. Estimated Cost of Corrective Measures. The estimated cost for all repairs at Areas 1,3,4, and 5 is \$261,393, including \$29,650 for E&D and \$16,200 for Supervision and Administration. See Cost Estimate Summary, Appendix C.

9. Justification. Rehabilitation of Corps constructed levees and structural features is desirable for the following reasons: (1) To correct design deficiencies, (2) to correct construction deficiencies, and (3) to fully comply with the original permit signed with the Service. These items are more fully described below:

A. Area 1: The 60" sluice gate and 36" slide gate were identified as having design and construction deficiencies. These items should be expected to have a reasonable usable life, which has not been the case. The Service has had to expend considerable effort to be able to even marginally operate the structures by using stop logs or sand bags. These features have been unusable for many years and the Service has not been able to perform needed repairs having spent considerable funds on maintaining the levees. The sense of urgency should come from the Corps in a effort to mitigate damage to our reputation as experts in the fields of water resource facility design, management, and construction.

B. Area 3: Abandon the existing gate structure as requested by the Service. Rebuild the eroded section of the levee to a 10 foot crown width and rip rap the White River face of the structure at Prosperous Bayou. A comparison of trip reports (87,88 and 90) and discussion with Service personnel emphasizes the urgency of the situation. The levees have deteriorated at an increasing rate that threatens the structural integrity of Levee A. The gate structure is in danger of being destroyed and with it goes the use of Reservoir A. This breach would provide access for White River flows down Prosperous Bayou. This would destroy Service ability to regulate and control water to the wildlife refuge and lead to increased erosion and destruction of wildlife and lands. Of greater concern to the Corps would be the frequent torrents of water that could flow down Prosperous Bayou toward the Arkansas Post Canal levee. This could lead to future expensive maintenance problems for the Corps.

C. Area 4: Provide stone protection at the 18" cmp that was installed by the Service, located near the top of Levee A. Although this culvert was installed by the Service, it was a replacement for a (deteriorated) 36" cmp originally installed by the Corps. Accordingly, it is reasonable to expect the Corps to provide adequate stone protection (as desired by the Service) or for the Corps to provide a new 36" gate structure. Since the lower cost fix is acceptable to the Service, we should expeditiously complete this rehabilitation.

D. Area 5: Construct a new 1,500 foot section of levee inland from the White River to replace that previously eroded. To comply with the permit with the Service, these mitigation structures were supposed to last as long as the Arkansas Post Canal, subject only to normal maintenance. The Service has provided adequate maintenance; however, the original facilities have not provided the required useful life.

E. Legal Obligations: The failure of the mitigation features to fulfill our legal agreements with the Fish and Wildlife Service also makes the Corps technically out of legal compliance with the Fish and Wildlife Coordination Act and the National Environmental Policy Act. Without rehabilitation, one could advance a good position that the Corps is violating these laws and, should litigations ensue, the Corps would be exposed to unfavorable publicity especially since the problems are directly related to design and construction issues. It is, therefore, in the Nation's best interest to accomplish this work now.

G. ER 1165-2-119: In applying the guidelines contained in ER 1165-2-119, it is important to note that the mitigation features were to operate for the life of the navigation project that traverses through the refuge. Compared with the adjacent navigation features, it is obvious that the failure of mitigation

features is attributable to a combination of design and construction deficiencies. Application of ER 1165-2-119 criteria is as follows:

(1) The project does not function according to the agreements and intended purposes, nor are the features viable or operational.

(2) The conditions and mitigation requirements have not changed. The features are essential to fulfill the authorized project purposes and various environmental laws.

(3) Rehabilitation would bring the project into compliance with authorized purposes.

(4) Rehabilitation costs associated with existing features are significantly less and incrementally justified compared with alternative measures that would be required.

(5) Maintenance of the mitigation features is not the cause of failure. The Service keeps national wildlife refuges (such as the White River National Wildlife Refuge) well maintained and operational because of the high waterfowl usage. Since major rehabilitation of project features is now required, the costs greatly exceed the maintenance budget of the White River National Wildlife Refuge.

10. Cost Sharing. Not applicable. Under terms of the permit signed by the Corps and the Service, the levees and structural features that were constructed by the Corps were in payment for use of Service (Government) lands. There was no cost sharing per se. Instead, the Corps was required to mitigate damages to the wildlife refuge caused by the construction of the Arkansas Post Canal. There was no first cost for the Service, which was required only to provide future normal maintenance. Since the Corps did not fully construct the levees, roads, and other features in accordance with normal Corps design and construction standards and since the Corps did not comply with the terms of the permit, it is unreasonable to expect the Service to share in major rehabilitation costs.

11. Environmental Considerations:

A. Introduction.

(1) The White River National Wildlife Refuge was established in the 1930's as a waterfowl refuge. The 139 channel scar lakes on the 115,000 acre refuge have furnished good sport and commercial fishing from the beginning. In the 1960's the refuge was opened to deer hunting for the first time and has been open yearly since. Squirrel hunting has always been opened for the first few days of squirrel season. Duck hunting in limited areas is now permitted for half-days, three days a week, during the state waterfowl season.

(2) When the McClellan-Kerr Navigation System was constructed, the preferred route for the Arkansas Post Canal linking the Arkansas and White Rivers for navigation purposes was across the south end of the refuge. In exchange for the right-of-way across the land belonging to the Department of Interior, the Corps constructed three green-tree reservoirs, complete with levees and water control structures, to facilitate waterfowl management on the refuge. The Service agreed to operate and maintain the reservoirs after construction.

(3) However, damage has occurred to one of the levees constructed by the Corps; damage that exceeds the expectation of ordinary maintenance. The concrete water-control structures have also shown damage which could not have been prevented by maintenance. As a result, the Corps has agreed to repair the structures and gates, and to restore the levee destroyed by erosion from the White River.

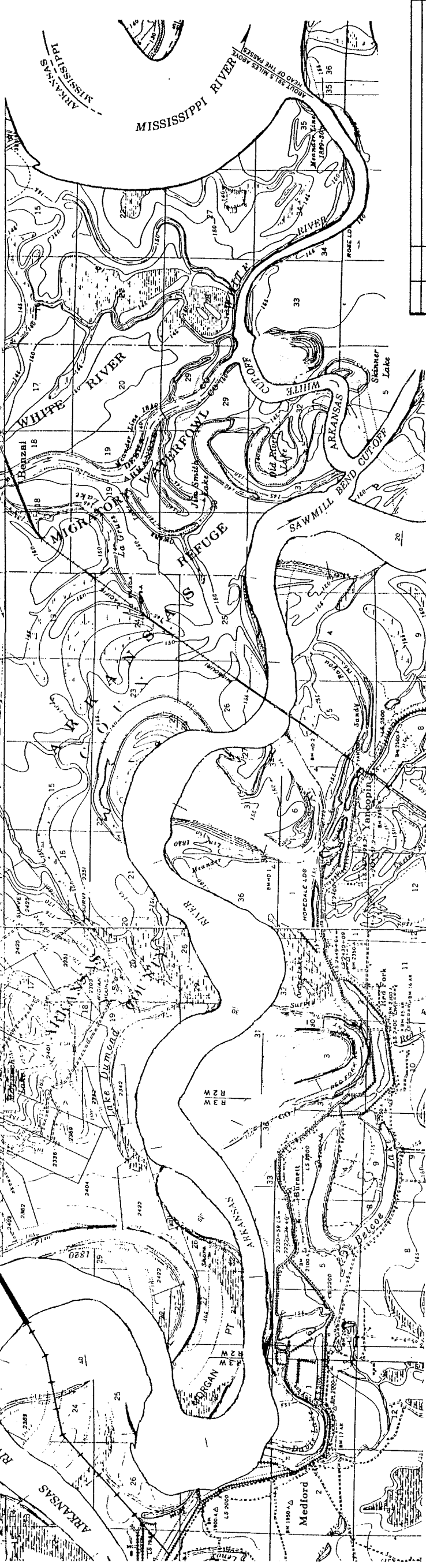
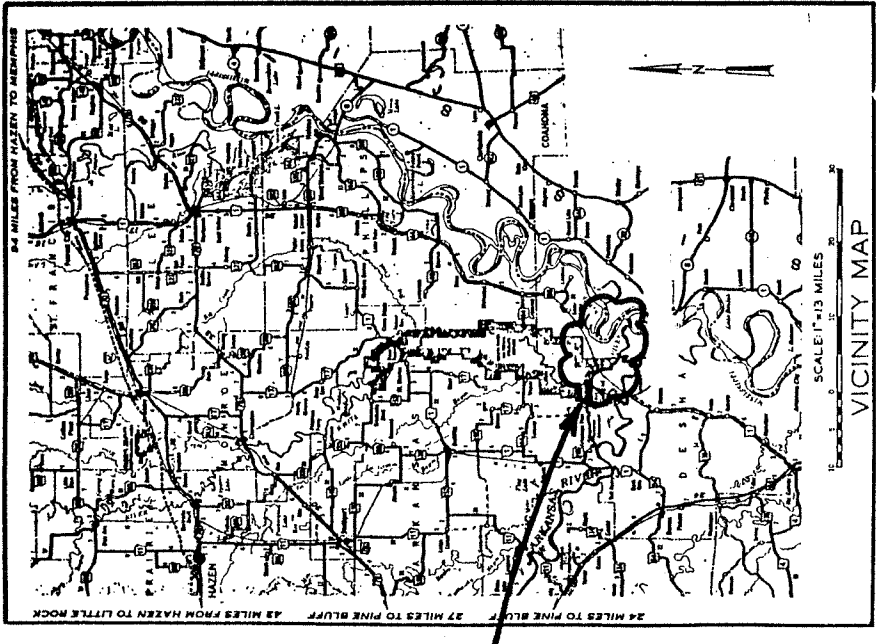
B. Environmental Resources. The natural resources of the project area (Plates 1 and 2) are many and varied, and of considerable significance regionally. The green-tree reservoirs furnish excellent fishing, particularly in the springtime. In the fall, they furnish resting and feeding areas for all migratory waterfowl. The migrating eagles use the snags in the reservoirs for perching and watching for prey. Alligators are seen frequently in the sloughs and bayous encompassed by the reservoirs. Deer and turkey are common to abundant in the area. Furbearers such as beaver, muskrat, skunk, river otter, raccoon, and coyote are resident to the area. Occasionally seen are black bears, year 'round residents of the refuge. Over 200 species of song birds have been identified as residents and/or visitors to the area. In short, the area abounds with terrestrial and aquatic species of wildlife, and contributes to the area by providing hunting, fishing, birdwatching, wildlife photography, sightseeing, camping, and other opportunities.

C. Cultural Resources. There are no recorded archeological sites in the immediate project area according to the records of the Arkansas Archeological Survey. A shipwreck located in the White River channel, upstream of the project area, should not be affected. Numerous archeological sites of the late prehistoric and early historic period are located in the surrounding area but they should not be affected by the project. Telephone coordination with the Arkansas State Historic Preservation Officer (SHPO) was conducted on 10 April 1991. The SHPO requested that all new borrow areas or areas to be impacted by levee construction should be surveyed for cultural resources. Archeological fieldwork has been delayed by high water levels in the project area.

D. Environmental Compliance. Draft versions of the Environmental Assessment, Finding of No Significant Impact (FONSI), and Section 404 (b) (1) Evaluation Report are virtually

complete, but are not included in this report. A Section 404 Joint Public Notice (for the new levee section only) will be submitted at a later date in accordance with regulations. A Section 106 coordination letter will be sent to the Arkansas State Historic Preservation Officer (SHPO) following a reconnaissance of the 1500 foot levee replacement in Area 5, which will occur after the White River recedes.

12. Recommendations. Recommend that this report be approved as a basis for funding the design and rehabilitation of project features described herein. Additionally recommend that construction funds in the amount of \$261,393 be included in the FY93 Construction General Budget for this purpose.



DESIGNED BY MAB	DRAWN BY MAB		CHECKED BY JXX	SUBMITTED BY	
DATE			DESCRIPTION		
DEPARTMENT OF THE ARMY LITTLE ROCK DISTRICT, CORPS OF ENGINEERS LITTLE ROCK, ARKANSAS					
WHITE RIVER AND TRIBUTARIES			ARKANSAS POST CANAL WHITE RIVER NATIONAL WILDLIFE REFUGE PROJECT LOCATION		
ANAKSAS RIVER, ARKANSAS			SCALE AS SHOWN MARCH 1958 HY. SERIAL NO.		
DRAWING NUMBER			PLATE 1 SHEET 1 OF 4		
ENGINEER					

UNZERT

- LOCK
NAVIGATION DAM
BRIDGE
LEEVE
DRAINAGE DITCH
CANAL
SURGE & PASSING AREA

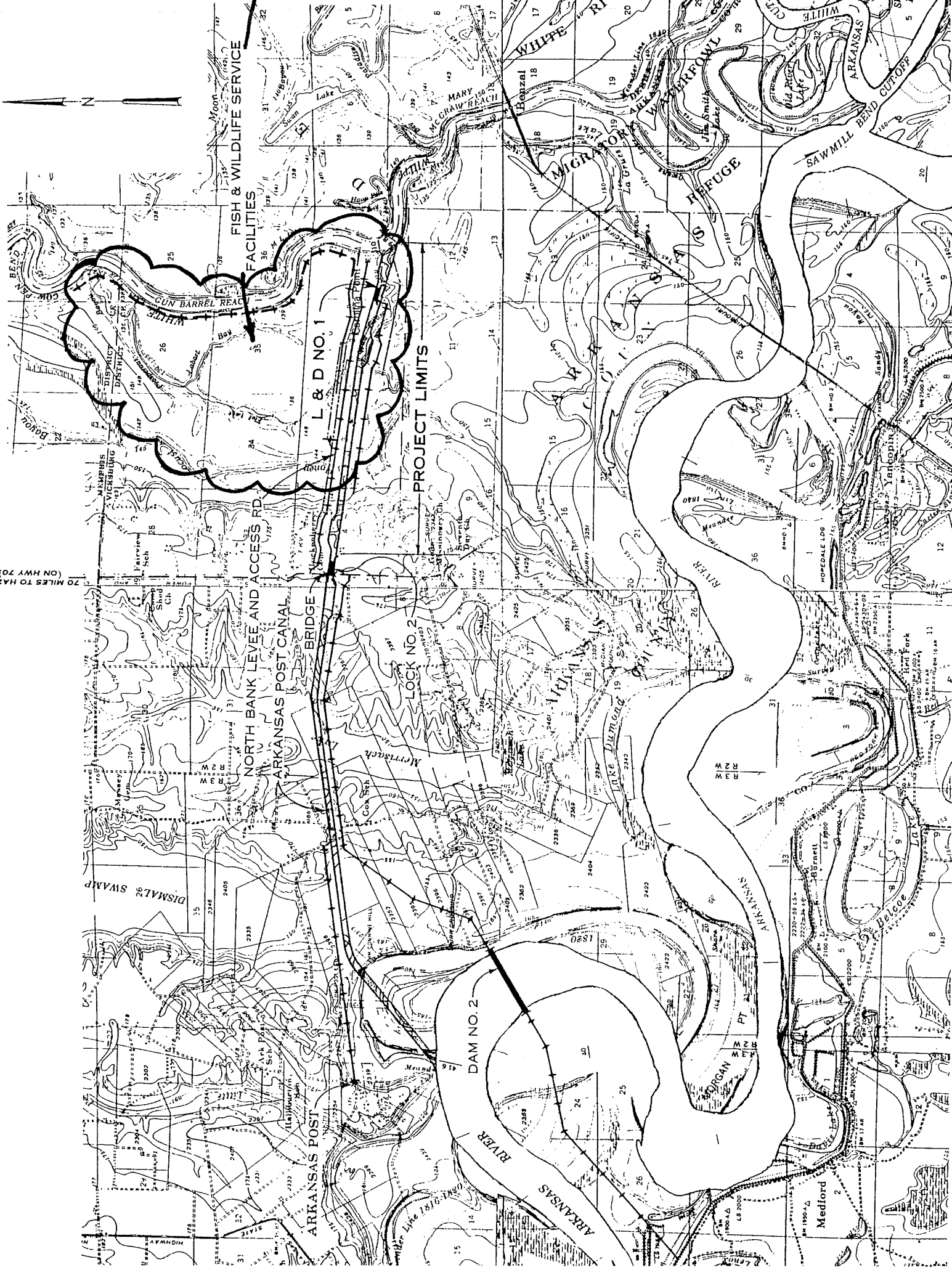
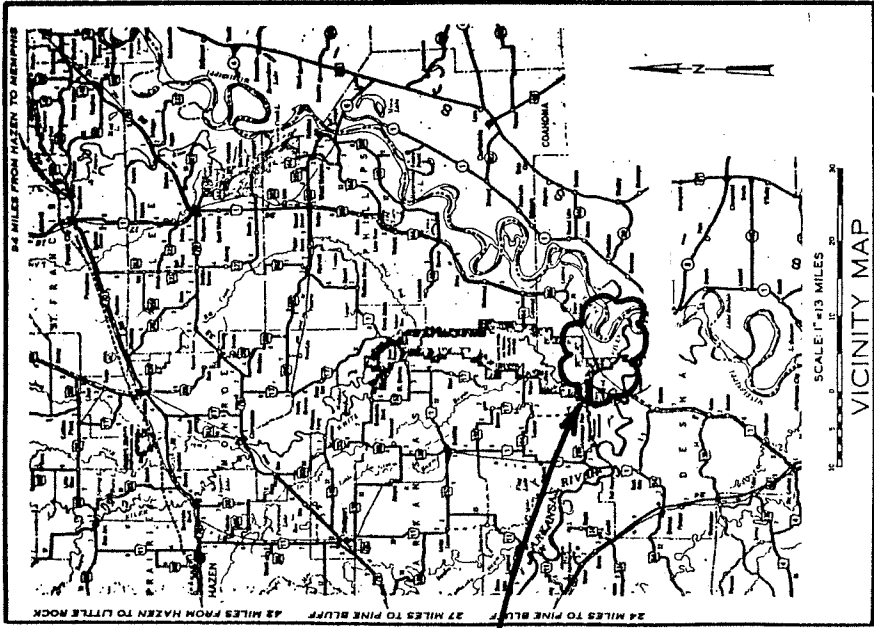
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DATUM IS MEAN SEA LEVEL
CONTOUR INTERVAL 5 FEET

RIVER MILES ARE BASED ON 1943 SURVEY
BANK LINES BASED ON 1960 AERIAL PHOTOGRAPHS
DRAWING COMPILED FROM COMPOSITE OF QUADRANGLE MAPS

42 MILES TO LITTLE ROCK
HAZEN
84 MILES TO MEMPHIS, TENN.



LEGEND

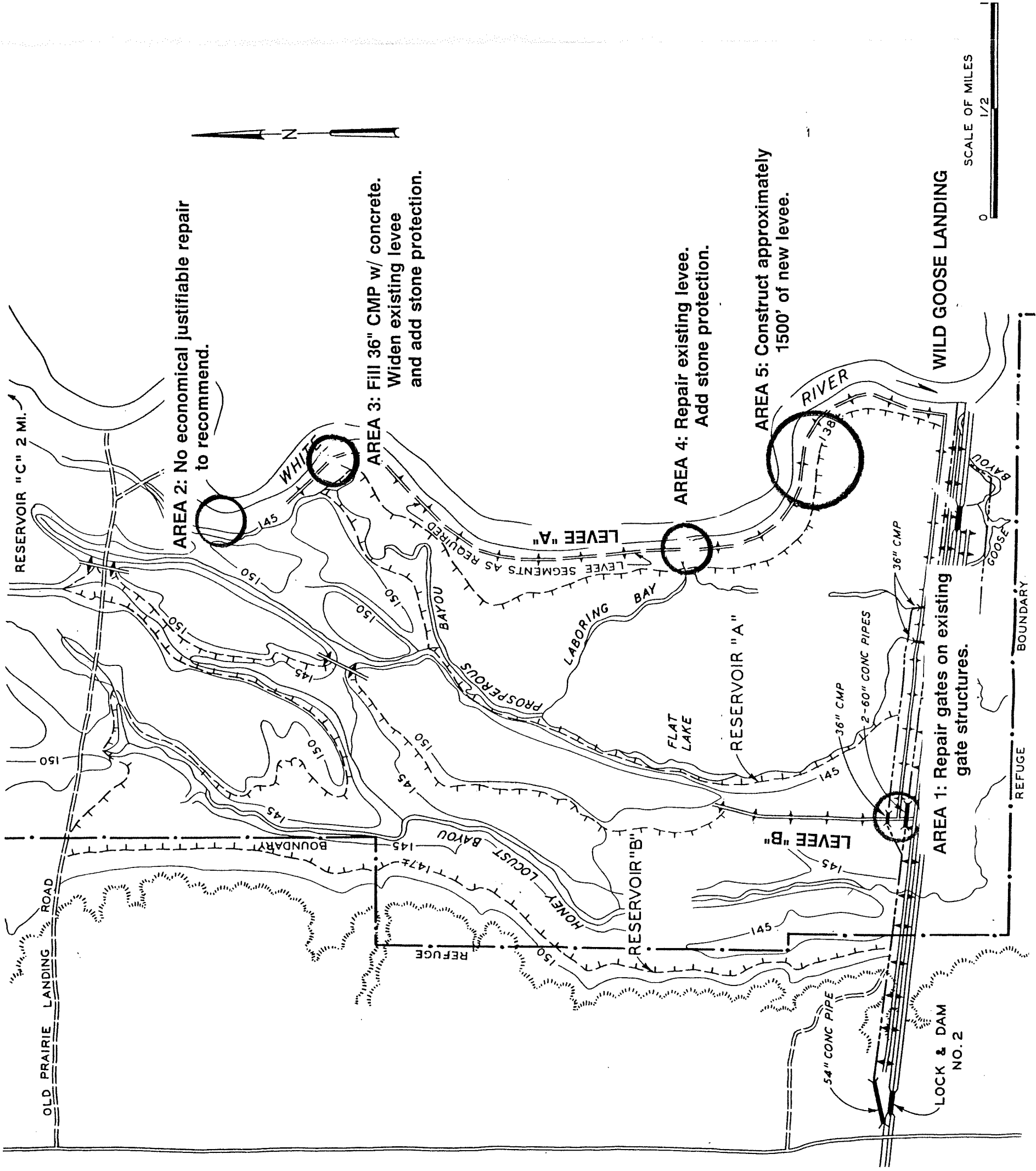
- LOCK
- NAVIGATION DAM
- BRIDGE
- LEVEE
- DRAINAGE DITCH
- CANAL
- SURGE & PASSING AREA

SCALE 1:40,000
4,000 0 4,000 8,000 12,000 FEET

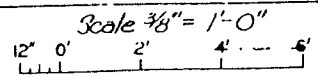
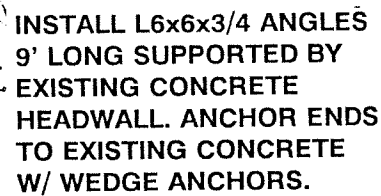
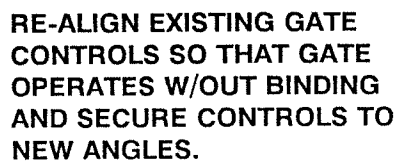
DATUM IS MEAN SEA LEVEL
CONTOUR INTERVAL 5 FEET

RIVER MILES ARE BASED ON 1943 SURVEY
BANK LINES BASED ON 1960 AERIAL PHOTOGRAPHS
DRAWING COMPILED FROM COMPOSITE OF QUADRANGLE MAPS

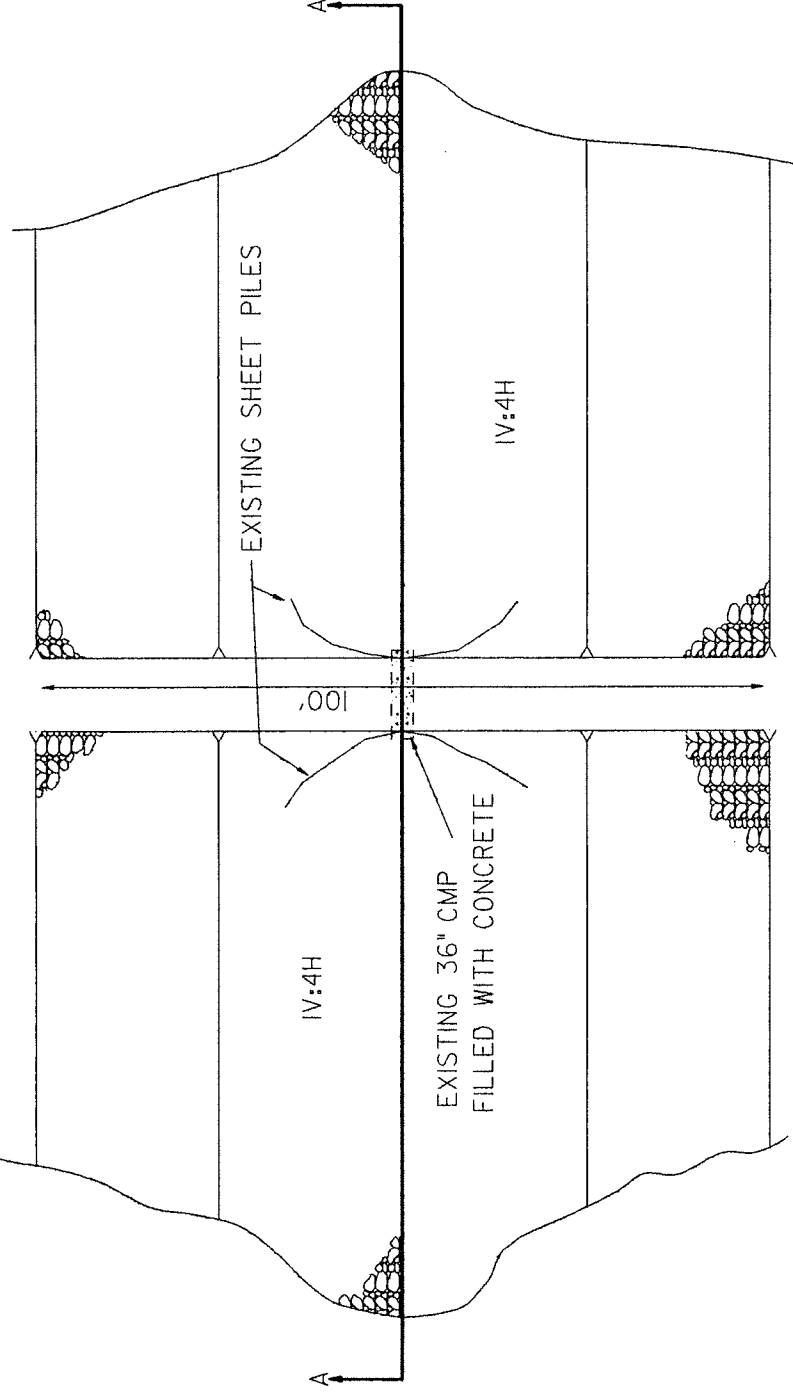
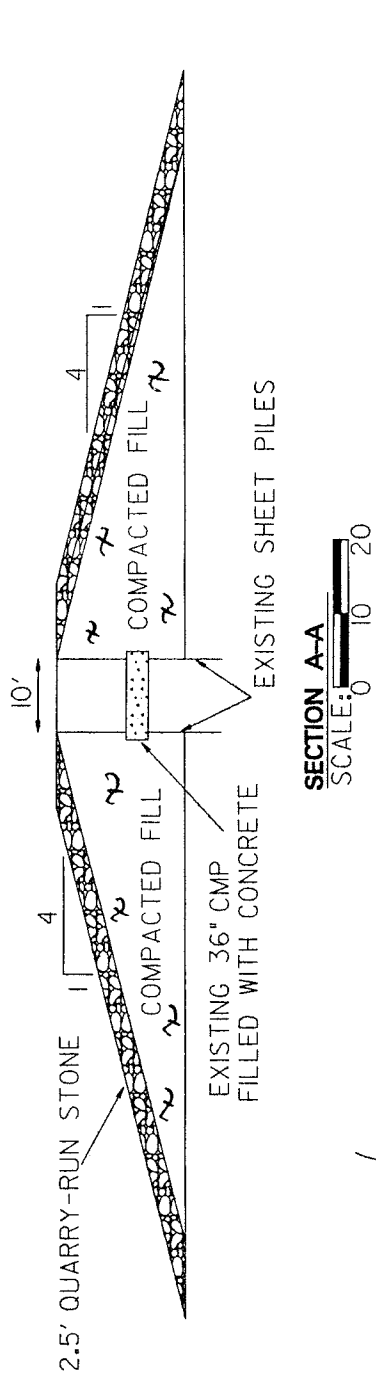
REVISION	DATE	DESCRIPTION	BY
		DEPARTMENT OF THE ARMY LITTLE ROCK DISTRICT CORPS OF ENGINEERS LITTLE ROCK, ARKANSAS	
DESIGNED BY	MS	WHITE RIVER AND TRIBUTARIES	
DRAWN BY	MS	ARIZONA POST CANAL	
CHECKED BY	XX	WHITE RIVER NATIONAL WILDLIFE REFUGE	
SUBMITTED BY		PROJECT LOCATION	
ENGINEER		SCALE AS SHOWN	MARCH 1951 INV. SERIAL NO.
		SHEET 1 OF 4	DRAWING NUMBER
			PLATE 1



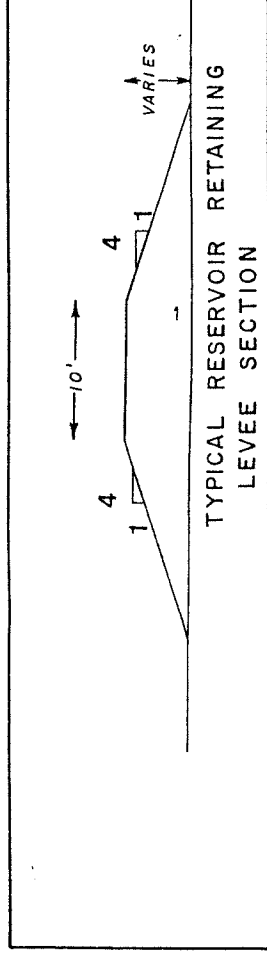
REVISION	DATE	DESCRIPTION	BY
DEPARTMENT OF THE ARMY LITTLE ROCK DISTRICT, CORPS OF ENGINEERS WHITE RIVER AND TRIBUTARIES			
DESIGNED BY:	DATE:	ARIZONA POST CANAL	
DRAWN BY:	DATE:	WHITE RIVER NATIONAL WILDLIFE REFUGE	
CHECKED BY:	DATE:	SUMMARY	
SUBMITTED BY:	DATE:	SCALE: AS SHOWN	
ENGINEER:	DATE:	DRAWING NUMBER	
MARCH 1958		SHEET 2 OF 4	
INT. SERIAL NO.		PLATE 2	



AREA 1 - 60" SLUICE GATES

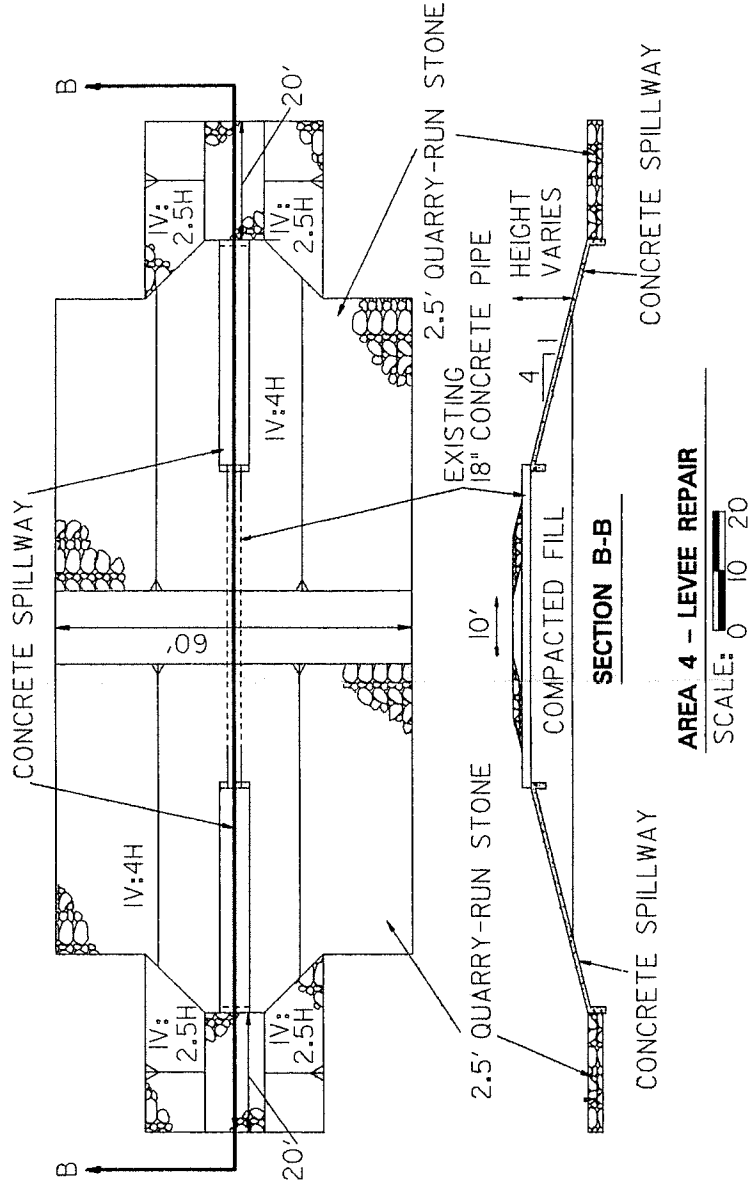


AREA 3 - LEVEE REPAIR

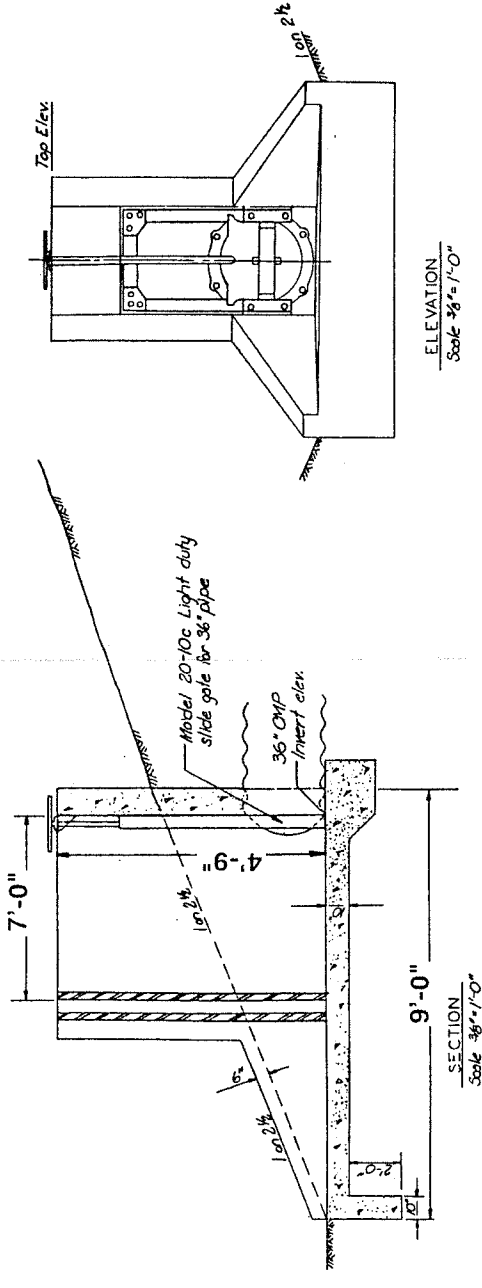


AREA 5 - NEW LEVEE

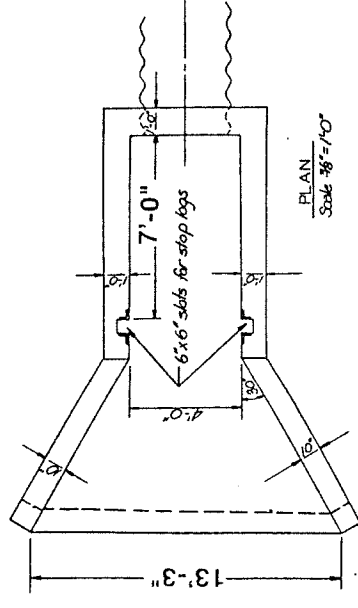
NOTE: BORROW MATERIAL WILL BE AVAILABLE ON SITE AS DIRECTED BY THE USFW. NO EXCAVATION MAY OCCUR W/IN 50' OF LEVEE TOE OR TO A DEPTH GREATER THAN 5'



AREA 4 - LEVEE REPAIR



**REPLACE MISSING GATE
AT EXISTING HEADWALL**



AREA 1 - 36" SLIDE GATE

REVISION	DATE	DESCRIPTION	BY
		DEPARTMENT OF THE ARMY LITTLE ROCK DISTRICT, CORPS OF ENGINEERS LITTLE ROCK, ARKANSAS	
		WHITE RIVER AND TRIBUTARIES	ARKANSAS RIVER, ARKANSAS
DESIGNED BY MKB		ARKANSAS POST CANAL WHITE RIVER NATIONAL WILDLIFE REFUGE DETAILS 2	
DRAWN BY MKB			
CHECKED BY XXX			
SUBMITTED BY		SCALE: AS SHOWN	MARCH 1951
		DRAWING NUMBER	HY. SERIAL NO.
ENGINEER		SHEET 4 OF 4 PLATE 4	

PERMIT
TO THE
UNITED STATES CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY
TO USE AND OCCUPY PROPERTY IN THE
WHITE RIVER NATIONAL WILDLIFE REFUGE, ARKANSAS

WHEREAS, the United States Bureau of Sport Fisheries and Wildlife and its predecessor agencies, herein referred to as the "Bureau", has acquired certain lands in fee title as the White River National Wildlife Refuge, Arkansas, for the benefit and protection of migratory birds and other forms of wildlife, and

WHEREAS, pursuant to the Rivers and Harbors Act of July 24, 1946, as amended, the U. S. Corps of Engineers, herein referred to as the "Corps", has been authorized to construct, maintain and operate the Arkansas River Navigation Canal Project, and

WHEREAS, the Corps, in connection with the Arkansas River Multiple-Purpose Project, proposes to locate and construct on the Refuge a portion of the navigation canal and Lock and Dam No. 1;

NOW, THEREFORE, to further the aims and purposes of the Arkansas River Multiple-Purpose Project, the Corps is hereby granted a permit to use and occupy 545 acres of Refuge land upon which it may construct, maintain, and operate said navigation canal and Lock and Dam No. 1, upon which it may locate a public access area as heretofore agreed, and upon which additional recreational or other facilities may be located in future years on mutual agreement of the Bureau and Corps. This permit to remain in effect for as long as these facilities are maintained and operated for purposes authorized in the above act. The area covered by this permit, which is for an indefinite period, is described below and shown in blue on attached map, Exhibit "A", which is made a part hereof.

DESCRIPTION - PARCEL "A" - 545.00 Acres

A tract of land situated in the county of Arkansas, State of Arkansas, being a part of Sections 1, 2, and 3, Township 8 South, Range 2 West of the Fifth Principal Meridian, and being more particularly described as follows:

Beginning at a point on the west line of said Section 3, which is 1,040 feet north of the west quarter corner thereof, being on the west boundary line of the White River National Wildlife Refuge and being 610 feet north of Station 164+20 on

the centerline of the Navigation Canal; thence southeasterly 2,120 feet to a point which is 635 feet north of Station 143+00; thence southeasterly 2,000 feet to a point which is 645 feet north of Station 123+00; thence southeasterly 750 feet to a point which is 645 feet north of Station 115+50; thence southeasterly 450 feet to a point which is 660 feet north of Station 111+00; thence southeasterly 2,400 feet to a point which is 660 feet north of Station 87+00; thence southeasterly 1,780 feet to a point which is 650 feet north of Station 70+20; thence northeasterly 1,130 feet to a point which is 1,125 feet north of Station 59+85; thence southeasterly 2,775 feet, more or less, to a point on the ordinary high-water line, right bank of White River, which is 1,325 feet north of Station 32+00; thence southerly along the meanders of said ordinary high-water line to its intersection with a line extended southerly and perpendicular to Station 13+00; thence southwesterly along said line extended from Station 13+00 to its intersection with the south line of said Section 1; thence westerly along said south line 910 feet to a point on the southerly right-of-way line for said Navigation Canal, which is 800 feet south of Station 22+80; thence along said right-of-way line as follows north 74° 22' west 1,500 feet to a point; thence south 83° 50' west 1,080 feet to a point, said point being 1,200 feet south of Station 46+50; thence north 74° 22' west 5,210 feet to a point; thence north 07° 23' east 320 feet to a point which is 700 feet south of Station 100+00; thence north 82° 37' west 6,300 feet to a point on the west line of said Section 3; thence, departing from said right-of-way line, north along said section line 1,310 feet to the point of beginning, and containing 545.00 acres, more or less.

Also, to facilitate construction work, the Corps is permitted, for a period not to exceed five years after execution of this permit, to use and occupy an additional 80 acres of Refuge Land, as shown in red on map Exhibit "A" and described below:

DESCRIPTION - PARCEL "B" - 80.00 Acres

A tract of land situated in the county of Arkansas, State of Arkansas, being a part of Sections 1, 2, and 3, Township 8 South, Range 2 West of the Fifth Principal Meridian, and being more particularly described as follows:

Beginning at a point on the west line of said Section 3, which is 1,040 feet north of the west quarter corner thereof,

being on the west boundary line of the White River National Wildlife Refuge and being 610 feet north of Station 164+20 on the centerline of the Navigation Canal; thence southeasterly 2,120 feet to a point which is 635 feet north of Station 143+00 on said centerline; thence southeasterly 2,000 feet to a point which is 645 feet north of Station 123+00 on said centerline; thence southeasterly 750 feet to a point which is 645 feet north of Station 115+50; thence southeasterly 450 feet to a point which is 660 feet north of Station 111+00; thence southeasterly 2,400 feet to a point which is 660 feet north of Station 87+00; thence southeasterly 1,780 feet to a point which is 650 feet north of Station 70+20; thence northeasterly 1,130 feet to a point which is 1,125 feet north of Station 59+25; thence southeasterly 2,775 feet, more or less, to a point on the ordinary high-water line, right bank of White River, which is 1,325 feet north of Station 32+00; thence northerly along the meanders of said ordinary high-water line 275 feet to a point which is 1,600 feet north of Station 33+00; thence northwesterly 2,725 feet to a point which is 1,360 feet north of Station 60+00; thence southwesterly 1,130 feet to a point which is 900 feet north of Station 70+35; thence northwesterly 1,785 feet to a point which is 900 feet north of Station 87+00; thence north 50 feet to a point which is 950 feet north of said Station 87+00; thence northwesterly 5,600 feet to a point which is 950 feet north of Station 143+00; thence south 150 feet to a point which is 800 feet north of said Station 143+00; thence northwesterly 2,140 feet to a point on the west line of said Section 3, which is 800 feet north of Station 164+40; thence south along said west line 190 feet to the point of beginning, and containing 80.00 acres, more or less.

In consideration of this permit granted by the Bureau, the Corps as a part of project costs agrees:

1. To construct necessary levees and control structures to create Reservoirs A and B on Refuge land immediately north of the navigation canal for management by the Bureau in their water-fowl program. Construction items for these two reservoirs are to include:
 - a. Controllable inlet and diversion from Pool No. 2 designed to supply water at a rate of 150 c.f.s. for gravity delivery to White River National Wildlife Refuge.

- b. Diversion Ditch "A" designed to convey water supply from inlet structure to the interceptor drainage ditch.
- c. Interceptor Drainage Ditch, a project feature comprised of sections "B" and "C", designed to convey waters from the 28.1 square mile drainage area of Honey Locust Bayou to White River and also water supply for wildlife purposes.
- d. Control Structure in Interceptor Drainage Ditch between sections "B" and "C" designed to impound Reservoir "B" and also to divert water into Reservoir "A". Access roadway from project retaining levee would be incorporated in this structure. The section of the structure in the drainage ditch should have stoplog spillway sections for controlled upstream impoundment to elevation 148 feet m.s.l. in Reservoir "B". Structure openings should be of adequate size to provide prompt evacuation of storm drainage. Maximum length of ponding of storm runoff shall be four days.
- e. Diversion Ditch "D" designed to convey water from the main control structure to Reservoir "A".
- f. Levee section separating Reservoir "A" on the south end from the interceptor drainage ditch. It would be constructed to about elevation 141 feet.
- g. Two water-control structures in south retaining levee at crossings of Wild Goose Bayou.
- h. Intermittent levee sections along bank of White River to about elevation 141 feet m.s.l. for Impounding Reservoir "A".
- i. A stoplog water-control structure in the levee section constructed across the mouth of Laboring Bay.
- j. A water-control structure in the levee section to be constructed across Paradise Bayou.
- k. Levee sections separating Reservoirs "A" and "B". This levee would extend north from the main control structure and would be constructed to about elevation 150 feet m.s.l. Total length would be about 22,780 feet.

The Fish and Wildlife Plan, which includes the location and layout of the above construction features, is shown on attached Exhibit "B", and is made a part hereof.

2. To operate and maintain a water diversion structure at Lock No. 2; to permit the Bureau to withdraw from pool at said lock sufficient water to properly manage Reservoirs A and B. The total annual diversion is estimated to be approximately 10,000 acre feet of water, which, if necessary, may be diverted to Reservoirs A and B within a 30-day period. The diversion is to be coordinated with the navigation locking requirements which will be given first priority.
3. To close the public access area at Lock and Dam No. 1 between November 1 and March 15 of any year if requested to do so by the Regional Director, Bureau of Sport Fisheries and Wildlife.
4. To use and occupy the area without cost or expense to the Bureau.
5. To maintain the area in good condition and repair.
6. To protect the property from fire and vandalism. Also, it shall make and enforce such rules and regulations as are necessary, within its legal authority, to exercise the privileges granted in this permit.
7. To report to the Bureau any interference with or damage to any refuge property described herein arising from the exercise of privileges herein granted, and further, that it will correct any such interference or damage to the satisfaction of the Regional Director, Bureau of Sport Fisheries and Wildlife.
8. That the Bureau, its employees, agents, and assigns may at all times have full rights of access to and through said area for any work whatever involving Bureau operations or wildlife management and protection.
9. That in granting this permit the intent of the Bureau is to convey to the Corps only those rights necessary to (1) operate, use, and maintain the navigation canal, (2) operate, use and maintain Lock and Dam No. 1, and (3) operate, use, and maintain the public access area at Lock and Dam No. 1. All other rights, and especially those relating to fish and wildlife, are reserved to the Bureau.

In connection with the operation and maintenance of fish and wildlife features of the project, as provided herein and shown on Exhibit "B", the Corps and Bureau mutually agree that:

10. The Corps shall operate and maintain the water diversion structure at Lock No. 2.
11. The Bureau shall operate and maintain all other structures, ditches and levees incident to the management of Reservoirs A and B.
12. In the event water is needed for the proper management of Reservoirs A and B, and the Corps is unable to provide the necessary operating service, the Bureau may on a temporary emergency basis operate all water control structures leading to Reservoirs A and B--including those at Lock No. 2, after obtaining assurance from the District Engineer or his authorized representative that the Corps is unable to provide the necessary operating service at the time requested.
13. Any signs constructed by the permittee involving public access, recreation, or both, shall give full recognition to the United States Fish and Wildlife Service on the cooperative nature of the land development.

OCT 2 1963

(Date)

Robert A. Fidelity
Regional Director, Bureau of Sport
Fisheries and Wildlife

2 January 1964

(Date)

Charles D. Maynard
CHARLES D. MAYNARD, Colonel, CE
District Engineer, U. S. Army Engineer
District, Little Rock

*Record of Permit
Drawing filed in Historical
in Real Estate files*

HISTORY OF PROJECT DEFICIENCIES
White River National Wildlife Refuge
(McClellan-Kerr Arkansas River Navigation System)

1. On 29 August 1967, the Service provided a letter of inspection and acceptance of the mitigation features which noted that current velocity along the White River had increased significantly due to channelization on the lower White River below the Arkansas Post Canal. The resulting erosion had endangered Levee A, which was constructed by the Corps in connection with other mitigation measures on the refuge. The Corps was requested to take immediate steps to provide bank stabilization for those portions of the White River subject to this greatly increased erosion. (This requested work was not accomplished by the Corps.)

2. Reference: Fish and Wildlife Service Memo, 23 April 1987.

A. Areas 3,4 & 5 (See Encl 2, Plate 2): "In at least two places, on the right descending bank of the White River in the vicinity of RM 13.5 (Area 3) and between miles 10 to 12 (Areas 4 & 5), there is considerable danger of the complete loss of Levee A due to headcutting during high river flow. Only through temporary repairs has the Service prevented the headcut near mile 13.5 from dewatering the Levee A greentree impoundment."

B. Area 1: "An additional problem exists at the southern end of "Levee B" where two separate water control structures were constructed. The larger of the two structures consists of two separate pipes and drop gates; the smaller is only one pipe and drop gate. At the present time, apparently due to settling and cracking, the concrete wall on the larger structure is broken and one of the drop gates cannot be raised to dewater the Levee B impoundment. The dropgate on the smaller structure has broken off and an improvised stop log system is utilized. Although functional, this improvised system is not nearly so efficient as the original drop gate and requires extensive time and labor to operate and maintain."

3. Reference: Fish and Wildlife Service Memo, 20 May 1988. "The Fish and Wildlife Service is becoming increasingly concerned over the deteriorating condition of Greentree reservoir levees A, B, and C and the associated water control structures.the levees and pipe/drop structures will require major rehabilitation."

4. CESWL-PL-A (CESWL-PL/2 Aug 88) 2nd End stated, "We find that the project has not fulfilled the needs for which it was conceived and constructed. This failure to fulfill the needs is due to design and construction shortcomings in providing the

water control structures. The failure of the levee is due to normal occurrences. We also find that the ordinary maintenance by the US Fish and Wildlife Service has been adequate."

5. A CESWL-ED-DP trip report dated 8 December 1988 described the following results of an 18 November 1988 District inspection:

A. Area 1 contains two gate structures which pass water through Levee B. The first structure consists of 2-60" concrete pipes with concrete headwalls, stop logs and slide gates. The north gate is inoperable. Apparently the contraction and expansion of the soils in the area has shifted the structure to the point where the gate shaft is binding and prevents operation of the gate. Concrete has broken and/or spalled off of the headwall around the gate support bracket and an anchor bolt is broken. The anchor bolt broke in 1984 and the sliding gate shaft was in a bind for several years before 1984. After the anchor bolt broke, it could no longer be lowered, so they have used stop logs since. The second structure on Levee B is approximately 100 feet north of the first structure. It consists of 1-36" CMP with concrete headwalls, stop logs and a slide gate. The slide gate on the structure has been missing since at least 1978.

B. "Area 2 is vastly different than the 1967 quad map shows. Levee A in this area is completely gone as is the access road that the Service used to maintain all of Levee A. It appears the White River has meandered inland 400± causing extensive bank caving as it progressed. Currently at high river stages the White River is developing a channel and entering into Prosperous Bayou..... If this continues, it could prove disastrous for the refuge and navigation on the White River."

C. Area 3. "The original structure consisted of 1-36" CMP with concrete headwalls and stop logs. That structure and parts of Levee A were lost due to bank caving. When this was lost, the use of reservoir A was also lost. The Service moved inland and constructed a new levee section to plug the hole and a gate structure so Reservoir A could be put back into service. The sheet pile headwalls were installed to protect the levee and gate structures from erosion. Flood waters currently overtop the levee and are causing erosion from behind the sheet piles. The result is a distressed condition on the levee slope with a potential for a breach. Currently the road across the structure is only 5 feet wide making it almost impassible."

D. "Area 4 was not visited on this trip. The Service poured two concrete spillways in 1981 through Levee A north and south of Area 4 and placed rip-rap along the levee for protection. This was done to reduce the severe headcutting of Levee A during high water."

E. Levee A presently ends at Area 5. There is no longer a connection road along Levee A to Wild Goose landing because a large section of the levee had been eroded away."

6. Reference: CESWD-PL-R Memorandum, 5 July 1988.

A. ".... it appears that the FWS refuge people may have a very reasonable request for the Corps to repair the mitigation features."

B. It appears that the Corps "made structural and design changes in the mitigation features without consulting FWS. Additionally, it looks like we (Corps) underestimated the altered flow velocities and subsequent under designed the mitigation features."

7. Reference: CESWL-ED-DG Memorandum, 18 September 1989.

A. Area 1: "It is our belief that the failure of the two gates, one 60" sluice gate and one 36" slide gate, is due to design and construction deficiencies. The concrete has spalled at the support bracket on the 60" sluice gate apparently due to poor concrete. The 36" slide gate has popped off."

B. Area 3: The large lengths of levee A that have caved into the White River have done so as a normal occurrence. These levees have not been lost as a result of lack of maintenance by the service. In fact, the Service has done a lot of work in repairing and maintaining the levees. When the levee at Prosperous Bayou (Area 3) was lost, the Service moved inland to build a new levee and protected the levee and gate structure with sheet pile headwalls. This structure is now in danger of being lost and with it goes the use of Reservoir A. This breach would provide access for White River flows down Prosperous Bayou."

C. Area 4: The Service has replaced a blow-out and added some rip-rap in this area.

D. "Recommendation: As a replacement to the Wildlife Service, we recommend that the Corps repair the above gates, fill and rip-rap the White River face of the structure at Prosperous Bayou. It is in the Corps' best interest to do the work in exchange for Wildlife Service lands that are used for dredge disposal on the lower White River."

8. Reference: CESWL-PL-R Memorandum For Record, 8 February 1991.

A. Area 1 - Verified inoperable condition of the north 60" sluice gate. The 36" slide gate was inoperable. Flow was controlled by use of a stop log. A Service representative stated that they had replaced the deteriorated 36" pipe through Levee B the previous summer.

B. Area 2 - This area had been severely eroded by the White River. No additional work was requested since it was not constructed by the Corps.

C. Area 3 - Verified condition of the eroded levee.

D. Area 4 - Examined an area where the Service had inserted an 18" pipe near the top of Levee A to speed drainage of Reservoir A.

E. Area 5 - The Service representative indicated that approximately 900 feet of Levee A had been washed out and he suggested that a new section of levee be constructed farther back from the river.

CESWL-ED-C

March
28 ~~APRIL~~ 1991

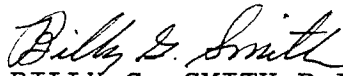
MENORANDUM FOR: Chief, Planning Division, Project Reports Br.
Attn: Terry Daniel

SUBJECT: Request for Revised Cost Estimate, Reconnaissance Report to
Correct Design and Construction Deficiencies at the White
River National Refuge, Arkansas

The revised cost estimate is inclosed. It includes the scope of
as outlined in the memorandum dated 28 March 1991 (subject as above)
provided to us by the Ch, Gen. Engr. Sec.

This estimate includes 7.85% for escalation and 25% contingencies
on construction work. It also includes for the prime contractor 10% for
FOOH, 5% for HOOH, 10% for profit and 1% for bond.

Encl 1


BILLY G. SMITH P.E.
Chief, Cost Engineering Branch

Randall R. Montgomery P.E.
Cost Engr, Cost Engineering Branch

PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
WHITE RIVER WILDLIFE REFUGE TEST

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TITLE PAGE 1

WHITE RIVER NATIONAL WILDLIFE
REFUGE, REHABILITATION OF
DETERIORATING STRUCTURES,
RECONNAISSANCE REPORT

Designed By: LITTLE ROCK DIST CORP OF ENGR
Estimated By: COST ENGINEERING BRANCH

Prepared By: RANDY MONTGOMERY

Date: 03/21/91

M - C A C E S G O L D E D I T I O N
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Release 4.84

This revised cost estimate is for "Reconnaissance Report to Correct Design and Construction Deficiencies at the White River National Refuge, Arkansas".

This estimate uses 10% for FOOH, 5% for HOOH, 10% for profit and 1% for bond charged to the prime contractor. Subcontractors were not used in the cost estimate.

An escalation of 7.85% and a 25% contingency was applied to this estimate.

This cost estimate is based on the following scope of work:

1. Repair 60 inch sluice gate:
 - a. Clean and paint both 60 inch sluice gates.
 - b. Adjust existing guides on both 60 inch sluice gates.
 - c. On the 60" gate that is inoperable raise the floorstand and support it on two 9 ft L6x6x3/4 spanning across the top of the concrete headwall. Anchor the steel angles into the concrete headwall with wedge anchors. Attach the floorstand support bracket to the angles with steel bolts or weld.
 - d. Repair the broken and spalled concrete caused by the cantilevered support bracket with grout.
2. Replace 36 inch slide gate:
 - a. Install new 36 inch slide gate on existing structure.
3. Eliminate existing gate structure and repair 100 lf of levee:
 - a. Plug existing 36" CMP with 2 ft of concrete on each end. Use 3.14 cy of concrete.
 - b. Clear and grub 0.34 acres.
 - c. Compact 2,625 cy of fill to 1V:4H sideslopes.
 - d. Place 2,470 tons of quarry run stone 2 1/2 ft thick on both sides of the levee.
 - e. Establish 0.02 acres of turf on the levee crown and all other disturbed areas lacking stone protection.
4. Laboring Bay - Repair 60 lf of existing levee and 18" CMP and add stone protection.
 - a. Clear and grub 0.07 acres.
 - b. Compact 150 cy of fill.
 - c. Add 2 1/2 ft (530 tons) of quarry run stone protection on both sides of the levee and drainage channel.
 - d. Place 3.06 cy of concrete and 165 sf of WWF in slab spillways.
 - e. Establish 0.03 acres of turf on crown and all disturbed areas where stone protection is lacking.
5. Construct approx. 1,500 lf of levee with compacted fill using 1V:4H side slopes. This will replace an orig levee that was washed out.
 - a. Clear and grub 1.44 acres.
 - b. Place and compact 4,400 cy of fill.
 - c. Establish 1.44 acres of turf.

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SETTINGS PAGE 14

*** CONTRACTOR SETTINGS ***

	AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
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A PRIME CONTRACTOR

PRIME CONTRACTOR OVERHEAD	P			10.00						
PRIME CONTRACTOR HOME OFFICE OVERHEAD	P			5.00						
PRIME CONTRACTOR PROFIT	P			10.00						
PRIME CONTRACTOR BOND	P			1.00						

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WHITE RIVER WILDLIFE REFUGE TEST
** PROJECT OWNER SUMMARY - LEVEL 1 **

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SUMMARY PAGE 1

	QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11	LEVEES AND FLOODWALLS	159,887	12,547	43,109	215,543	
30	ENGINEERING AND DESIGN	29,650	0	0	29,650	
31	SUPERVISION AND ADMINISTRATION	16,200	0	0	16,200	
	WHITE RIVER NATIONAL WILDLIFE	205,737	12,547	43,109	261,393	

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 WHITE RIVER WILDLIFE REFUGE TEST
 ** PROJECT OWNER SUMMARY - LEVEL 6 **

TIME 14:57:27

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	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
11 LEVEES AND FLOODWALLS							
11.1 LEVEES							
11.1.1 MOBILIZATION AND DEMOBILIZATION							
11.1.1.1 LOAD AND UNLOAD EQUIPMENT TO BE							
LOAD AND UNLOAD EQUIPMENT TO BE	10.00	PCS	635	50	171	857	85.65
11.1.1.2 TRANSPORT EQUIPMENT (MOB & DEMOB							
TRANSPORT EQUIPMENT (MOB & DEMOB	80.00	HRS	4,715	370	1,271	6,357	79.46
11.1.1.3 MOB & DEMOB EQPMT TO BE DRIVEN,							
MOB & DEMOB EQPMT TO BE DRIVEN,	8.00	HRS	743	58	200	1,002	125.23
MOBILIZATION AND DEMOBILIZATION			6,094	478	1,643	8,215	
11.1.2 REPAIR 60" SLUICE GATES							
11.1.2.B METALS							
11.1.2.B.1 REMOVE EXISTING 60" SLUICE GATES							
REMOVE EXISTING 60" SLUICE GATES	2.00	EA	919	72	248	1,239	619.74
11.1.2.B.3 CLEAN AND PAINT GATE							
CLEAN AND PAINT GATE	2.00	EA	984	77	265	1,326	662.99
11.1.2.B.5 ADJUST EXISTING GATE GUIDES							
ADJUST EXISTING GATE GUIDES	2.00	EA	514	40	138	692	346.17

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 WHITE RIVER WILDLIFE REFUGE TEST
 ** PROJECT OWNER SUMMARY - LEVEL 6 **

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11.1.2.B.7 INSTALL 60" SLUICE GATE

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
INSTALL 60" SLUICE GATE	2.00	EA	460	36	124	620	309.87

11.1.2.B.8 REPAIR SPALLED CONCRETE

REPAIR SPALLED CONCRETE	98	8	26	132
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11.1.2.B.9 METAL WORK FOR IN-OPERABLE GATE

METAL WORK FOR IN-OPERABLE GATE	672	53	181	906
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METALS	3,646	286	983	4,916
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REPAIR 60" SLUICE GATES	3,646	286	983	4,916
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11.1.3 REPLACE 36" SLIDE GATE

11.1.3.B METAL WORK

11.1.3.B.1 Rem Ext 36" Slide Gate & Framewk

Rem Ext 36" Slide Gate & Framewk	927	73	250	1,249
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11.1.3.B.3 Install New 36" Slide Gate

Install New 36" Slide Gate	5,888	462	1,587	7,937
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METAL WORK	6,815	535	1,837	9,187
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REPLACE 36" SLIDE GATE	6,815	535	1,837	9,187
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11.1.4 ELINMINATE GATE STR & REPR LEVEE

11.1.4.B SITE WORK

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** PROJECT OWNER SUMMARY - LEVEL 6 **

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SUMMARY PAGE 19

		QUANTITY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT

11.1.4.B.1 CLEAR AND GRUB								
CLEAR AND GRUB				1,310	103	353	1,766	
11.1.4.B.2 EXC, PL, COMPACT & GRADE FILL								
11.1.4.B.2.1	EXCAVATE AND PLACE NEW FILL MAT	2625.00	CY	4,549	357	1,227	6,133	2.34
11.1.4.B.2.2	INSTALL GEOTEXTILE MATERIAL	3878.00	SY	8,762	688	2,362	11,811	3.05
11.1.4.B.2.3	SPREAD AND SHAPE TO GRADE	2625.00	CY	1,901	149	512	2,562	0.98
11.1.4.B.2.4	COMPACTION	2625.00	CY	1,231	97	332	1,659	0.63
11.1.4.B.2.5	CHECK GRADE	2625.00	CY	157	12	42	212	0.08
EXC, PL, COMPACT & GRADE FILL		2625.00	CY	16,599	1,303	4,475	22,377	8.52
11.1.4.B.4 HAUL & DUMP RIPRAP ON WORK SITE								
HAUL & DUMP RIPRAP ON WORK SITE		2470.00	TON	54,593	4,284	14,719	73,597	29.80
11.1.4.B.5 PLACE RIPRAP ON SLOPES								
PLACE RIPRAP ON SLOPES		2470.00	TON	15,661	1,229	4,223	21,113	8.55
11.1.4.B.9 ESTABLISH TURF ON TOP OF LEVEE								
11.1.4.B.9.1	Replace Top Soil	17.00	CY	178	14	48	241	14.15
11.1.4.B.9.2	Till or Prepare Seedbed	871.00	SF	89	7	24	120	0.14
11.1.4.B.9.3	Seed and Fertilize	97.00	SY	16	1	4	21	0.22
ESTABLISH TURF ON TOP OF LEVEE		871.00	SF	283	22	76	381	0.44
SITE WORK				88,447	6,941	23,847	119,234	
11.1.4.C CONCRETE								
11.1.4.C.1 PREPARE CULVERT TO RECEIVE CONC								
PREPARE CULVERT TO RECEIVE CONC				72	6	19	97	

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WHITE RIVER WILDLIFE REFUGE TEST
** PROJECT OWNER SUMMARY - LEVEL 6 **

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SUMMARY PAGE 20

		QUANTITY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT

11.1.4.C.3 PLACE CONC PLUG IN CULVERT								
PLACE CONC PLUG IN CULVERT		3.14	CY	674	53	182	908	289.26
CONCRETE				746	59	201	1,005	
11.1.4.E METALS								
11.1.4.E.1 REMOVE EXISTING GATE STRUCTURE								
REMOVE EXISTING GATE STRUCTURE				460	36	124	620	
METALS				460	36	124	620	
ELINMINATE GATE STR & REPR LEVEE				89,652	7,036	24,172	120,860	
11.1.5 REPAIR 60' OF LEVEE & ADD RIPRAP								
11.1.5.B SITE WORK								
11.1.5.B.1 CLEAR AND GRUB								
CLEAR AND GRUB				270	21	73	364	
11.1.5.B.3 EXC, PL, COMPACT & GRADE FILL								
11.1.5.B.3.1	EXCAVATE AND PLACE FILL MATERIAL	150.00	CY	260	20	70	350	2.34
11.1.5.B.3.2	INSTALL GEOTEXTILE MATERIAL	222.00	SY	526	41	142	709	3.19
11.1.5.B.3.3	SPREAD AND SHAPE TO GRADE	150.00	CY	109	9	29	146	0.98
11.1.5.B.3.4	COMPACTION	150.00	CY	70	6	19	95	0.63
11.1.5.B.3.5	CHECK GRADE	150.00	CY	9	1	2	12	0.08
EXC, PL, COMPACT & GRADE FILL		150.00	CY	974	76	263	1,313	8.75
11.1.5.B.4 HAUL RIPRAP FROM QUARRY TO SITE								
HAUL RIPRAP FROM QUARRY TO SITE		530.00	TON	11,714	919	3,158	15,792	29.80

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 ** PROJECT OWNER SUMMARY - LEVEL 6 **

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 SUMMARY PAGE 21

		QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT

11.1.5.B.5 PLACE QUARRY RUN STONE							
PLACE QUARRY RUN STONE		530.00 TON	3,360	264	906	4,530	8.55
11.1.5.B.7 ESTABLISH TURF ON LEVEE CROWN							
11.1.5.B.7.1	Replace Top Soil	24.00 CY	252	20	68	340	14.15
11.1.5.B.7.2	Prepare Seed Bed	1307.00 SF	134	10	36	180	0.14
11.1.5.B.7.3	Seeding and Fertilizer	145.00 SY	23	2	6	31	0.22
ESTABLISH TURF ON LEVEE CROWN			409	32	110	551	
SITE WORK			16,727	1,313	4,510	22,550	
11.1.5.C CONCRETE SPILLWAY WORK							
11.1.5.C.1 PREPARE SURFACE AREA TO RECEIVE							
PREPARE SURFACE AREA TO RECEIVE		350.00 SF	181	14	49	243	0.70
11.1.5.C.2 PLACE FORMS FOR CONCRETE SPILLWY							
PLACE FORMS FOR CONCRETE SPILLWY		160.00 LF	148	12	40	199	1.25
11.1.5.C.3 PLACE WWF (W6 X 6) IN SPILLWAY							
PLACE WWF (W6 X 6) IN SPILLWAY		350.00 SF	129	10	35	173	0.50
11.1.5.C.4 PLACE CONCRETE IN SPILLWAY							
PLACE CONCRETE IN SPILLWAY		3.06 CY	357	28	96	481	157.19
11.1.5.C.5 FINISH CONCRETE IN SPILLWAY							
FINISH CONCRETE IN SPILLWAY		350.00 SF	87	7	23	117	0.33

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11.1.5.C.6 CURE CONCRETE IN SPILLWAY

	QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
CURE CONCRETE IN SPILLWAY	3.50 CSF	15	1	4	20	5.81
CONCRETE SPILLWAY WORK	3.06 CY	916	72	247	1,235	403.48
REPAIR 60' OF LEVEE & ADD RIPRAP		17,643	1,385	4,757	23,784	

11.1.6 CONST 1500 LF OF LEVEE

11.1.6.B CONST 1500 LF OF LEVEE

11.1.6.B.1 CLEAR AND GRUB

CLEAR AND GRUB	1.44 ACR	5,548	435	1,496	7,479	5193.61
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11.1.6.B.3 CONST 1500 LF OF LEVEE

11.1.6.B.3.1 Exc, Haul & Place fill	4400.00 CY	7,625	598	2,056	10,280	2.34
11.1.6.B.3.2 Apply Geotextile Material	6500.00 SY	15,309	1,201	4,128	20,638	3.18
11.1.6.B.3.3 Spread, and Shape to Grade	4400.00 CY	3,186	250	859	4,295	0.98
11.1.6.B.3.4 Compaction	4400.00 CY	2,063	162	556	2,781	0.63
11.1.6.B.3.5 Check Grade	4400.00 CY	263	21	71	355	0.08
CONST 1500 LF OF LEVEE		28,446	2,232	7,670	38,348	

11.1.6.B.5 ESTABLISH TURF

11.1.6.B.5.1 Replace and Spread Top Soil	1162.00 CY	923	72	249	1,244	1.07
11.1.6.B.5.2 Prepare Seed Bed	62726 SF	172	14	46	232	0.00
11.1.6.B.5.3 Seeding and Fertilizing	6970.00 SY	948	74	256	1,278	0.18
ESTABLISH TURF	1.44 ACR	2,043	160	551	2,755	1913.03
CONST 1500 LF OF LEVEE		36,037	2,828	9,716	48,582	
CONST 1500 LF OF LEVEE		36,037	2,828	9,716	48,582	
LEVEES		159,887	12,547	43,109	215,543	
LEVEES AND FLOODWALLS		159,887	12,547	43,109	215,543	

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 PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
 WHITE RIVER WILDLIFE REFUGE TEST
 ** PROJECT OWNER SUMMARY - LEVEL 6 **

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QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
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30 ENGINEERING AND DESIGN

30.B ENGRG & DESIGN PRIOR TO 03-28-91

30.B.2 ENGR SUPERVISION & REVIEW

ENGR SUPERVISION & REVIEW	25.00 MHR	1,250	0	0	1,250	50.00
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30.B.4 DESIGN BY THIS DISTRICT

DESIGN BY THIS DISTRICT	200.00 MHR	10,000	0	0	10,000	50.00
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30.B.7 RECONN & DETAIL PROJECT REPORTS

RECONN & DETAIL PROJECT REPORTS	40.00 MRS	2,000	0	0	2,000	50.00
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ENGRG & DESIGN PRIOR TO 03-28-91		13,250	0	0	13,250	
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30.H PLANS AND SPECIFICATIONS

30.H.L BIDABILITY, CONSTRUCTIBILITY AND

BIDABILITY, CONSTRUCTIBILITY AND	40.00 MHR	2,000	0	0	2,000	50.00
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PLANS AND SPECIFICATIONS		2,000	0	0	2,000	
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30.J ENGINEERING DURING CONSTRUCTION

30.J.1 AE CONTR AWARD/ADMINISTRATION

AE CONTR AWARD/ADMINISTRATION	8.00 MHR	400	0	0	400	50.00
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30.J.3 VALUE ENGRG CH PROPOSALS (VECP)

VALUE ENGRG CH PROPOSALS (VECP)	8.00 MHR	400	0	0	400	50.00
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30.J.5 PERIODIC INSPECTIONS

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 WHITE RIVER WILDLIFE REFUGE TEST
 ** PROJECT OWNER SUMMARY - LEVEL 6 **

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	QUANTY UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
PERIODIC INSPECTIONS	40.00 MHR	2,400	0	0	2,400	60.00
ENGINEERING DURING CONSTRUCTION		3,200	0	0	3,200	
30.M COST ENGINEERING						
COST ENGINEERING	80.00 MHR	4,000	0	0	4,000	50.00
30.N CONST & SUPPLY CONTR AWARD ACTV						
30.N.1 PREPARATION OF BID DOCUMENTS						
PREPARATION OF BID DOCUMENTS	16.00 MHR	800	0	0	800	50.00
30.N.2 CONTRACT NEGOTIATIONS						
CONTRACT NEGOTIATIONS	8.00 MHR	400	0	0	400	50.00
30.N.3 CONTRACTING OFFICE ACTIVITIES						
CONTRACTING OFFICE ACTIVITIES	24.00 MHR	1,200	0	0	1,200	50.00
CONST & SUPPLY CONTR AWARD ACTV		2,400	0	0	2,400	
30.T PED PHASE LCPM						
PED PHASE LCPM	96.00 MHR	4,800	0	0	4,800	50.00
ENGINEERING AND DESIGN		29,650	0	0	29,650	
31 SUPERVISION AND ADMINISTRATION						
31.B CONTRACT ADMINISTRATION						
31.B.1 PRE-AWARD ACTIVITIES						
PRE-AWARD ACTIVITIES		500	0	0	500	
31.B.5 PROGRESS AND COMPLETION REPORTS						

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** PROJECT OWNER SUMMARY - LEVEL 6 **

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SUMMARY PAGE 25

	QUANTY	UOM	CONTRACT	ESCALATN	CONTNGCY	TOTAL COST	UNIT
PROGRESS AND COMPLETION REPORTS	1,200		0	0		1,200	
CONTRACT ADMINISTRATION	1,700		0	0		1,700	
31.C BENCH MARKS AND BASELINES							
BENCH MARKS AND BASELINES	800		0	0		800	
31.D REVIEW OF SHOP DRAWINGS							
REVIEW OF SHOP DRAWINGS	1,700		0	0		1,700	
31.E INSPECTION AND QUALITY ASSURANCE							
31.E.1 SCHEDULE COMPLIANCE							
SCHEDULE COMPLIANCE	1,800		0	0		1,800	
31.E.2 COMPLIANCE SAMPLING AND TESTING							
COMPLIANCE SAMPLING AND TESTING	4,500		0	0		4,500	
INSPECTION AND QUALITY ASSURANCE	6,300		0	0		6,300	
31.F PROJECT OFFICE OPERATION							
PROJECT OFFICE OPERATION	3,200		0	0		3,200	
31.H CONTR INIT CLAIMS & LITIGATIONS							
CONTR INIT CLAIMS & LITIGATIONS	800		0	0		800	
31.T CONSTRUCTION PHASE LCPM							
CONSTRUCTION PHASE LCPM	1,700		0	0		1,700	
SUPERVISION AND ADMINISTRATION	16,200		0	0		16,200	
WHITE RIVER NATIONAL WILDLIFE	205,737		12,547	43,109		261,393	

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11 LEVEES AND FLOODWALLS				4,089		45,667	68,854	45,366	159,887	
30 ENGINEERING AND DESIGN				56		29,250	400	0	29,650	
31 SUPERVISION AND ADMINISTRATI				305		15,250	685	265	16,200	
WHITE RIVER NATIONAL WILDLIF ESCALATN				4,450		90,167	69,939	45,631	205,737	
									12,547	
SUBTOTAL									218,285	
CONTNGCY									43,109	
TOTAL INCL OWNER COSTS									261,393	

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 WHITE RIVER WILDLIFE REFUGE TEST
 ** PROJECT DIRECT SUMMARY - LEVEL 6 **

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			QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST

11 LEVEES AND FLOODWALLS												
11.1 LEVEES												
11.1.1 MOBILIZATION AND DEMOBIL												
11.1.1.1 LOAD AND UNLOAD EQUIPM												

			LOAD AND UNLOAD EQ	10.00	PCS		22	281	354	0	635	63.54
11.1.1.2 TRANSPORT EQUIPMENT (M												

			TRANSPORT EQUIPMEN	80.00	HRS		80	851	3,864	0	4,715	58.94
11.1.1.3 MOB & DEMOB EQPMT TO B												

			MOB & DEMOB EQPMT	8.00	HRS		32	321	422	0	743	92.89

			MOBILIZATION AND D				134	1,453	4,641	0	6,094	
11.1.2 REPAIR 60" SLUICE GATES												
11.1.2.B METALS												
11.1.2.B.1 REMOVE EXISTING 60"												

			REMOVE EXISTING 60	2.00	EA		32	392	528	0	919	459.71
11.1.2.B.3 CLEAN AND PAINT GATE												

			CLEAN AND PAINT GA	2.00	EA		32	392	528	64	984	491.79
11.1.2.B.5 ADJUST EXISTING GATE												

			ADJUST EXISTING GA	2.00	EA		32	392	122	0	514	256.78

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.2.B.7 INSTALL 60" SLUICE G										
INSTALL 60" SLUICE	2.00	EA		16	196	264	0	460	229.86	
11.1.2.B.8 REPAIR SPALLED CONCR										
REPAIR SPALLED CON				4	49	17	32	98		
11.1.2.B.9 METAL WORK FOR IN-OP										
METAL WORK FOR IN-				16	196	82	394	672		
METALS				132	1,616	1,540	490	3,646		
REPAIR 60" SLUICE				132	1,616	1,540	490	3,646		
11.1.3 REPLACE 36" SLIDE GATE										
11.1.3.B METAL WORK										
11.1.3.B.1 Rem Ext 36" Slide Ga										
Rem Ext 36" Slide				32	395	532	0	927		
11.1.3.B.3 Install New 36" Slid										
Install New 36" Sl				16	196	264	5,428	5,888		
METAL WORK				48	591	796	5,428	6,815		
REPLACE 36" SLIDE				48	591	796	5,428	6,815		
11.1.4 ELINMINATE GATE STR & RE										
11.1.4.B SITE WORK										

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PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
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** PROJECT DIRECT SUMMARY - LEVEL 6 **

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QUANTITY UOM CREW ID			OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
<hr/>									
11.1.4.B.1 CLEAR AND GRUB									
CLEAR AND GRUB			31	350	960	0	1,310		
<hr/>									
11.1.4.B.2 EXC, PL, COMPACT & G									
11.1.4.B.2.1	EXCAVATE AND PLACE	2625.00 CY	86	1,104	3,446	0	4,549	1.73	
11.1.4.B.2.2	INSTALL GEOTEXTILE	3878.00 SY	4	42	11	8,708	8,762	2.26	
11.1.4.B.2.3	SPREAD AND SHAPE T	2625.00 CY	48	729	1,172	0	1,901	0.72	
11.1.4.B.2.4	COMPACTION	2625.00 CY	48	695	535	0	1,231	0.47	
11.1.4.B.2.5	CHECK GRADE	2625.00 CY	10	100	57	0	157	0.06	
EXC, PL, COMPACT &			195	2,669	5,222	8,708	16,599	6.32	
<hr/>									
11.1.4.B.4 HAUL & DUMP RIPRAP O									
HAUL & DUMP RIPRAP			1,213	12,899	29,967	11,727	54,593	22.10	
<hr/>									
11.1.4.B.5 PLACE RIPRAP ON SLOP									
PLACE RIPRAP ON SL			1,115	11,970	3,691	0	15,661	6.34	
<hr/>									
11.1.4.B.9 ESTABLISH TURF ON TO									
11.1.4.B.9.1	Replace Top Soil	17.00 CY	16	151	28	0	178	10.49	
11.1.4.B.9.2	Till or Prepare Se	871.00 SF	8	75	14	0	89	0.10	
11.1.4.B.9.3	Seed and Fertilize	97.00 SY	1	5	1	10	16	0.16	
ESTABLISH TURF ON			24	231	42	10	283	0.32	
SITE WORK			2,579	28,119	39,882	20,446	88,447		
<hr/>									
11.1.4.C CONCRETE									
<hr/>									
11.1.4.C.1 PREPARE CULVERT TO R									
PREPARE CULVERT TO			4	49	23	0	72		

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		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
11.1.4.C.3 PLACE CONC PLUG IN C											
PLACE CONC PLUG IN		3.14	CY		25		308	145	222	674	214.57
CONCRETE					29		357	168	222	746	
11.1.4.E METALS											
11.1.4.E.1 REMOVE EXISTING GATE											
REMOVE EXISTING GA					16		196	264	0	460	
METALS					16		196	264	0	460	
ELIMINATE GATE ST					2,624		28,671	40,314	20,667	89,652	
11.1.5 REPAIR 60' OF LEVEE & AD											
11.1.5.B SITE WORK											
11.1.5.B.1 CLEAR AND GRUB											
CLEAR AND GRUB					6		72	198	0	270	
11.1.5.B.3 EXC, PL, COMPACT & G											
11.1.5.B.3.1	EXCAVATE AND PLACE	150.00	CY		5		63	197	0	260	1.73
11.1.5.B.3.2	INSTALL GEOTEXTILE	222.00	SY		2		22	6	499	526	2.37
11.1.5.B.3.3	SPREAD AND SHAPE T	150.00	CY		3		42	67	0	109	0.72
11.1.5.B.3.4	COMPACTION	150.00	CY		3		40	31	0	70	0.47
11.1.5.B.3.5	CHECK GRADE	150.00	CY		1		6	3	0	9	0.06
EXC, PL, COMPACT &		150.00	CY		13		172	304	499	974	6.49
11.1.5.B.4 HAUL RIPRAP FROM QUA											
HAUL RIPRAP FROM Q		530.00	TON		260		2,768	6,430	2,516	11,714	22.10

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QUANTITY UOM CREW ID			OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST

11.1.5.B.5 PLACE QUARRY RUN STO									
PLACE QUARRY RUN S	530.00	TON	239	2,569	792	0	3,360	6.34	
11.1.5.B.7 ESTABLISH TURF ON LE									
11.1.5.B.7.1 Replace Top Soil	24.00	CY	23	213	39	0	252	10.49	
11.1.5.B.7.2 Prepare Seed Bed	1307.00	SF	12	113	21	0	134	0.10	
11.1.5.B.7.3 Seeding and Fertil	145.00	SY	1	7	1	15	23	0.16	
ESTABLISH TURF ON			35	333	61	15	409		
SITE WORK			554	5,913	7,785	3,030	16,727		
11.1.5.C CONCRETE SPILLWAY WORK									
11.1.5.C.1 PREPARE SURFACE AREA									
PREPARE SURFACE AR	350.00	SF	17	161	20	0	181	0.52	
11.1.5.C.2 PLACE FORMS FOR CONC									
PLACE FORMS FOR CO	160.00	LF	4	52	9	87	148	0.92	
11.1.5.C.3 PLACE WWF (W6 X 6) I									
PLACE WWF (W6 X 6)	350.00	SF	4	49	12	67	129	0.37	
11.1.5.C.4 PLACE CONCRETE IN SP									
PLACE CONCRETE IN	3.06	CY	10	115	26	216	357	116.60	
11.1.5.C.5 FINISH CONCRETE IN S									
FINISH CONCRETE IN	350.00	SF	5	70	17	0	87	0.25	

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST

11.1.5.C.6 CURE CONCRETE IN SPI											
	CURE CONCRETE IN S	3.50	CSF		1	6	1	9	15	4.31	
	CONCRETE SPILLWAY	3.06	CY		41	454	84	378	916	299.30	
	REPAIR 60' OF LEVEE				595	6,366	7,869	3,408	17,643		
11.1.6 CONST 1500 LF OF LEVEE											
11.1.6.B CONST 1500 LF OF LEVEE											
11.1.6.B.1 CLEAR AND GRUB											
	CLEAR AND GRUB	1.44	ACR		131	1,483	4,065	0	5,548	3852.56	
11.1.6.B.3 CONST 1500 LF OF LEV											
11.1.6.B.3.1	Exc, Haul & Place	4400.00	CY		144	1,850	5,776	0	7,625	1.73	
11.1.6.B.3.2	Apply Geotextile M	6500.00	SY		59	559	153	14,596	15,309	2.36	
11.1.6.B.3.3	Spread, and Shape	4400.00	CY		80	1,222	1,964	0	3,186	0.72	
11.1.6.B.3.4	Compaction	4400.00	CY		80	1,165	897	0	2,063	0.47	
11.1.6.B.3.5	Check Grade	4400.00	CY		16	168	96	0	263	0.06	
	CONST 1500 LF OF L				379	4,963	8,887	14,596	28,446		
11.1.6.B.5 ESTABLISH TURF											
11.1.6.B.5.1	Replace and Spread	1162.00	CY		17	224	699	0	923	0.79	
11.1.6.B.5.2	Prepare Seed Bed	62726.00	SF		14	150	22	0	172	0.00	
11.1.6.B.5.3	Seeding and Fertil	6970.00	SY		14	150	22	776	948	0.14	
	ESTABLISH TURF	1.44	ACR		46	524	743	776	2,043	1419.06	
	CONST 1500 LF OF L				556	6,970	13,695	15,373	36,037		
	CONST 1500 LF OF L				556	6,970	13,695	15,373	36,037		
	LEVEES				4,089	45,667	68,854	45,366	159,887		
	LEVEES AND FLOODWA				4,089	45,667	68,854	45,366	159,887		

		QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
30 ENGINEERING AND DESIGN											
30.B ENGRG & DESIGN PRIOR TO 03											
30.B.2 ENGR SUPERVISION & REVIE											
ENGR SUPERVISION &		25.00	MHR		0	1,250	0	0	0	1,250	50.00
30.B.4 DESIGN BY THIS DISTRICT											
DESIGN BY THIS DIS		200.00	MHR		0	10,000	0	0	0	10,000	50.00
30.B.7 RECONN & DETAIL PROJECT											
RECONN & DETAIL PR		40.00	MRS		0	2,000	0	0	0	2,000	50.00
ENGRG & DESIGN PRI					0	13,250	0	0	0	13,250	
30.H PLANS AND SPECIFICATIONS											
30.H.L BIDABILITY, CONSTRUCTIBI											
BIDABILITY, CONSTR		40.00	MHR		0	2,000	0	0	0	2,000	50.00
PLANS AND SPECIFIC					0	2,000	0	0	0	2,000	
30.J ENGINEERING DURING CONSTRU											
30.J.1 AE CONTR AWARD/ADMINISTR											
AE CONTR AWARD/ADM		8.00	MHR		8	400	0	0	0	400	50.00
30.J.3 VALUE ENGRG CH PROPOSALS											
VALUE ENGRG CH PRO		8.00	MHR		8	400	0	0	0	400	50.00
30.J.5 PERIODIC INSPECTIONS											

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 ** PROJECT DIRECT SUMMARY - LEVEL 6 **

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	QUANTITY	UOM	CREW	ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
PROGRESS AND COMPL	24						1,200	0	0	1,200	
CONTRACT ADMINISTR	34						1,700	0	0	1,700	
31.C BENCH MARKS AND BASELINES											
BENCH MARKS AND BA	15						750	35	15	800	
31.D REVIEW OF SHOP DRAWINGS											
REVIEW OF SHOP DRA	34						1,700	0	0	1,700	
31.E INSPECTION AND QUALITY ASS											
31.E.1 SCHEDULE COMPLIANCE											
SCHEDULE COMPLIANC	36						1,800	0	0	1,800	
31.E.2 COMPLIANCE SAMPLING AND											
COMPLIANCE SAMPLIN	80						4,000	450	50	4,500	
INSPECTION AND QUA	116						5,800	450	50	6,300	
31.F PROJECT OFFICE OPERATION											
PROJECT OFFICE OPE	56						2,800	200	200	3,200	
31.H CONTR INIT CLAIMS & LITIGA											
CONTR INIT CLAIMS	16						800	0	0	800	
31.T CONSTRUCTION PHASE LCPM											
CONSTRUCTION PHASE	34						1,700	0	0	1,700	
SUPERVISION AND AD	305						15,250	685	265	16,200	
WHITE RIVER NATION	4,450						90,167	69,939	45,631	205,737	

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PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
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** PROJECT DIRECT SUMMARY - LEVEL 6 **

SUMMARY PAGE 78

	QUANTITY	UOM	CREW ID	OUTPUT	MANHOURS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST	UNIT COST
ESCALATN									12,547	
SUBTOTAL									<u>218,285</u>	
CONTNGCY									43,109	
TOTAL INCL OWNER COSTS									<u>261,393</u>	

U.S. Army Corps of Engineers
PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
WHITE RIVER WILDLIFE REFUGE TEST
** CONTRACTOR INDIRECT SUMMARY - LEVEL 1 **

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	QUANTY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
<hr/>									
11.	LEVEES AND FLOODWALLS								
A	PRIME CONTRACTOR		124,600	12,460	6,853	14,391	1,583	159,887	
30.	ENGINEERING AND DESIGN								
	NOT IDENTIFIED								
31.	SUPERVISION AND ADMINISTRATION								
	NOT IDENTIFIED								

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PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
WHITE RIVER WILDLIFE REFUGE TEST
** CONTRACTOR INDIRECT SUMMARY - LEVEL 6 **

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		QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
11.1.4.B.2.1.	EXCAVATE AND PLACE NEW FILL MAT								
A	PRIME CONTRACTOR		3,545	355	195	409	45	4,549	
11.1.4.B.2.2.	INSTALL GEOTEXTILE MATERIAL								
A	PRIME CONTRACTOR		6,828	683	376	789	87	8,762	
11.1.4.B.2.3.	SPREAD AND SHAPE TO GRADE								
A	PRIME CONTRACTOR		1,481	148	81	171	19	1,901	
11.1.4.B.2.4.	COMPACTION								
A	PRIME CONTRACTOR		959	96	53	111	12	1,231	
11.1.4.B.2.5.	CHECK GRADE								
A	PRIME CONTRACTOR		122	12	7	14	2	157	
11.1.4.B.9.1.	Replace Top Soil								
A	PRIME CONTRACTOR		139	14	8	16	2	178	
11.1.4.B.9.2.	Till or Prepare Seedbed								
A	PRIME CONTRACTOR		69	7	4	8	1	89	
11.1.4.B.9.3.	Seed and Fertilize								
A	PRIME CONTRACTOR		12	1	1	1	0	16	
11.1.5.B.3.1.	EXCAVATE AND PLACE FILL MATERIAL								
A	PRIME CONTRACTOR		203	20	11	23	3	260	
11.1.5.B.3.2.	INSTALL GEOTEXTILE MATERIAL								
A	PRIME CONTRACTOR		410	41	23	47	5	526	
11.1.5.B.3.3.	SPREAD AND SHAPE TO GRADE								
A	PRIME CONTRACTOR		85	8	5	10	1	109	
11.1.5.B.3.4.	COMPACTION								
A	PRIME CONTRACTOR		55	5	3	6	1	70	
11.1.5.B.3.5.	CHECK GRADE								
A	PRIME CONTRACTOR		7	1	0	1	0	9	
11.1.5.B.7.1.	Replace Top Soil								
A	PRIME CONTRACTOR		196	20	11	23	2	252	
11.1.5.B.7.2.	Prepare Seed Bed								
A	PRIME CONTRACTOR		104	10	6	12	1	134	
11.1.5.B.7.3.	Seeding and Fertilizer								
A	PRIME CONTRACTOR		18	2	1	2	0	23	
11.1.6.B.3.1.	Exc, Haul & Place fill								

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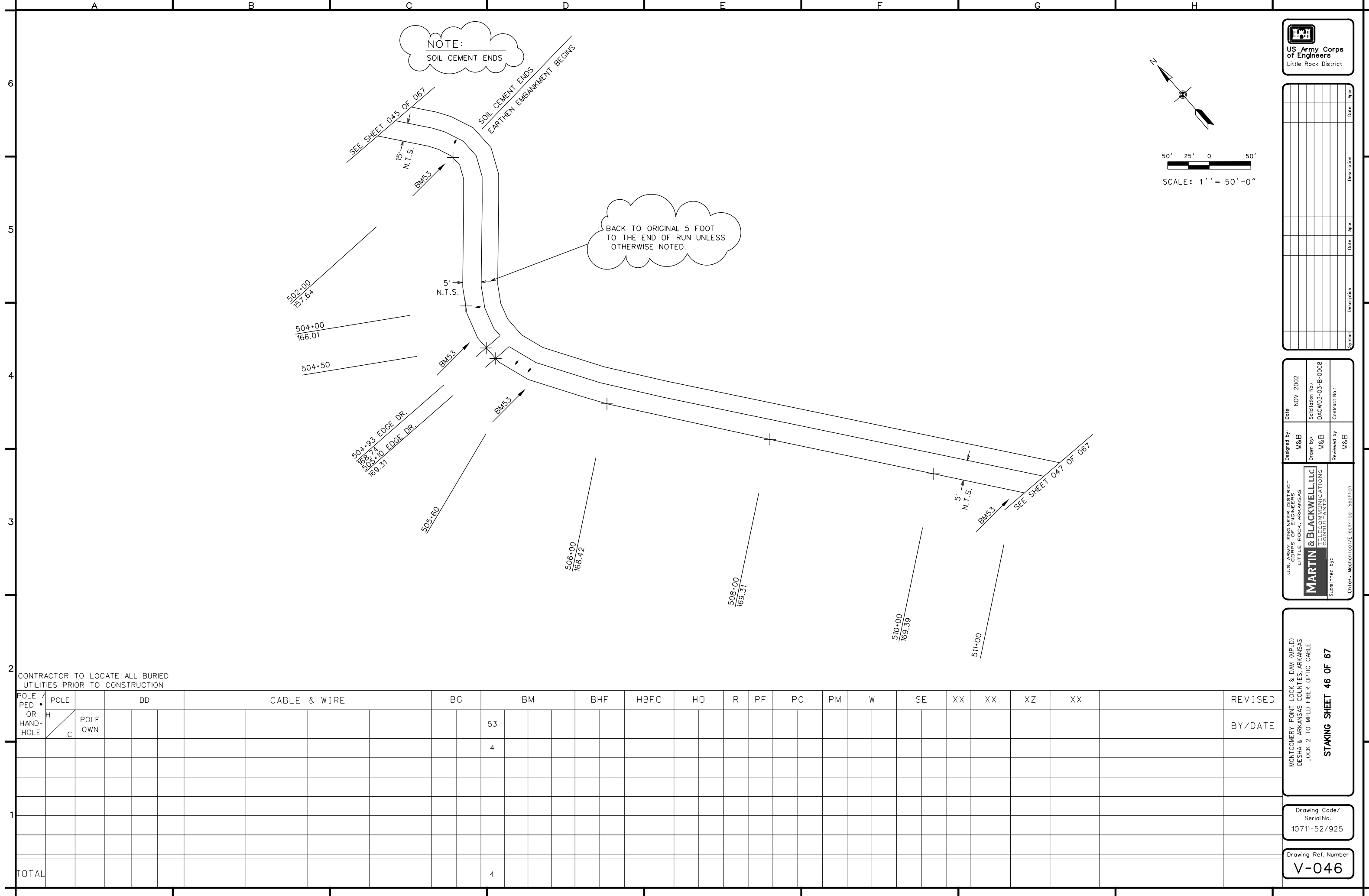
PROJECT WRRFGH: WHITE RIVER NATIONAL WILDLIFE - REFUGE, REHABILITATION OF
WHITE RIVER WILDLIFE REFUGE TEST
** CONTRACTOR INDIRECT SUMMARY - LEVEL 6 **

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	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
A PRIME CONTRACTOR		5,942	594	327	686	75	7,625	
11.1.6.8.3.2. Apply Geotextile Material								
A PRIME CONTRACTOR		11,930	1,193	656	1,378	152	15,309	
11.1.6.8.3.3. Spread, and Shape to Grade								
A PRIME CONTRACTOR		2,483	248	137	287	32	3,186	
11.1.6.8.3.4. Compaction								
A PRIME CONTRACTOR		1,607	161	88	186	20	2,063	
11.1.6.8.3.5. Check Grade								
A PRIME CONTRACTOR		205	21	11	24	3	263	
11.1.6.8.5.1. Replace and Spread Top Soil								
A PRIME CONTRACTOR		719	72	40	83	9	923	
11.1.6.8.5.2. Prepare Seed Bed								
A PRIME CONTRACTOR		134	13	7	15	2	172	
11.1.6.8.5.3. Seeding and Fertilizing								
A PRIME CONTRACTOR		739	74	41	85	9	948	

28. ATTACHMENT C

Referenced Drawings



MONTGOMERY POINT LOCK & DAM (MPLD)
 DESHA & ARKANSAS COUNTIES, ARKANSAS
 LOCK 2 TO MPLD FIBER OPTIC CABLE

STAKING SHEET 46 OF 67

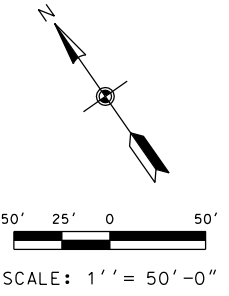
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Drawing Ref. Number
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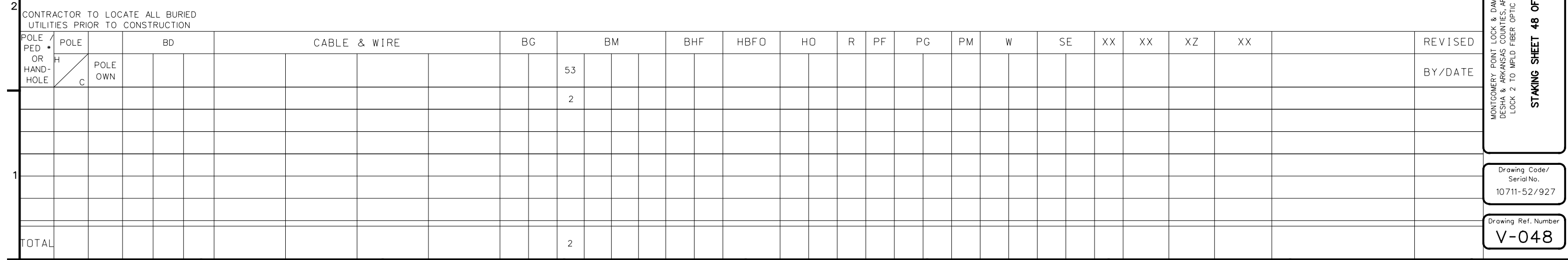
MARTIN & BLACKWELL, LLC ENGINEERING COMMUNICATIONS CONSULTANTS 1000 N. W. 10th Ave., Suite 100 Ft. Lauderdale, FL 33304 Phone: (305) 556-1100 Fax: (305) 556-1101 E-Mail: martin@blackwellllc.com	Submitted by:	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS LITTLE ROCK, ARKANSAS		
	Designed by: M&B Date: NOV 2002	Drawn by: M&B Solicitation No.: DACW03-03-B-0008	Reviewed by: M&B Contract No.:	
Chief, Mechanical/Electrical Section				

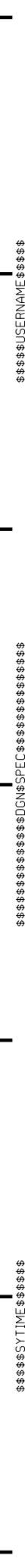
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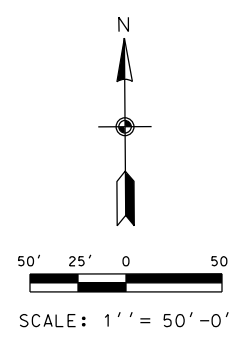
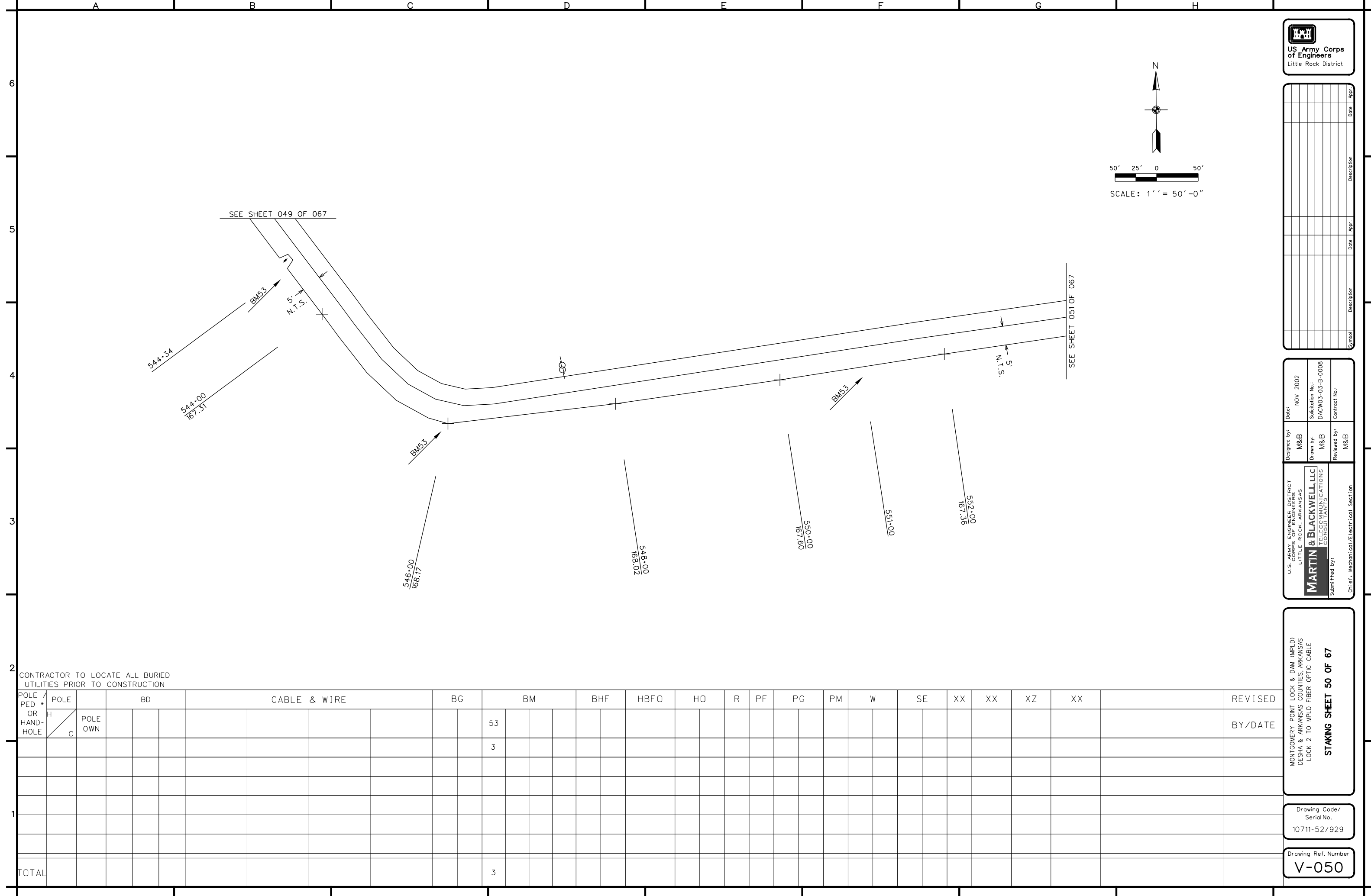
US Army Corps
of Engineers
Little Rock District




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 US Army Corps of Engineers Little Rock District		Date: NOV 2002 Drawn by: M&B Solicitation No.: DACW03-03-B-0008 Contract No.: Reviewed by: M&B	
MARTIN & BLACKWELL, LLC TELECOMMUNICATIONS CONSULTANTS		Submitted by: Chief, Mechanical/Electrical Section	

MONTGOMERY POINT LOCK & DAM (MPLD) DESHA & ARKANSAS COUNTIES, ARKANSAS LOCK 2 TO MPLD FIBER OPTIC CABLE			
STAKING SHEET 50 OF 67			

Drawing Code/ Serial No. 10711-52/929	Drawing Ref. Number V-050
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STAKING SHEET

NAME

AE 21

PROJECT Montgomery Point

CONSTRUCTION

PRI. WIRE SIZE 350

KIND: MCN 25 kv

DESIGN TENSION UG

PHASE 40

NO. WIRES 4

RULING SPAN: UG

RETIREMENT

PRI. WIRE SIZE

KIND: _____

PHASE _____

NO. WIRES _____

COUNTY DESHA

TWP. _____ RG. _____ SEC. _____

MAP DETAIL NO. _____

WORK PLAN REFERENCE NO. _____

WORK

STA

CHE

REV

SHE

TYPE (EO) (L&H) (NEW)	POLE NUMBER	SPAN	POLES		PRI. UNIT	R/W CLEARING	TRANS.		GR.	GUY			ANCHOR		SECONDARY O.H.			SERVICE O.H.			SECONDARY BURIED			SEC. OR SER. WIRE SIZE
			H. & C.	O.H.			"G"	"UG"		NO.	UNIT	LEAD	NO.	UNIT	SPAN	SEC. ONLY	NO.	OR	SPAN	NO.	OR	NO.	UNIT	

New STA 1199+80 2400 2)45-2 UCH 2) -11

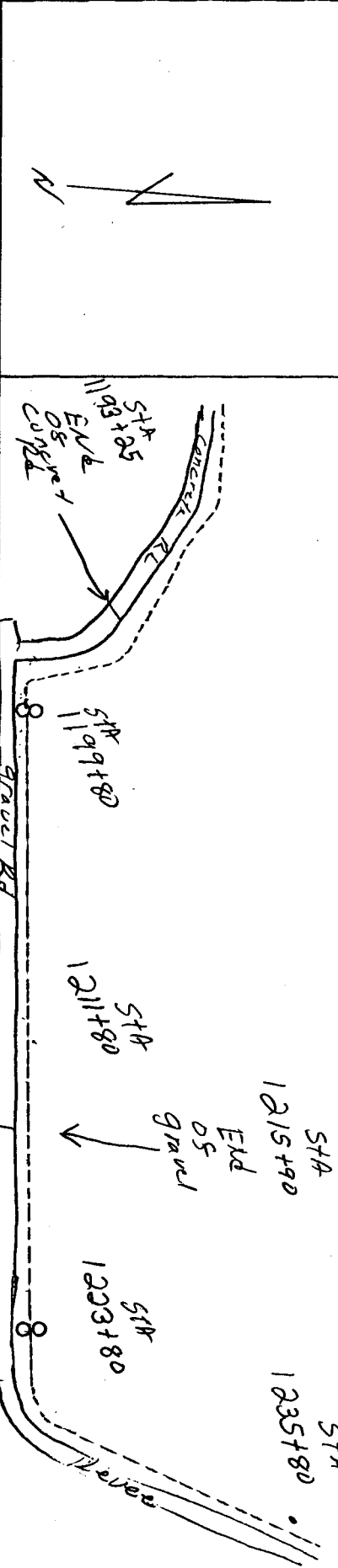
New STA 1211+80 UMB-6

New STA 1223+80 2400 2)45-2 UCH 2) -11

New STA 1235+80 UMB-6

NOTES:

SKETCH OF WORK:



CONSTRUCT

PRI. O.H.

PRI. BURIED

SEC. O.H.

SEC. BURIED

RETIREMENT

PRI. O.H.

PRI. BURIED

SEC. O.H.

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