Mississippi Valley Division,
Regional Planning and Environment Division South

Pearl River Basin, Mississippi, Federal Flood Risk Management Project

Appendix M- NFI Report Plan Formulation

June 2024

Pearl River Basin, Mississippi
Federal Flood Risk Management Project
Hinds And Rankin Counties, Mississippi

Appendix A
Plan Formulation

October 2017 (Updated May 2022)

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1.0 INTRODUCTION

This appendix provides supplemental plan formulation information on the Pearl River Watershed Integrated Feasibility Study and Environmental Impact Statement (FS/EIS). It supplements the information in Section 3 of the main report and includes tables and maps used in the development, screening, and evaluation of management measures and alternative plans.

2.0 PROBLEM

Headwater flooding of the Pearl River (up to 10 feet deep in some areas) has caused disruption to businesses and industry throughout the Jackson metropolitan area, damaging over 5,000 commercial and residential structures within a 50 square mile zone that includes parts of Rankin and Hinds counties. Numerous flood events have affected the Study Area, most notably the Easter Flood of 1979 and the May Flood of 1983. The 1979 event flooded homes and businesses, causing damages that at that time totaled approximately $223-million. If the same event occurred in the present day, damages would surpass $1-billion.

Problems in the Study Area

1. *Severe rainfall in the Upper Pearl River Watershed causes a high risk of downstream flooding in the Study Area, threatening approximately 44,000 people and approximately 5,000 structures.*
2. *High risk of flooding threatens critical infrastructure, including an existing wastewater treatment facility.*
3. *Major transportation routes and evacuation routes become impassible and damaged during flood events in the Study Area.*

More than 13,000 businesses, altogether employing over 180,000 people, are located in the Rankin and Hinds extents of the Jackson metropolitan area. As the capital of Mississippi, Jackson's downtown Central Business District (CBD) is home to many state and federal offices. Major transportation routes, including interstates, state highways, local streets, and major rail carriers are affected by flooding, causing detours throughout the area. Flooding causes infrastructure damage, including damages to the 46 million gallons per day (MGD) Savanna Street Wastewater Treatment Plant (WWTP), which serves this area.

As of the 2010 US Census, the population for the Jackson metropolitan area has increased to over 500,000 and that number continues to increase. According to the Census tract data, approximately 43,800 people reside within the existing 1% annual chance event floodplain. Additionally, traffic counts on major highways and interstates have increased 100% over the last 25 years [traffic data provided by the Mississippi Department of Transportation (MDOT)]. According to the Mississippi Department of Transportation's Mississippi's Unified Long-Range Trasportation Infrasturcture Plan (MULTIPLAN) 2035, "The locations of Mississippi's largest businesses… follow its interstate and state highway system, underscoring the importance of highway access to the state's economy." For example, Interstate 55, described in the MULTIPLAN 2035 report as "the major north-south corridor of statewide significance in Mississippi" and was innundated during the 1979 Flood, has an annual average daily traffic count of between 110,000 and 140,000 for 2018. In addition to the economic impacts that the flood damages would have due to innundation of this and other vital traffic routes within the project reach, detours would inhibit the movement of emergency personnel, first responders, and impede access to local healthcare facilities.

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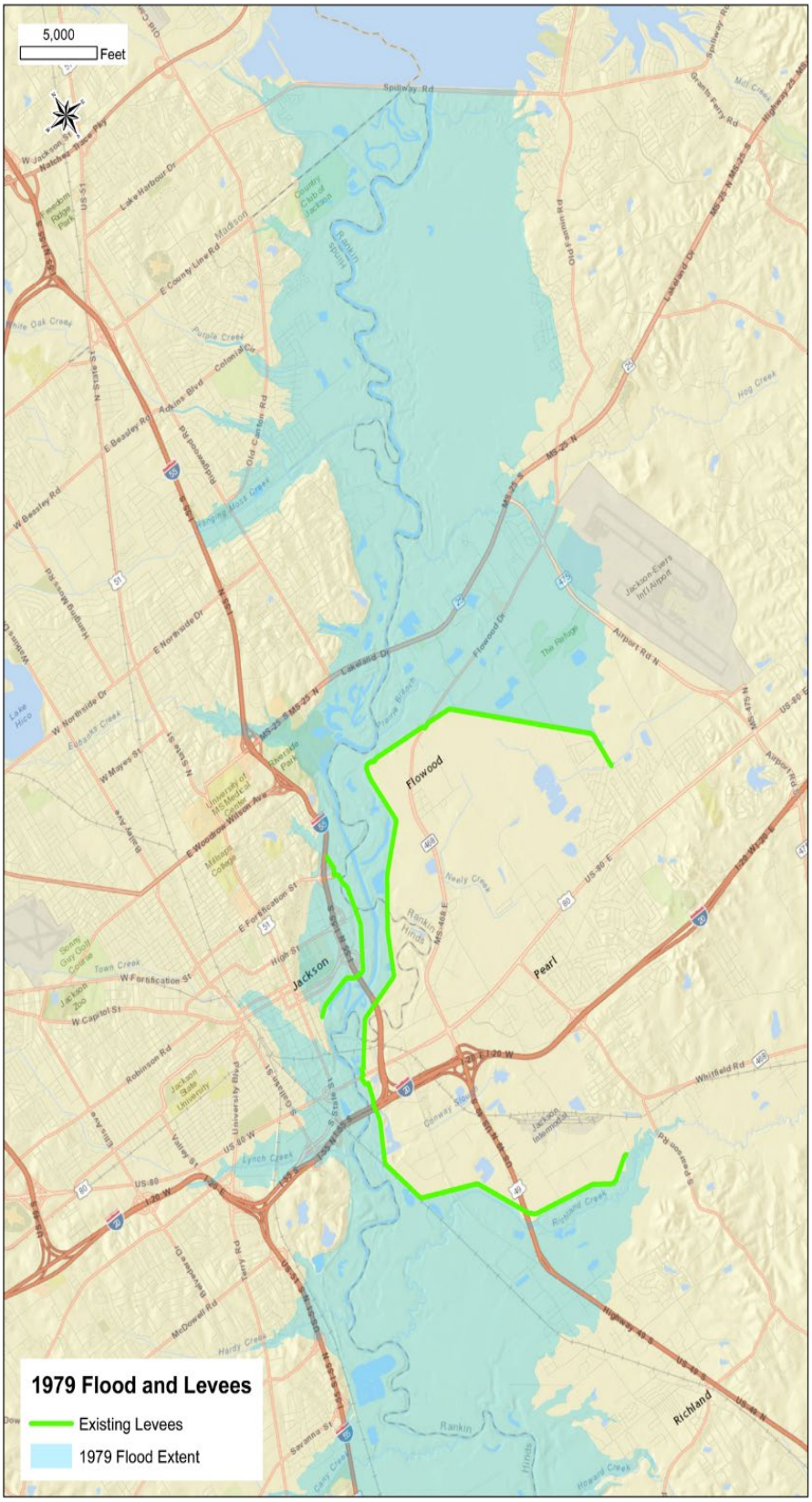

Figure 2-1. In 1979, the west section of the 13.5 mi levee protecting Jackson, MS was breached by floodwater. Shown are the locations of the levees and the extent of flooding during the 1979 event.

Approximately 13.5 miles of levees currently protect portions of the Jackson metropolitan area (Figure 2-1). Much of Rankin and Hinds counties remain unprotected from Pearl River flooding, including major transportation routes. The existing protection provides flood risk management to portions of the cities of Jackson, Pearl, Flowood, and Richland. Although some protection exists, the Jackson levee was compromised during the 1979 flood, and flood water inundated the Mississippi State Fairgrounds, surrounding businesses, and Interstate 55 (Figure 2-1).

2.1 Need for Action

Critical needs were identified based on problems experienced within the Study Area. A levee system was constructed in the 1960s to help reduce flood damages for a portion of the Jackson metropolitan area. Consisting of levees, pumps, and channelization, this system is more expressly described in Section 2.2.1. The levee system has generally been effective in flood reduction for the protected areas during annual flood events; however, the west levee was compromised during the 1979 flood of record. In response to strong local, regional, and state requests for assistance, studies of the Pearl River Watershed, Mississippi, were authorized by congressional resolutions adopted 9 May 1979. Numerous attempts over the intervening years to find a feasible and reliable alternative have failed to gain support from state and local leadership or the local community, despite recognition that the existing levee system only provides protection of approximately 30% of the structures, valued at over $1-billion, within the flood-risk area.

Critical Needs in the Area

1. Reduce flood risk in the Jackson metropolitan area;
2. Reduce the flood risk of critical infrastructure, including the Savanna Street Wastewater Treatment Facility;
3. Improve access to transportation routes, evacuation routes, and critical care facilities during flood events.

2.2 Opportunities

Opportunities to address flood damage issues caused by the Pearl River within the Jackson metropolitan area were identified based on input from the local sponsor, stakeholders, government agencies and the public.

Study Opportunities

Reduce flood risk to residential, commercial, and industrial structures within the Jackson metropolitan area and provide additional protection for areas where existing levees exist;

Provide measures to ensure accessible public transportation corridors for public safety during flood events;

Provide measures to remove properties with recurring flood damages;

Provide education to local officials and residents of risk of living in flood prone areas; and

Provide environmental design features to conserve and improve natural resources, and provide recreational opportunities.

2.3 Goals and Objectives

The goal of this FS/EIS was developed to help prioritize solutions to be targeted based on recognized problems, needs, and opportunities. Reducing flood-associated damage, providing long-needed flood relief, was identified.

Study Goal
To provide a comprehensive solution to reduce flood risk in the Jackson metropolitan area caused by the Pearl River.

The objective of the FS/EIS is to investigate measures to alleviate flooding in the Study Area based on the FS/EIS goal (Table 2-1).

2.4 Planning Constraints

Planning constraints have been determined for the area based on prior study documentation and updated information from recent data collection. While numerous obstacles and challenges had to be addressed during this study, many of these constraints were identified based on prior and updated information.

The study goals, objectives, and constraints are identified in Sections 1 and 3 of the report. They are shown on Figure 2-2 and described in Table 2-1 as a point of reference for understanding details of the screening process.

Table 2-1: Objectives and Constraints.

Objectives	Constraints
Reduce Pearl River estimated annual flood damages in the Jackson metropolitan area through the year 2065.	Avoid adverse impacts to flood elevations, water quantity, and water quality upstream or downstream of the Study Area.
Reduce loss of transportation routes with Average Daily Traffic (ADT) Counts of 10,000 or higher and also routes to critical care facilities.	Avoid adverse impacts to the water supply and water quality being provided by the existing withdrawal at River Mile (RM) 290.7.
Reduce the flood risk of critical infrastructure, specifically the Savanna Street Jackson Wastewater Treatment Facility.	Avoid the existing wetland mitigation area within the project boundaries when possible.
Integrate environmental design features into flood risk reduction features to conserve or improve natural resources.	Avoid adverse effects on minimal flow releases from the Ross Barnett Reservoir.
Provide flood risk management educational information to local officials and residents living in flood prone areas.	

As noted above, existing data from previous Pearl River flood studies was used to the fullest possible extent, especially during plan formulation. In addition to aiding in the identification of potential planning constraints, the prior reports were an efficient and effective data source and allowed the non-Federal sponsor to avoid duplicating previous work. These reports were used in combination with updated and more expansive data collected during the re-scoping and FS/EIS process.

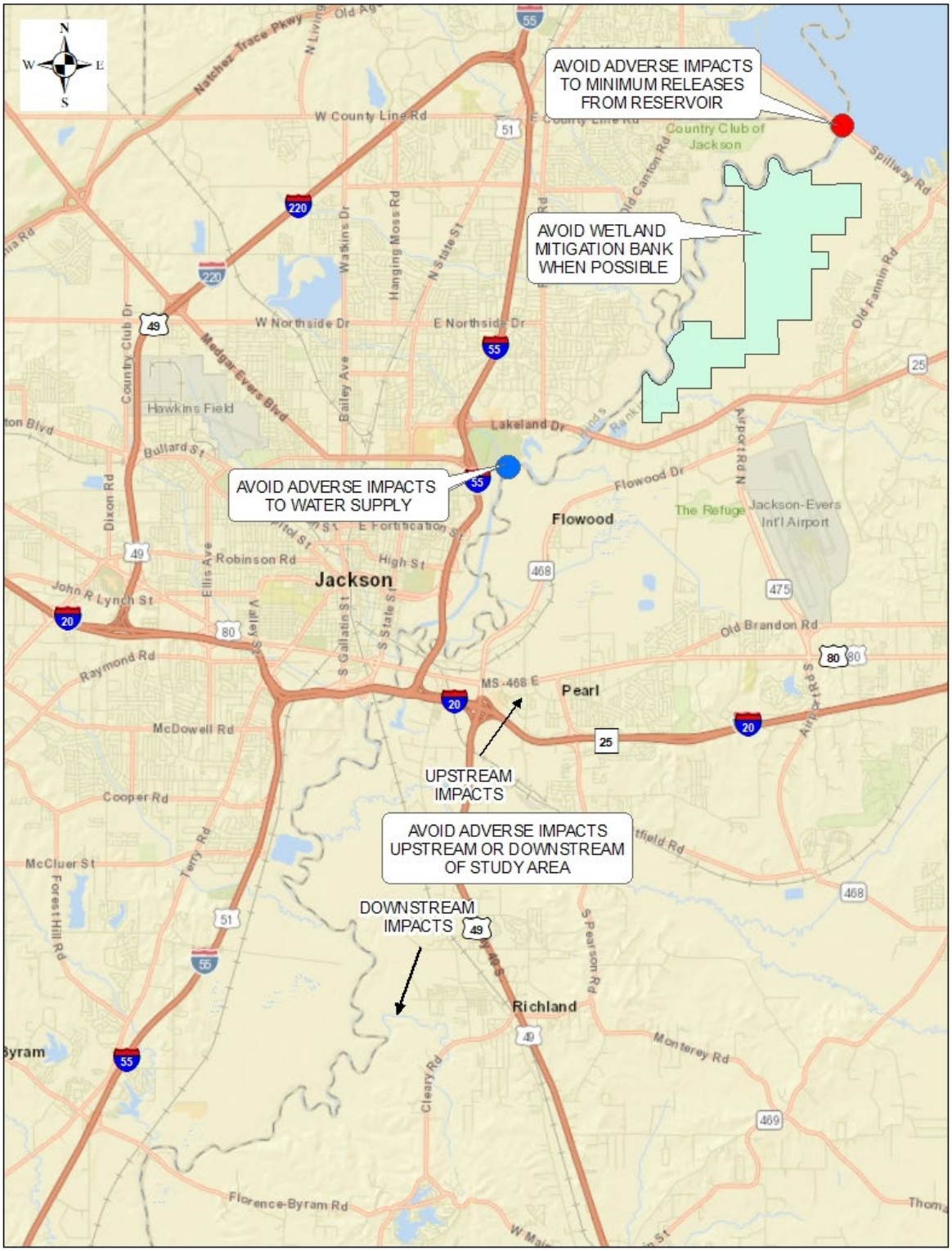

Figure 2-2. Constraints

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3.0 HISTORY OF PEARL RIVER FLOOD RISK MANAGEMENT REPORTS

As stated in the Integrated FS/EIS, this study is the continuation of the efforts of previous studies. Specifically, data from these earlier studies and multiple sources was used during the plan formulation process to update and review arrays of alternatives and recommended plans. So much available data made it possible for an extensive number of alternatives to be efficiently evaluated, or re-evaluated as the case may be, and in some cases, the plans were hydraulically modeled to ensure the review was thorough and complete.

3.1 Pearl River Basin Interim Report on Flood Control and Environmental Impact Statement (1985) – Shoccoe Dam

After the Flood of Record in 1979, The Pearl River Basin Intern Report on Flood Control and Environmental Impact Statement May 1984 was developed. This report references over 8 clearing plans and numerous other initial alternatives from raising levees, modifying the Ross Barnett Reservoir, building dry dams, and constructing additional reservoirs (Table 3-1). Non-structural analysis within this study provided information on page 89 of Volume 1 (included in Attachment 2) clarified that non-structural alternatives would directly befit only a few families and business while doing relatively little to alleviate the flood problem in Jackson. Although the Dry Dam (Shoccoe) was selected as the recommended plan, the national economic development (NED) plan was a clearing plan (1G in Table 3-1) for 23 miles which was a channel improvement and clearing plan that went from mile 279 to mile 302 (Ross Barnett Reservoir). According to the 1985 report, Shocoe Dam would have provided 91% flood reduction with the clearing plan (NED) providing only 46% reduction (Volume 1, page 71). The planning objective for the study was to "provide effective protection against floods, including the larger floods". The Shoccoe Dam plan more effectively met the project objective as that plan provided a high degree of protection. The NED plan, Plan 1G, would provide a relatively lower degree of protection and therefore, was less effective at achieving the planning objectives. Authorization of the construction of Shoccoe Dam was contained in Section 401(e) of the Water Resources Development Act (WRDA) of 1986 but was subsequently determined to be "unimplementable" from a local interest standpoint.

3.2 Flood Control, Pearl River Basin, Mississippi, Jackson Metropolitan Area, Mississippi, Draft Feasiblity *(sic)* Report and Draft Environmental Impact Statement (1996) – Levee Plan

In 1990, the U.S. Army Corps of Engineers completed a reconnaissance study at the request of Pearl River Basin Development District and the Hinds County Board of Supervisors to investigate alterative flood control measures since the 1984 plan described above was not implemented. The Flood Control, Pearl River Basin Jackson Metropolitan Area, Mississippi Draft January 1996 report recommended a more comprehensive levee plan after six (6) levee plans and four (4) clearing plans were reviewed and analyzed (Table 3-2). Only one (1) clearing plan was deemed justifiable, and only marginally justifiable at that. During this study, non-structural measures proved to be impractical. Furthermore, property owners were not receptive to non-structural measures, especially those required structures raising, relocations, acquisition/demolition, etc. (Page 6-43 Volume III). The recommended plan consisted of construction of 21.9 miles of new levee, 3,720 feet of floodwall, enlarging 10.5 miles of existing levee, clearing floodways, and relocating 30 commercial buildings that contained over 100 businesses. This plan was opposed by local property owners opposed to the non-structural measures and by

downstream parties concerned that a levee system would pass flood event flows at higher rates, impacting flow timing and inducing downstream flooding.

3.3 Flood Control, Pearl River Basin, Mississippi, Pearl River Watershed, Mississippi, Feasibility Study Draft and Environmental Impact Statement - Preliminary (2007) – Lefleur Lakes Plan

Unable to identify a local sponsor to support the levee plan, the effort to provide flood risk management in the Jackson metropolitan area continued with the 2007 Feasibility Study and Draft Environment Impact Statement, which looked at additional alternatives of the locally preferred Lefleur Lakes plan and a revised levee plan (Table 3-3). At that time, WRDA 2007 modified the WRDA 1986 and 1996 authorization, giving the nonfederal sponsor the option of constructing **the NED, the Locally Preferred Plan, or a combination thereof** under WRDA 1986, Section 211. However, work on this draft report was suspended prior to Public Review.

3.4 Pearl River Basin, Mississippi, Federal Flood Risk Management Project, Rankin and Hinds Counties, Integrated Feasibility Study and Environmental Impact Statement (Current)

After some initial inquiries of a locally preferred plan with a smaller footprint, the flood risk management effort continued in 2013 when the Rankin Hinds Flood Control District team began rescoping the project with input from the U.S. Army Corps of Engineers (USACE) - Vicksburg District, input from additional agencies and the public, and a review of previous alternatives. The USACE - Vicksburg District was involved with the initial rescoping charrette and review of the initial array of alternatives, which included a briefing at the Vicksburg District with vertical chain members. At this point, the USACE performed a preliminary analysis which indicated the locally preferred plan, Alternative C, was feasible.

With extensive data already gathered in the previous reports and USACE input, the non-Federal sponsor decided that in addition to reviewing new alternatives, previous alternatives should be reviewed to determine what, if any, changes from past studies may be deemed practical solution. In the rescoping process, the over 60 plans examined in prior reports were distilled to an initial array of 16 to be reviewed to determine the potential changes that might be possible. In some cases, the plans were updated with current cost estimates and rates; other plan updates included continued hydraulically modeled to ensure the review was thorough and complete. To efficiently and effectively consider as many measures as possible, analysis from the previous reports was utilized where possible. Additionally, new planning constraints, such as the new mitigation bank in the area upstream of the proposed project footprint, presented new factors to consider with respect to the footprint of previous alternatives. These new planning constraints helped shape the objectives. Similar to the 1984 study, the **Study Goal** was "*To provide a comprehensive solution to reduce flood risk in the Jackson metropolitan area caused by the Pearl".*

Based on discussion with the Corps, the non-Federal sponsor determined a non-structural alternative had to be pushed forward to the final array of alternatives to comply with USACE guidelines. Therefore, despite non-structural measures being identified in prior studies as not practical, the buyout plan was moved forward as a non-structural alternative since it was the only non-structural plan providing the level of comprehensive flood risk management identified in the study goal.

Table 3-1: 1985 Initial Array of Alternatives (Shoccoe Dam)

Pearl River Basin Interim Report on Flood Control and Environmental Impact Statement (1985)	
Plan Formulation	B/C Ratio
Initial Array of Alternatives	(when calculated)
No Action	
Levees	
Raising Existing Levees	
Additional Levees	
North Jackson Levee and pumps	0.36
Prairie Branch Levee and pumps	0.22
Eubanks Creek Levee and pumps	0.25
Belhaven Creek Levee and pumps	0.02
Town Creek Levee and pumps	0.5
South Jackson Levee and pumps	0.25
Richland Levee and pumps	0.05
Caney Creek Levee and pumps	0.05
Byram Levee with Pumps	
North Jackson Levee (with diversion)	
East Jackson Parkway Levee	
Variations of Northeast Jackson Levee	
Single Levee Plan for Northeast Jackson & pump	0.5
Channel Modifications	
Channel enlargement From Ross Barnett through Jackson	not effective
Riverbend Cutoff	
3,200 Foot Cutoff at River Mile (RM) 284 (Landfill)	0.6
Clearing Plans	
Plan 1 Sanitary Landfill to Creosote Slough (RM 285-289.6)	
Plan 2 Sanitary Landfill to Railroad Bridge (RM 285-290.58)	
Plan 3 Sanitary Landfill to Highway 25 (RM 285-292.63)	
Plan 4 Richland Creek to Highway 35(RM 282.5-292.63)	
Plan 5 Caney Creek to Highway 35 (RM 278.83-292.63)	see final array
Plan 6 Caney Creek to Purple Creek (RM 278.83-296.25)	
Plan 7 Sanitary Landfill to Ross Barnett Reservoir(RM 285-301.8)	
Plan 8 Caney Creek to Ross Barnett Reservoir (RM 278.73-301.8)	
Variations of Clearing Alternatives	
1A Sanitary to Old Brandon Rd (RM 285.3-287.55) Partial Clearing	
1B Sanitary to Old Brandon Rd (RM 285.3-287.55) Total Clearing	
1C Below Sanitary Landfill to Old Brandon Road (RM 284.25-287.55) Partial Clearing	
1D Below Sanitary Landfill to Old Brandon Road (RM 284.25-287.55) Complete/Partial Clearing	1
1E Below Sanitary Landfill to Old Brandon Road (RM 284.25-287.55) Total Clearing	
5A Plan 5 with Partial Clearing	see final array
1F Extension of Partial Clearing from Cany Creek	see final array
1G Extension with Complete Clearing Cany Creek	see final array
Upstream Impoundments	
Edinburg Lake 27,000 acres and 486,000 acre ft of storage	
Flood Control, Recreation	0.26
Flood Control, Recreation, Hydropower	0.31
Flood Control, Recreation, Hydropower, Recreation/Tourism	0.34
Dry Dam	0.23
Carthage and Ofahoma Reservoirs	
Carthage Dam with Pools	0.28
Ofahoma Dam with Pools	0.27
Carthage Dry Dam	0.3
Ofahoma Dry Dam	0.29
Carthage and Oahoma Dry Dam	0.31
US Soil Conservation Service Reservoirs	
14 Reservoirs	0.75
9 Reservoirs	1.05
Upgrade Ross Barnett Reservoir $418,000,000 in 1985	
Dam at Head of Ross Barnett Reservoir (Shoccoe Dam)	1.7
Other Alternatives	2
Diversion to Big Black River	
Remove Encroachments	
Modification of Bridges	3
Non Structural	
Floodproofing of Structures within the 10-year Flood Plain	Not Practical
Relocation of Structures within the 10-year Flood Plain	0.52 4
Final Array of Alternatives	
Highway 25 Improvements + Overbank Clearing Plan 1D	
1-F	1.3
1-G	1.7
5	1.1
5A	0.6
Riverbend Cutoff	0.6
Shoccoe Dam	1.3
Comprehensive Plan (Shoccoe and Clearing)	1.7
Selected Plan	
Shoccoe Dam	1.2

Table 3-2: 1996 Initial Array of Alternatives (Levee Plan)

Flood Control, Pearl River Basin, Mississippi Jackson Metropolitan Area, Mississippi Draft Feasiblity Report & Draft Environmental Impact Statement (1996)	
Plan Formulation	B/C Ratio
Initial Array of Alternatives	(when calculated)
No Action	
Non-Structural	
Flood Proofing	Not Practical
Raising Structures	Not Practical
10-year Flood Plain Relocation	
Flood Insurance	
Structural	
Shoccoe Dam (could not be implemented due to public opposition)	
Reservoirs, Diversions, and Dams (referenced 1985 report)	
Individual Levees and Levee Modifications (referenced 1985 report)	
Comprehensive Levee Plans	
A-1 Levees and Flood Plain Clearing	1.6
A-2 Levees and Flood Plain Clearing	
B-1 Levees and Flood Plain Clearing	1.5
B-2 Levees and Flood Plain Clearing	
C-1 Levees and Flood Plain Clearing	1.5
C-2 Levees and Flood Plain Clearing	
Clearing Plans	
D-1 Extension of 1G from 1985 report	1.1
D-2 Extension of 1F from 1985 report	0.6
E-1 Extension of 5 from 1985 report	0.8
E-2 Extension of 5A from 1985 report	0.5
Recommended Plan	
A-1 Levees and Flood Plain Clearing (no sponsor)	1.6

Table 3-3: 2007 Initial Array of Alternatives (Lefleur Lakes Plan)

Flood Control, Pearl River Basin, Mississippi Pearl River Watershed, Mississippi Feasibility Study Draft & Environmental Impact Statement Preliminary (2007)	
Plan Formulation	B/C Ratio
Initial Array of Alternatives	(when calculated)
No Action	
Structural	
Measures considered in previous studies	
Comprehensive Levee Plan (1996 report's Recommended Plan)	1.2
Lefleur Lakes Plan (Channel Improvements and 2 weirs)	0.2

In summary, the efforts to achieve effective flood risk management for the Jackson metropolitan area, spanning from 1984 to today, have screened over 85 alternatives of plans or combinations of plans. Alternatives for the study were developed to fully update the analysis of previously proposed dry dam plans, levee plans, and channel improvement plans, and to analyze other reasonable alternatives to provide a comprehensive plan for flood risk management. Other alternatives included clearing plans, watershed diversions, pumps, reservoir modifications, bridge modifications, new reservoirs, non-structural, and no action alternatives. Also, plans providing both more and less flood risk management benefits were considered in the initial array of alternatives. However, plans were moved forward with consideration as to how they met this study's goals and objectives to provide a "comprehensive solution to reduce flood risk".

The criteria used to assess the overall characteristics of each alternative in order to identify those alternatives most likely to meet the project goals and objectives can be found in the following sections. Likewise, a summary of each plan is included in the following sections. Plans with similar features have been grouped together for discussion purposes.

4.0 STUDY AREA

The Study Area for plan formulation focuses on the areas receiving flood risk management benefits and includes parts of Hinds and Rankin Counties (Figure 4-1). Major tributaries of the Pearl River within the Study Area include Caney, Eubanks, Hanging Moss, Hog, Lynch, Prairie Branch, Purple, Richland, and Town Creeks. The Study Area is primarily affected by headwater flooding caused by the Pearl River. Headwater flooding is caused by unusually heavy and intense rainfall over the upper Pearl River Basin. Headwater flooding of the Pearl River has caused disruption to businesses and industry throughout the Study Area, putting over 5,000 commercial and residential structures at risk of flood damage (Table 4-1).

Table 4-1: Structures affected by type for various frequency flood events in Existing Conditions (No Action Alternative)

	Annual Percent Chance Exceedance Flood Event							
	50%	20%	10%	4%	2%	1%	0.5%	0.2%
Residential Structures	86	220	325	960	1,459	2,074	2,889	3,511
Mobile Homes	0	0	1	6	11	18	26	29
Commercial Establishments	63	138	219	404	682	1,069	1,365	1,604
		358	*545*	*1,370*	*2,152*	*3,161*	*4,280*	*5,144*

Although the Study Area is located primarily within the boundaries as described, additional areas downstream were included to the extent needed to ensure impacts (if any) and concerns were addressed appropriately for proposed project alternatives. Hydraulic modeling, water quality modeling, and additional impact analysis was conducted as far downstream as at least Bogalusa, LA.

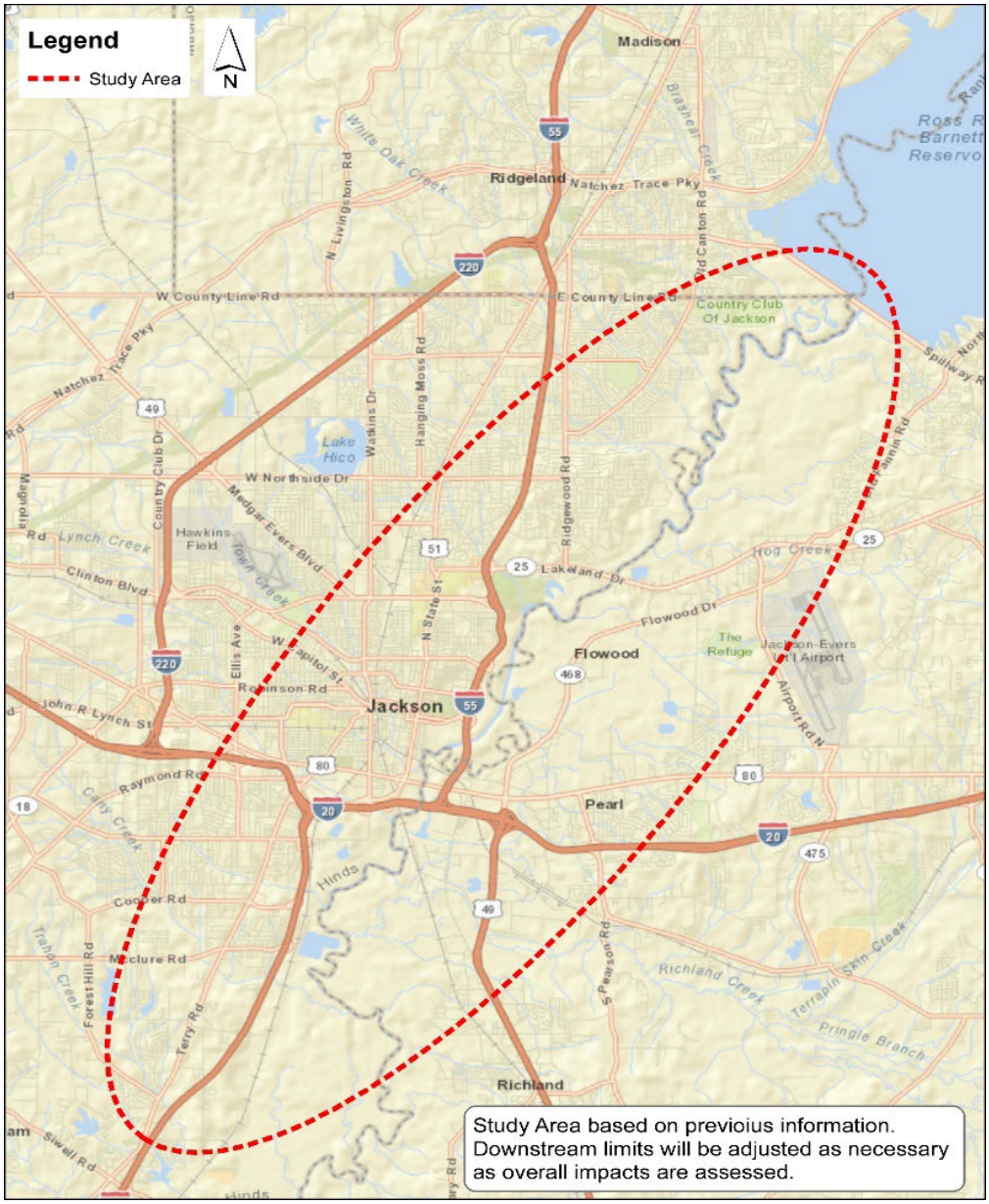


Figure 4-1. Study Area**,** which includes parts of Hinds and Rankin Counties, is primarily affected by headwater flooding of the Pearl River.

5.0 SCREENING CRITERIA

Screening criteria is presented in Table 5-1 and was used to screen alternatives during the Initial Array of Alternatives. Alternatives were screened and scored by study team based on the criteria set forth herein, described in ER 1105-2-100.

Table 5-1: Plan screening criteria used during the initial array of alternatives.

Effectiveness	The extent to which the alternative plans contribute to achieving the planning objectives.	Whether the alternative would provide acceptable level of flood reduction benefits for the Jackson metropolitan area. ○ Must provide flood risk management benefits ○ Reduce transportation impact risk ○ Reduce other infrastructure risk ○ Provide environmental design features for habitat conservation
Completeness	The extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.	To what degree does the alternative provide and account for the realization of the project's objectives? Are all of the objectives met or will additional actions be required?
Acceptability	The extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies.	Whether there are significant outstanding technical, social, legal or institutional issues that affect the ability to implement the alternative (implementable) and potential effects on community cohesion and compliance with policy. ○ Avoid when possible landowner conflicts. ○ Is project acceptable to local sponsor, municipalities, and resource agencies? ○ Can plan be implemented and is it technically feasible?
Efficiency	The extent to which an alternative plan is the most cost-effective means of achieving the objectives.	Whether the alternative will cost less than other alternatives for a given level of benefits, and no other alternative yields more benefits for a lower cost. ○ The first cost of the project, costs of local operations and maintenance, and long-term residual costs, including the ability to fund and recover project costs.

ER 1105-2-100 also states that "appropriate mitigation of adverse effects shall be an integral component of each alternative plan." Accordingly, planning considerations such as impacts to threatened and endangered species and avoidance of known cultural resource sites were used as additional considerations (Table 5-2). To determine if the plans were viable for further evaluation, each plan was assessed on how well it met objectives and avoided constraints.

Table 5-2: Additional screening considerations

Environmental Effects	Direct and indirect effects on environment, natural resources, and cultural resources. Environmental Expectable impacts of: ○ Water quality and minimum flows. ○ Wetland impacts ○ Threatened and Endangered Species
Social Effects	Direct and indirect effects on socio-economic resources such as transportation, regional growth, public safety, employment, recreation, public facilities, and public services. Benefits of reduced flood risk meet or exceed environmental justice standards.

6.0 MANAGEMENT MEASURES CONSIDERED AND SCREENED (*NEPA REQUIRED*)

Management measures considered for the study included non-structural and structural measures. A measure is an action that can be implemented at a specific location to address planning objectives. They can be used individually or combined with other management measures to form alternative plans. Measures were developed to address problems and to capitalize upon opportunities. They were derived from a variety of sources that include prior studies, study team input, local sponsor, and public involvement.

The study considered structural and non-structural measures to provide risk reduction and maximize project benefits. All measures were screened for capability to meet objectives and avoid constraints, for engineering and economic feasibility, and for the level of risk reduction. Measures that warranted continued consideration were assembled into alternative plans.

6.1 Non-Structural Measures

Several **non-structural (NS)** alternatives were considered in evaluating future possible actions in the Jackson metropolitan area.

- **Relocating structures (Full acquisition buy out)** allows for moving structures as part of the project and buying the land upon which the structures were located. This plan is most practical when structures can be relocated from a high flood hazard area to an area that is completely out of the floodplain.

  A large number of structures are located within this flood prone area. A significant number of these structures are located in multiple commercial areas, including downtown Jackson. It would be very difficult to relocate commercial and retail businesses based on the need to be in the Central Business District (CBD) to fulfill the needs of citizens and provide the necessary public services required for the State Capital.
- **Relocating structures (Limited acquisition buy out)** allows for moving structures as part of the project and buying the land upon which the structures were located. Development of relocation sites where structures could be moved, purchased, or demolished to achieve the planning objectives and retain such aspects as community tax base, neighborhood cohesion, etc., were investigated as part of other project alternatives.

- **Elevating structures** requires lifting the structure above a particular flood event. Due to most structures in the area constructed with slab-on-grade foundations, elevating structures is very difficult. Most structures located in downtown Jackson could not be elevated.
- **Flood proofing involves** waterproofing the structure which can be done to residential structures as well as other types of structures. As a stand-alone project, all construction materials and finishing materials need to be water resistant or "dry" flood proofing must be done. This measure achieves flood risk reduction if implemented; however; it is not recognized by the National Flood Insurance Program (NFIP) for any flood insurance premium rate reduction if applied to residential property.
- **Flood Warning, Preparedness, and Evacuation Plan** measures are applicable to the metropolitan area, and already in place for flood events with coordination between emergency operation personnel. The communities in the area have already developed emergency operation plans for floods and those plans are updated during and after flood events.
- **Flood Insurance** measures are **already** in place as per the National Flood Insurance Program (NFIP) and can help to rebuild after a flood; however, flood insurance does not prevent the flood from occurring and would still have large residual impacts on public safety and infrastructure. In addition, the recent rise in insurance premiums for this area makes this a very ineffective way to reduce risk. Premiums due to recent National Flood Insurance Program changes are causing rates to increase over 400 percent in some portions of the project area and throughout the Nation.
- **Flood Plain Ordinances** are already in place for the project area. However, updated ordinances should be considered and consistent throughout the area for better public awareness and education of hazards in building in flood prone areas.

Non-Structural Measure carried forward for consideration

1. Full acquisition/Buy-out
2. Limited acquisition /Buy-out
3. Flood Insurance
4. Update Flood Plain Ordinance to be consistent throughout Project Area.

6.2 Structural Measures

Several **structural** alternatives were considered in evaluating future possible actions for flood risk management in the Jackson metropolitan area.

- **Flood storage** involves both preserving natural floodplain areas and also constructing dams, or other water retention facilities, to detain water during flood events. Flood storage concepts include large dams or smaller distributed storage sites throughout the watershed. These facilities would need to be located in the Pearl River watershed upstream of the Jackson metropolitan area, in another county outside of local sponsor authority, to provide flood risk reduction for the Study Area.
- **Conveyance Improvements** consist of clearing vegetation along the channel and in overbank areas to improve conveyance and reduce flood levels due to reduced friction. Conveyance improvements

have been implemented in some portions of the project area over the last 30 years. One area of approximately 250 acres downstream of Interstate 55 is still maintained to minimize vegetation to maintain conveyance through the area.

- **Channel Improvements** consist of excavating areas along the Pearl River, including cutoffs where necessary, to improve conveyance. This strategy includes widening the existing channel to improve channel capacity, similar to what was done in the existing levee plan, in place from approximately river mile (RM) 285 to RM 291.
- **Levees and Floodwalls.** Approximately 13.5 miles of levees now protect portions of the Jackson metropolitan area. As previously discussed, much of the area is unprotected. This measure consists of building new levees and expanding the existing levees as needed. In some areas, floodwalls would be needed due to right-of-way restrictions.
- **River Training Structure** measures were screened to ensure planning objectives could be met with other structural measures. River training structures as a stand-alone feature were not considered because these structures alone cannot meet the objectives. However, they did help in the plan development to meet goals, objectives and adhere to planning constraints.

Structural Measures carried forward for consideration

1. Flood storage
2. Conveyance Improvements
3. Bridge Improvements
4. Channel Improvements
5. Levees/ Floodwalls and Pumps
6. River Training Structures

7.0 INITIAL ARRAY OF ALTERNATIVES *(NEPA REQUIRED)*

Structural and non-structural plans measures were combined into an initial array of **16 plans and 5 plans, respectively**. Maps and brief descriptions of each initial plan are included in this appendix. Many of these alternatives are similar to plans that have been previously studied, and thus, ample data was available for review and development of screening criteria. Multiple combinations and/or variations of the following plans were used to develop the initial array. Figure 7-1 provides river miles for reference. The Locally Preferred Plan in the 2007 USACE draft report, the Lefleur Lakes Plan including two weirs and channel excavation from RM 284 to RM 301, was not moved forward to the initial array of alternatives. Although a previous alternative, the Lefleur Lakes Plan would have significant impacts on planning constraints, especially the large impacts to the mitigation area downstream of the Ross Barnett Reservoir.

7.1 Non-Structural Plans

Although previous studies clearly revealed non-structural measures (1) benefitted few, (2) would not meet the project objective to alleviate flooding, (3) were not acceptable to the local community, and (4) impractical from a structural and economic perspective, non-structural measures were, discussions with the USACE during the initial rescoping process and charrettes indicated moving forward a non-structural plan into the final array of alternatives would be necessary. Non-Structural Measures forward were combined into an initial array of **5 Non-Structural (NS) plans**. A brief description is included with each plan along with a screening summary.

Figure 7-1. River miles above the Lake Borgne.

1

7.1.1 RELOCATING STRUCTURES (FULL ACQUISITION BUY OUT)

7.1.1.1 NS PLAN 1. FULL ACQUISITION BUY-OUT

NS Plan 1 incorporates both moving structures as part of the project and buying the land upon which the structures were located. This buy-out plan would include the acquisition of the over 3,000 structures within the annual 1% chance exceedance flood event flood plain. NS Plan 1 greatly expands upon previous proposed buy-out plans which focused only on the less than 550 structures within the footprint of the 10% annual chance exceedance flood event. The structures to be relocated in this alternative would include residential, commercial, schools, and hospitals. NS Plan 1 does NOT include structures behind existing levees, although the probability and risk for flood damages in these areas will still exist.

While evacuating the floodplain in the project area would reduce flood risk for the project period, other factors with major impacts on the area are listed below.

SCREENING SUMMARY

- Relocation of the significant number of structures located in multiple commercial areas including downtown Jackson and Flowood would be exceptionally difficult. Many commercial and retail businesses are located in the CBD to provide the necessary public services required for the State Capital and to fulfill the needs of local citizens and Capitol visitors.
- Community cohesion for areas with densely populated residential sections will be disrupted.
- The floodplain in Flowood, MS, includes multiple medical facilities, including two hospitals. Relocating these facilities would be impractical and disrupt the availability of community services for the area and the region.
- Transportation routes and the Savanna Street WWTP would not receive any flood reduction benefits.
- Relocation cost would include buyout, relocation assistance, demolition, infrastructure removal, and future maintenance of the lands acquired.
- Due to the logistics and cost associated with relocating the large number of structures located within this flood prone area, this alternative is impractical.

The Corps of Engineers provides guidelines and requirements to provide a non-structural alternative to all flood reduction studies. Due to USACE EP 1165-2-1, a standalone non-structural alternative must be considered through the entire process. Therefore, the alternative will continue to be considered.

7.1.2 RELOCATING STRUCTURES (LIMITED ACQUISITION BUY OUT)

Due to community impacts to tax base and community services with a full acquisition buyout plan, a range of combinations of limited acquisition plans were considered. After deliberation of multiple limited buyout alternatives, the following two plans were considered in the initial array of non-structural alternatives.

7.1.2.1 NS PLAN 2. LIMITED ACQUISITION BUY-OUT, RESIDENTIAL

Limit Acquisition to ONLY Residential Structures within the annual 1% chance exceedance flood event floodplain.

SCREENING SUMMARY

- The two distinct commercial areas, including the Central Business District (CBD) in Hinds County and the multiple health care facilities located in Rankin County commercial areas would not receive flood risk management benefits. A large percentage of the annual damages accumulated during flood events are accrued in these commercial areas. The total commercial annual damages are estimated to be over $12,500,000.
- Transportation routes and traffic congestion during flood events would not receive any flood risk management benefits.
- Flood risk management benefits for the Savanna Street WWTP would not be realized.

7.1.2.2 NS PLAN 3. LIMITED ACQUISITION BUY-OUT, ALL

Limited acquisition of ALL structures impacted by more frequent events to include annual 2% chance exceedance flood events or less. The impact of NS Plan 3 is more similar to the benefits studied in previous plans which considered the 10% ACE flood event. The cost of providing non-structural flood risk management benefits to structures impacted by the 10% ACE flood event exceeds the value of the structures themselves. Numerous structures are impacted by more frequent events, illustrated in Figure 7-2 which shows the location of structures impacted by the more recent flood event in February 2020 (approximately equivalent to the 10% ACE event) in Northeast Jackson. Figure 7-2 also illustrates the difficulty of providing non-structural solutions for this inundation area, as structures were several feet underwater for even this smaller magnitude event. Figure 7-3 shows an example of the failure of a non-structural flood risk management measure during the February 2020 event.

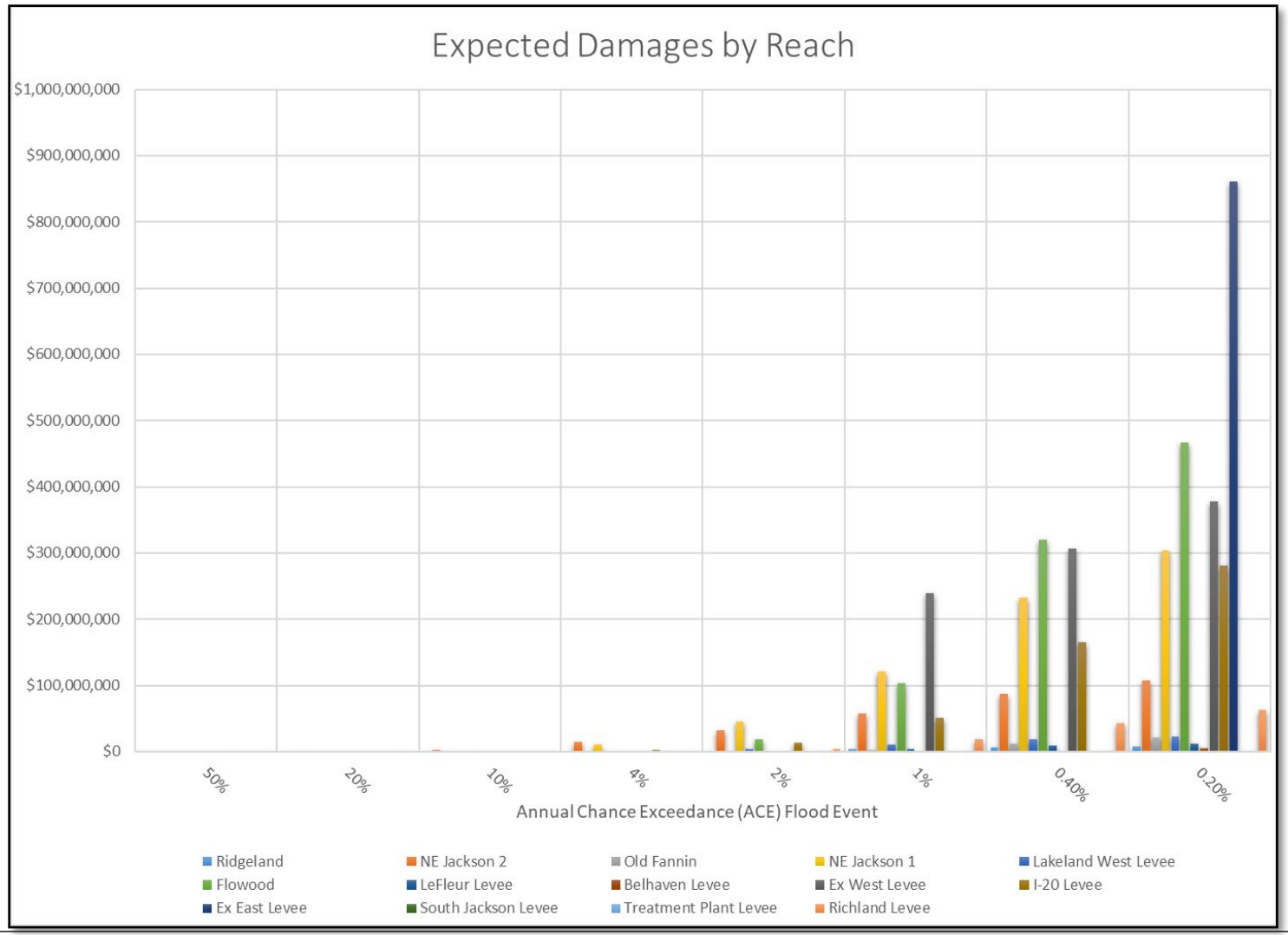
SCREENING SUMMARY

- Although the cost of this alternative would be low, this limited acquisition plan would not provide any substantial flood risk management benefits since the majority of annual damages are due to events greater than the annual 2% chance exceedance flood event frequency (Figure 7-4, Figure 7-5).
- Transportation routes during flood events would not receive any benefits.
- Flood risk reduction for the Savanna Street WWTP would not be realized.

Because **NS Plan 2 and NS Plan 3** do not provide substantial flood reduction benefits, do not provide any benefits to the Savanna Street WWTP, and do not provide flood reduction to transportation routes, these plans will not be considered for stand-alone alternatives. However, **NS Plan 2 and NS Plan 3 will be considered as part of other structural plans.**

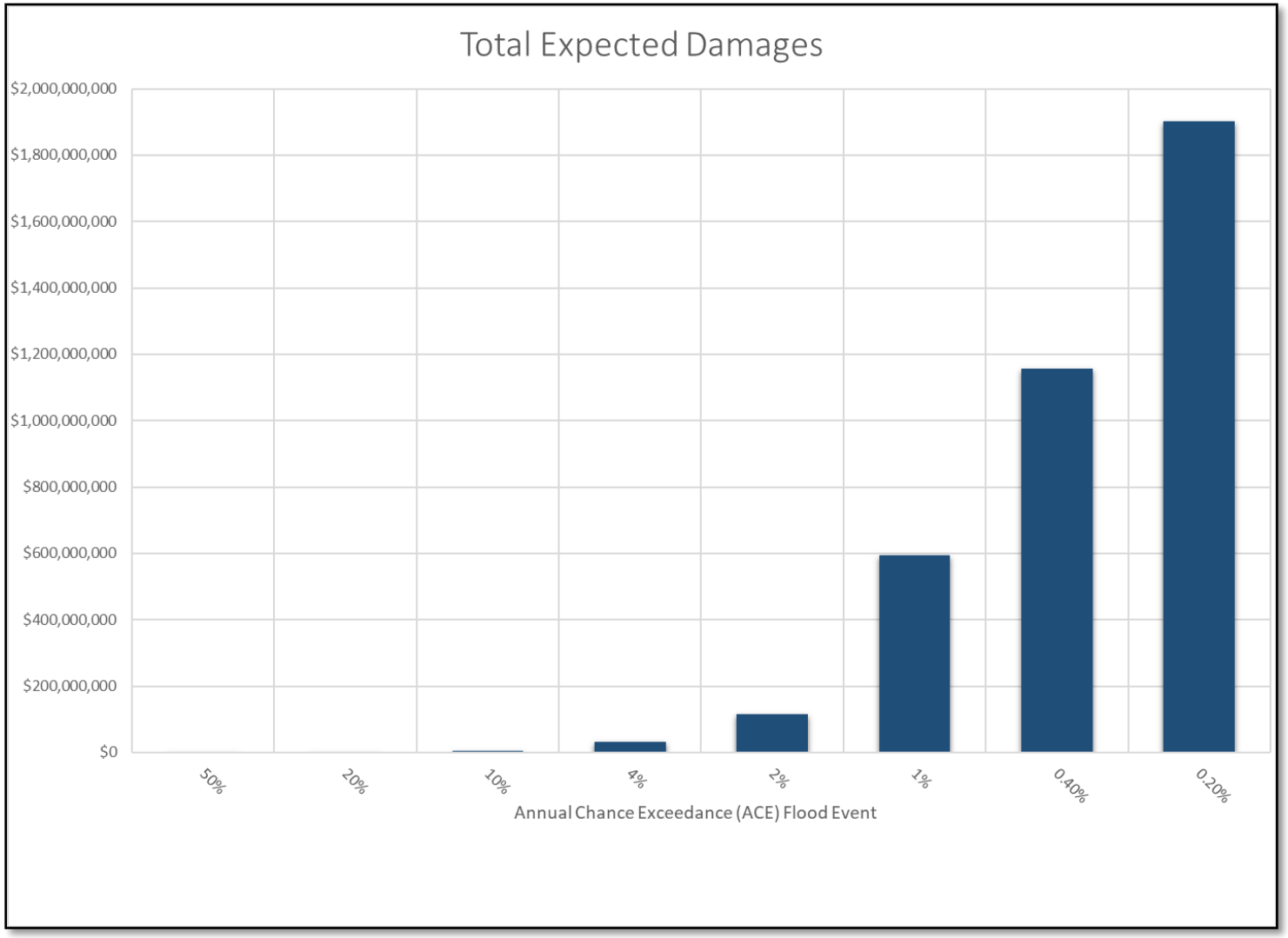
Figure 7-2. Inundation in Northeast Jackson during the February 2020 Flood Event

Figure 7-3. Failure of non-structural flood risk management measures during the February 2020 Flood Event. The yellow line indicates the water surface elevation during the event.



***Note*:** The Expected Damages includes damages to commercial structures, residential structures, and vehicles. The damages do not account for losses related to road and bridge damage, traffic rerouting, water and sewer infrastructure, etc.

Figure 7-4. Analysis of the Total Expected Damages by economic reach in Existing Conditions during various annual exceedance probability flood events



***Note*:** The Expected Damages includes damages to commercial structures, residential structures, and vehicles. The damages do not account for losses related to road and bridge damage, traffic rerouting, water and sewer infrastructure, etc.

Figure 7-5. Analysis of the Total Expected Damages in Existing Conditions during various annual exceedance probability flood events

7.1.3 FLOOD INSURANCE

Flood insurance measures are already in place, in accordance with the National Flood Insurance Program (NFIP), and can help to rebuild after a flood. However, flood insurance does not prevent the flood from occurring and would still have large residual impacts on public safety and infrastructure. Additionally, the recent rise in insurance premiums for this area makes this plan an ineffective way to reduce risk. Based on the recent rise in insurance premiums, it could be difficult for individuals to afford the cost of residential structures. However, some commercial users may be able to recoup or afford the higher cost.

7.1.3.1 NS PLAN 4. NATIONAL FLOOD INSURANCE

SCREENING SUMMARY

- Flood insurance premiums are on the rise and will not be affordable to most residents within the project area. Flood insurance rates are rising 5% to 25% per year until the full risk level is reached, which is 3 to 4 times the existing rate in many cases. Not only will many residents be unable to afford these rates, but they will be unable to sell their homes because of this flood insurance encumbrance.
- If a structural plan does not provide full protection of all commercial or public structures, flood insurance could be a means of providing additional flood risk reduction. Commercial users are more likely to be able to afford this insurance and many may not be required to purchase it. If they are required to purchase this insurance, the rate could possibly be less due to a structural alternative having some flood reduction benefit.

Though flood insurance is not a valid stand-alone non-structural alternative, it will be considered with combinations of other alternative structural and non-structural plans. Flood insurance will be considered as a part of other plans as some areas receive a flood reduction benefit due to structural alternatives, but still lie within the annual 1% chance exceedance flood event flood plain. **Therefore, NS Plan 4 will be considered with other structural alternatives.**

7.1.4 FLOOD PLAIN ORDINANCES

Flood Plain Ordinances cannot provide a stand-alone solution; however, they can provide future protection of a more restricted floodplain with other structural and non-structural plans.

7.1.4.1 NS PLAN 5. FLOOD PLAIN ORDINANCES

SCREENING SUMMARY

- The cost of this alternative would typically be passed to the consumer and would not provide any flood reduction benefits, only recovery benefits.
- Transportation routes during flood events would not receive any flood damage benefits.
- Under this plan, the Savanna Street WWTP will not receive any increased flood protection.

Updated ordinances should be considered and consistent throughout the area. They can help lead to better public awareness and increase education about the hazards of building in flood prone areas. **Therefore, NS Plan 5 would be considered with other alternative plans.**

7.2 Structural Plans

7.2.1 FLOOD STORAGE

7.2.1.1 ALTERNATIVE DESCRIPTIONS

Flood storage has been authorized, as already discussed in Section 1 of this report. However, a lack of support for the project from the local leadership, Mississippi State Legislators, and upstream communities resulted in the authorization not being implemented as designed. The prior storage project was reviewed to see if any parts of that plan could still be viable for this study. Two storage plans were considered:

Plan 1: Flood storage upstream of the Ross Barnett Reservoir.

Plan 2: Flood storage within the project area.

7.2.1.2 SCREENING SUMMARY

Following a Feasibility Study and Environmental Impact Statement, a Report by the Chief of Engineers in 1986, a large flood storage facility was authorized upstream of the Jackson metropolitan area. This dry dam, referred to as Shoccoe, was never funded due to the controversial nature of the project and potential large scale environmental impacts. This plan required an earth fill dam 45 feet in height and 2.8 miles in length. In addition, approximately 35,000 acres was required for flowage easement.

While not effectively controlling smaller floods, the project would have been effective in regulating larger floods.

The Shoccoe Dam project report stated that it would contribute to community health and safety. Large amounts of land would be necessary to implement a flood storage similar to Shoccoe. Although most flood storage projects would provide benefits in the local area, it was perceived that the benefits of this project were mainly for the Jackson metropolitan area, while the rural areas (Outside Rankin and Hinds County) were providing the necessary land for the project. This alternative had positive social impacts for the City of Jackson and negative social impacts for citizens upstream of the proposed dry dam in counties outside of Rankin and Hinds. In the case of Shoccoe Dam, a lack of benefits for the upstream communities was one reason for the low level of acceptability.

This project only benefitted the Jackson metropolitan area, and the plan was opposed by parties in Leake County and other communities upstream, where most of the real estate for the project would have been acquired with no local benefit. Approximately 64 families from the upstream communities would have been relocated if the project had been implemented at the time of the study. The number of homes in that area has risen since that study was completed. Additionally, a Mississippi Highway 43 bridge would have to be raised, and approximately 8 miles of the Natchez Trace Parkway (Property of the U.S. Department of Interior) would have to be relocated to accommodate the right abutment of the dam and raise it above the annual 2% chance exceedance flood event elevation.

The potential overall environmental impacts associated with the Shoccoe Dry Dam Project were never fully understood or documented. The approximately 35,000 acres flowage easement area included a significant amount of existing bottomland hardwood habitat that would be frequently flooded during significant rain events. The potential adverse effects from the frequent flooding of the forested ecosystems found within the project area were of great concern and the potential long-term effects were considered by many to be devastating to the diverse habitats that existed within the project area.

The proposed Shoccoe Dam project was controversial. It did not garner support from upstream citizens or the State Legislature, and it was never funded. Based upon recent conversations with upstream community leaders, concerns have not and will not change in regards to any dry storage upstream of the Ross Barnett. Furthermore, the local sponsor of RHPRFDCD does not have clear authority to fund or construct a project outside of the two counties. In addition, the Mississippi Executive Branch (Governor's Office) was not supportive of this plan.

In 1986, the estimated cost for this project was approximately $8 million annually, with a B/C ratio of 1.05. Based on current land values, construction cost, relocation cost, and mitigation cost, present-day implementation of this project would greatly exceed $500 million. This alternative, or a similar alternative, would have a low level of cost acceptance.

Other dry storage alternatives were considered; however, they do not have any positive flood reduction benefits on the Pearl River because of the small amount of the watershed entering the Pearl River downstream of the Ross Barnett Reservoir. Numerous small detention areas (storage) within these watersheds such as Town Creek, Hanging Moss Creek, or other tributaries cannot provide enough storage to provide any flood reduction on the Pearl River due to impacts from backwater of the Pearl River. In addition, these could actually exacerbate the problem; these tributaries typically peak three days prior to the Pearl River flood peaks and have already subsided when the Pearl River peak reaches the project area. Any storage facility (s) would have to be upstream of the Ross Barnett Reservoir, where it could accommodate the large watersheds.

Due to the large environmental impacts, negative social impacts, cost, and the low level of acceptance by the public, **Plan 1 and Plan 2 were no longer considered.**

7.2.2 CONVEYANCE IMPROVEMENTS

7.2.2.1 ALTERNATIVE DESCRIPTIONS

These similar plans consist of clearing vegetation along the channel and in overbank areas to improve conveyance and reduce flood levels due to reduction in friction. In addition, bridge conveyance improvements for existing railroad bridges were also analyzed. Three plans focused on the clearing of vegetation:

Plan 3: Conveyance improvements within bridge areas. Bridge improvements included opening improvements, bridge lengthening, conveyance improvements (clearing), along with raising the low chord of the lowest railroad bridge.

Plan 4: Conveyance improvements throughout the study reach (RM 284 to RM 302). These conveyance improvements of clearing and vegetation removal would be for the entire reach between Richland and the Ross Barnett Reservoir.

Plan 5: Combined conveyance improvements and bridge conveyance improvements. This alternative combines the conveyance improvements of Plan 4 with the railroad bridge improvements of Plan 3 throughout the entire project reach.

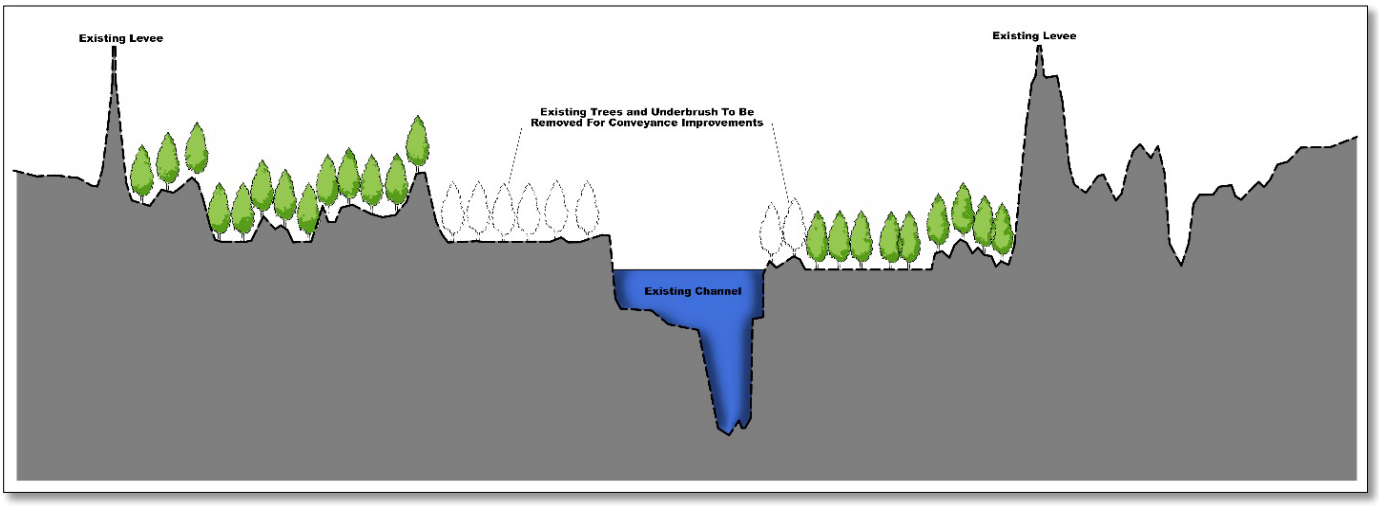


Figure 7-6. Existing trees and underbrush are removed to achieve Conveyance Improvements.

7.2.2.2 SCREENING SUMMARY

Clearing and conveyance improvements or bridge improvements as a stand-alone alternative are not effective in flood reduction. Clearing plans were presented in the above referenced Shoccoe Dam report as an alternative and showed that only a 10-percent flood reduction would be achieved with this alternative. To confirm, conveyances alternatives were modeled with updated information and confirmed that a range of conveyance improvements yielded less than 2.0 feet of flood reduction upstream of Highway 25. Moreover, the improvements outlined in Plan 4 and Plan 5 would conflict with the mitigation constraints by clearing areas within the western-most portions of the mitigation area along the Pearl River. Conveyance improvements, as a stand-alone alternative, have a very low level of effectiveness. Consequently, implementation of one of these plans as the only flood risk management measure would result in the continuation of emergency evacuations during flood events, causing disruption to transportation, businesses, and public services.

Cost of this alternative would be much less than most other structural alternatives. However, due to insufficient effectiveness, adverse environmental impacts, and minimal flood reduction benefits, overall cost for this as a stand-alone alternative would outweigh any benefit.

Although clearing and conveyance improvements were no longer considered as a stand-alone project, conveyance improvements were considered as measures with other alternatives. Therefore **Plans 3, Plan 4, and Plan 5 were no longer considered.**

7.2.3 CHANNEL IMPROVEMENTS

7.2.3.1 ALTERNATIVE DESCRIPTIONS

This alterative consists of channelization of areas along the Pearl River, including cutoffs where necessary, to improve conveyance and the development of a subsequent high flow channel. This includes widening the existing channel to improve channel capacity and cutoffs similar to what was constructed in the existing levee plan that is in place from approximately river mile (RM) 280 to RM 291. These plans do not include any modification to the existing levee system:

Plan 6: Channel Improvements from RM 284 to RM 291. These channel improvements would be within the channelized reach up to approximately the existing weir located at RM 290.7 and include a "subsequent channel" for high flow conveyance.

Plan 7: Channel Improvements from RM 284 to RM 294. These improvements would extend approximately 3 miles upstream of Plan 6 and upstream of Highway 25 and include a "subsequent channel" for high flow conveyance.

Plan 8: Channel Improvements with weir RM 284.0 to RM 294. This plan modifies the channel improvements from Plan 7 with and relocates the existing weir to RM 284.0 to insure water supply.

7.2.3.2 SCREENING SUMMARY

A range of channelization improvements were analyzed hydraulically from RM 280 to RM 302. This alternative essentially doubled the channel size throughout the reach. From the hydraulic analysis, approximately 2 to 3 feet of flood reduction is achieved in extreme flood events from the annual 1% chance exceedance flood event. Similar results were presented in previous studies. New available data was used to update and confirm these previous studies. The weir presently located at RM 290.7 is used for water supply and would have to be reconstructed and lengthened to continue to be used for water supply at this location. The maintenance requirements of these improvements combined with the significant impacts to the design constraints, such as those to the mitigation area, incurred if these plans are implemented as stand-alone alternatives result in a cost that is especially high when compared to the low level of flood protection that can be attained.

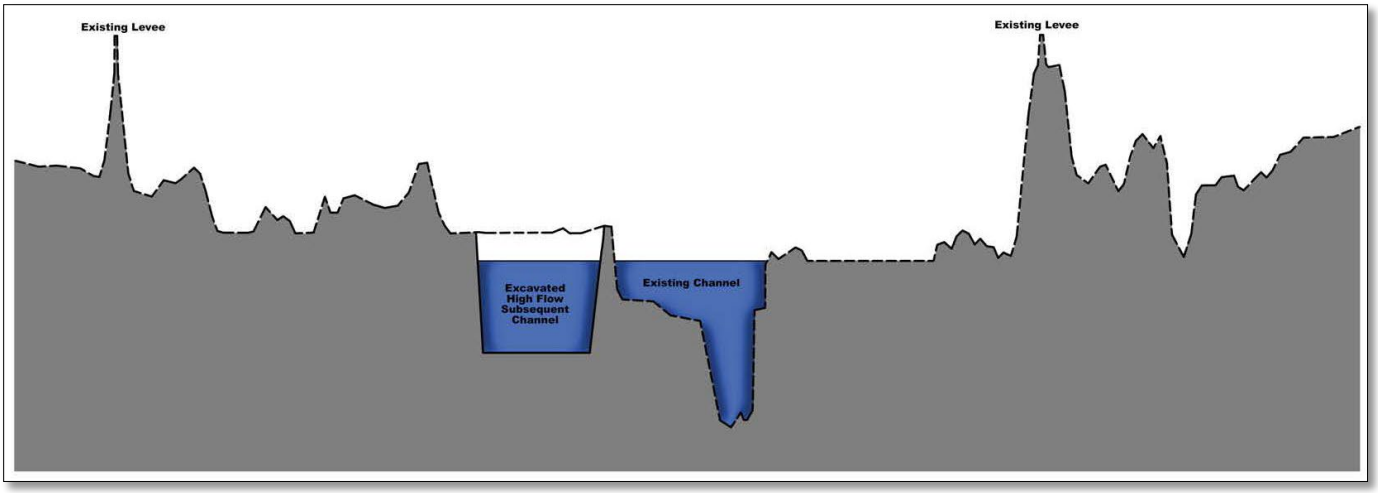


Figure 7-7. Expected high flow in Subsequent Channel Improvement.

Plan 8 is a modification of Plan 7 in which the channel enlargement is larger and the weir is relocated further downstream of the channel improvements. However, the amount of flood reduction benefits achieved upstream of Highway 25 is insignificant.

Due to the relatively minor decreases expected for flood risk management and impacts to constraints due to need of clearing and excavation in the mitigation area, these plans as stand-alone alternatives were removed from consideration for additional study. **Therefore, Plan 6, Plan 7, and Plan 8 were no longer considered.**

7.2.4 LEVEES, FLOODWALLS, AND PUMPS

Plan 9: Provides for additional levees in unprotected areas. Levees with this plan are included for unprotected areas only, with no additional levee upgrades to include gates and pumps as required.

Plan 10: This plan is the same as Plan 9 and also increases levee protection for existing areas already protected by levees by upgrading existing levee elevations.

Plan 11: This plan is the same as Plan 10 with additional conveyance improvements upstream from mile 294 to mile 302 so that induced flooding is not created from new levee measures. (Old Levee Plan).

Plan 12: This plan is the same as Plan 11 minus the Richland Levee and South Jackson Levee.

Plan 13: This plan is the same as Plan 12, however pumps and gates have been added behind levee structures for adequate dewatering of the Pearl River tributaries.

7.2.4.1 COMPREHENSIVE LEVEE PLANS

7.2.4.1.1 Alternative Descriptions

Approximately 13.5 miles of levees currently protect portions of the Jackson metropolitan area. Much of the flood-susceptible area remains unprotected. These alternatives consist of building new levees and expanding the existing levees. In some areas, floodwalls would be needed due to right of way restrictions.

Plan 9: Provide additional levees for unprotected areas. Levees with this plan are included for unprotected areas only, with no additional levee upgrades to include gates and pumps as required for flood risk management.

Plan 10: This plan expands upon Plan 9 by also increasing levee protection for areas already protected by levees by upgrading existing levee elevations.

Plan 11: This plan is the same as Plan 10 with additional conveyance improvements upstream from RM 294 to RM 302 such that induced flooding is not created from new levee measures (Old Levee Plan).

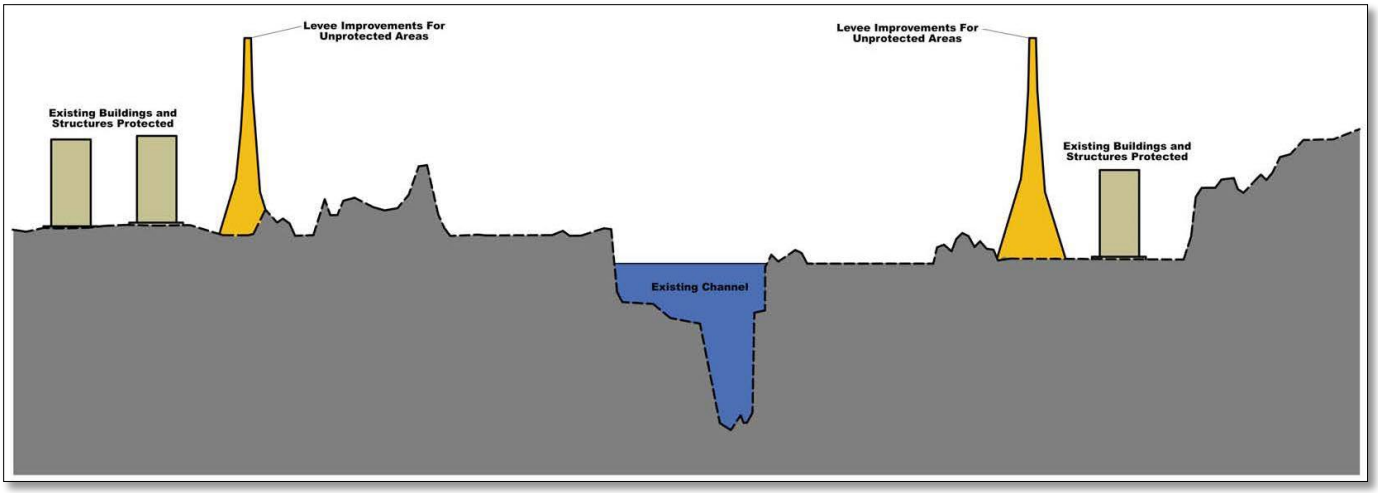


Figure 7-8. Levee Improvements for unprotected areas with existing buildings and structures.

7.2.4.1.2 Screening Summary

Levees are an effective means of providing flood protection. This alternative does improve existing protection and provide additional protection. Nevertheless, all structures behind levees will not typically be protected, such as those in low lying areas.

Land (or easements) would have to be acquired from numerous landowners. The previous levee plan included condemnation of 26 acres of existing developed commercial properties along Lakeland Drive and this would still be required with this plan. Although impacts to some transportation routes are improved with this alternative, a major thoroughfare, State Route 25 (Lakeland Drive), would still be impacted by overtopping. Traffic rerouting would continue during flood events, impacting this road that accommodates an Average Daily Traffic (ADT) count of over 60,000.

The cost of the levee alternative in the 2007 draft report was presented as $217 million. However, important environmental impacts, such as those caused by floodway clearing, do not appear to have been considered during the evaluations of the prior levee plan. New levee guidance developed in recent years will drive this cost up significantly when compared to the cost estimated in past studies. In addition, levee modifications to minimize impacts to the proposed Mississippi Department of Transportation mitigation area will lengthen proposed levee segments and include the addition of floodwalls in areas developed since the 2007 draft report. Also, pumps were not proposed in the 2007 draft report. When levees are placed across streams and drainage ways, the risk of flooding is created because closing the gates leaves no exit route for drainage behind the levees. Pumps are typically needed to ensure that levee obstructions do not increase flooding. Pumps to move water over the levees would make the alternative more effectual by reducing the risk of flooding behind the levees from interior drainage; however, pumps can drive the cost up considerably. From updated interior analysis, it appears that levees without pumps will put

property behind levees at an unreasonable risk of flooding in low lying areas behind levees. Without pumps, flood events on the Pearl River are highly likely to result in ponding behind the levees.

Although a possible increase in water surface elevation could be expected upstream without conveyance improvements, protection provided by the existing and proposed levees make this alternative an option for additional study. It should be noted that existing structures not protected by the proposed levees might have reduced protection because of the increase in flood elevations, unless conveyance improvements or additional levees on east bank are implemented. Moreover, the construction of levees without pumps places properties behind levees at extreme risk due to lack of storage. **Plans 9, Plan 10, and Plan 11 were no longer considered for further evaluation due to unacceptable risk.**

7.2.4.2 MODIFIED LEVEE PLANS

7.2.4.2.1 Alternative Descriptions

These alternatives consist of building new levees and expanding the existing levees. In some areas, floodwalls would be needed due to right of way restrictions. These plans are modifications of **Plans 9, 10, and 11,** specifically by the addition of pumps and gates as needed to minimize unacceptable risk of interior flooding;

Plan 12: This plan is the same as Plan 11 minus the Richland Levee and South Jackson Levee.

Plan 13: This plan is the same as Plan 12 with pumps and gates added behind levee structures for adequate dewatering of the Pearl River tributaries.

7.2.4.2.2 Screening Summary

Levees are effective in providing flood protection. This alternative improves existing protection and provides additional protection. Nevertheless, all structures behind levees will not typically be protected, such as those in low lying areas. In addition, the Richland area is more affected by high levels on the Pearl with headwater flooding of Richland Creek. The construction of levees will not provide flood risk management for flooding caused by headwater. As the estimated $2-million annual cost of constructing these levees ($50-million with the pumps) far exceeded the approximate benefits of $500,000 per year, the Richland levee was removed due to not being economically effective, as were the South Jackson segments.

Pumps were not proposed in the 2007 draft report. Pumps would typically make the alternative more effective, but will considerably increase the cost. From updated interior analysis, it appears levees without pumps will put property in low areas behind levees at an unreasonable level of flood risk.

Although a possible increase in water surface elevation could be expected upstream without conveyance improvements, protection from the existing and proposed levees make this Plan 13 with pumps alternative a viable option for additional study. Further, levees without pumps place properties behind levees at extreme risk due to lack of storage; therefore, plan 12 is no longer

considered. **Plan 12 was no longer considered and Plan 13 was considered for further evaluation.**

7.2.5 CHANNEL IMPROVEMENTS AND WEIR

7.2.5.1 ALTERNATIVE DESCRIPTIONS

Consistent with the letter from Assistant Secretary of the Army (Civil Works), dated September 17, 2010, a locally preferred one-lake alternative was included when the study was resumed. This alternative consists of significant channel modification from RM 284 to RM 294. Levees exist within much of this reach and would be relocated in some areas (east bank) to reduce flood levels. Relocating the existing levees expands the floodplain in these areas, beneficially minimizing the existing levee constrictions. This alternative would consist of excavating the overbanks of the channel. Excavation would be placed adjacent to existing levees, or adjacent to relocated levees. The large amount of excavation needed would provide substantial land mass or expanded levee widths and, therefore, additional protection. The weir now located at RM 290.7 would be relocated to approximate mile RM 284.0, where it would be modified to a higher elevation and expanded width. This provides a larger body of water for recreation, reduces existing channel maintenance burdens, and reduces the amount of future maintenance needed by a larger, expanded channel improvement. Pumps would not be needed to provide protection behind levees except where pumps already exist, and they would be modified as needed.

Plan 14: Channel Improvements with weir. This plan is the same as Plan 8 with the existing weir structure relocated to RM 284.0 to insure water supply and with the addition of a levee around the existing wastewater treatment plant.

Plan 15: Channel, Weir and Gate Improvements. This plan is the same as Plan 14 with added gate operations to the weir for low flow conditions.

Plan 16: Channel, Weir and Gate Improvements to RM 295. This plan is the same as Plan 15, however the channel improvements will extend to RM 295.

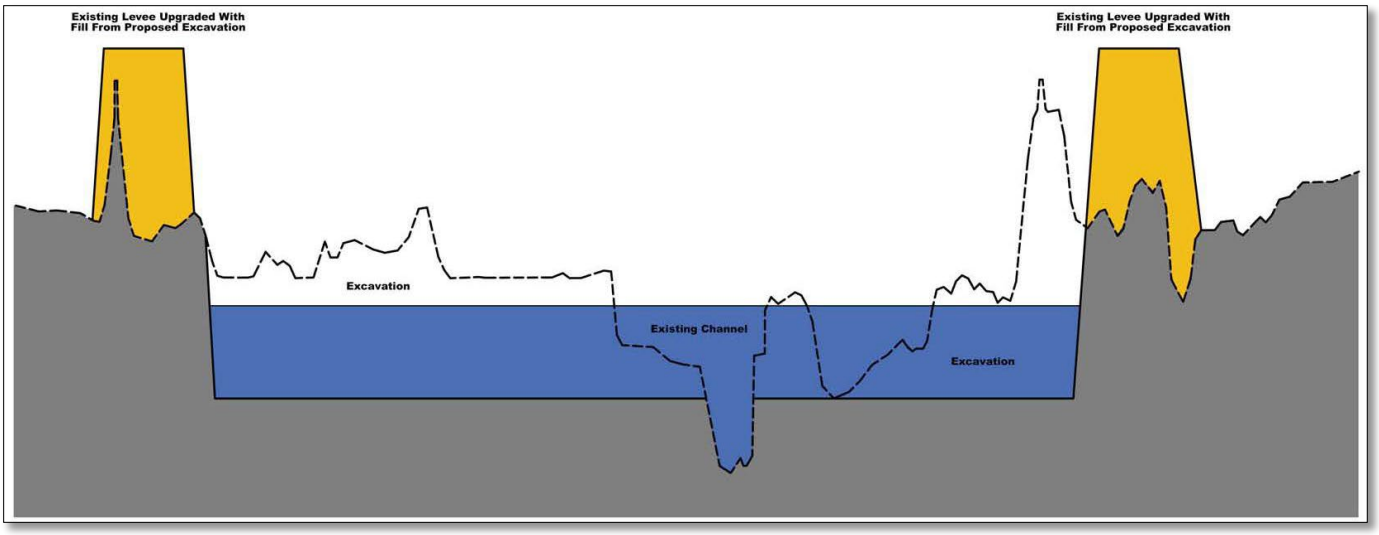


Figure 7-9. Channel Improvements with a relocated weir and improvements to existing levees.

7.2.5.2 SCREENING SUMMARY

This alternative is very effective providing flood reduction not only throughout RM 284 to RM 294 where improvements are proposed, but also upstream to RM 302. Flood reduction levels range from approximately 2 feet to greater than 8 feet. This alternative provides significant flood reduction throughout the reach. The difference between Plan 8 and Plan 14 is the addition of a levee around the WWTP to reduce flood damages.

The reduced flood risk would lead to many benefits: continued regional growth; public safety improvements, due to the minimized risk of catastrophic flooding; and, employment growth for the region, as businesses would not need to provide massive support for emergency measures. Recreational features would be included within the project area that would benefit local and regional communities. Local transportation would not be impacted during flood events and reduction of flood damages to highways and other infrastructure would decrease the need for evacuation of hospitals in Rankin County.

The preliminary weir elevation was selected to provide a cost-effective balance between the amount of conveyance needed to provide flood risk management and the expense of excavation. Relocating the weir allows for the water supply to be continued while the impoundment simultaneously reduces the vegetative maintenance requirements of the local sponsor. The local sponsor is currently responsible for maintaining over 300 of the 1,500 acres of the proposed footprint. Vegetation control in this area is difficult and if the vegetation is not properly maintained, conveyance is restricted. This expanded channel not only provides recreational benefits, the depth of the water also limits the local sponsor's maintenance requirements by reducing the area where spraying, mowing, or other vegetation control is needed.

The local community, the State of Mississippi, and local leadership has supported and continues to support this alternative because of its potential to provide flood risk management, positive social effects, regional growth opportunities, and the recreation benefits for improved access to the Pearl River and its natural resources. In addition to letters of support from local residents and

businesses, the project has received support resolutions from the Rankin County Board of Supervisors (June 2018, unanimous), the Hinds County Board of Supervisors (July 2018, unanimous), the City of Richland (June 2018), the City of Pearl (June 2018), the City of Flowood (June 2018), and the City Council of Jackson, Mississippi (July 2018). This alternative would have a high level of acceptability within the project area.

Because Plan 15 and Plan 16 have a high level of flood reduction along with a high level of acceptability, they seem to have the community support. Thus, these plans have much stronger cases for implementation and will be considered as viable alternatives for further study. **Plan 14 was no longer considered due to possible impacts of low flow, while Plan 15 and Plan 16 were considered for further evaluation.**

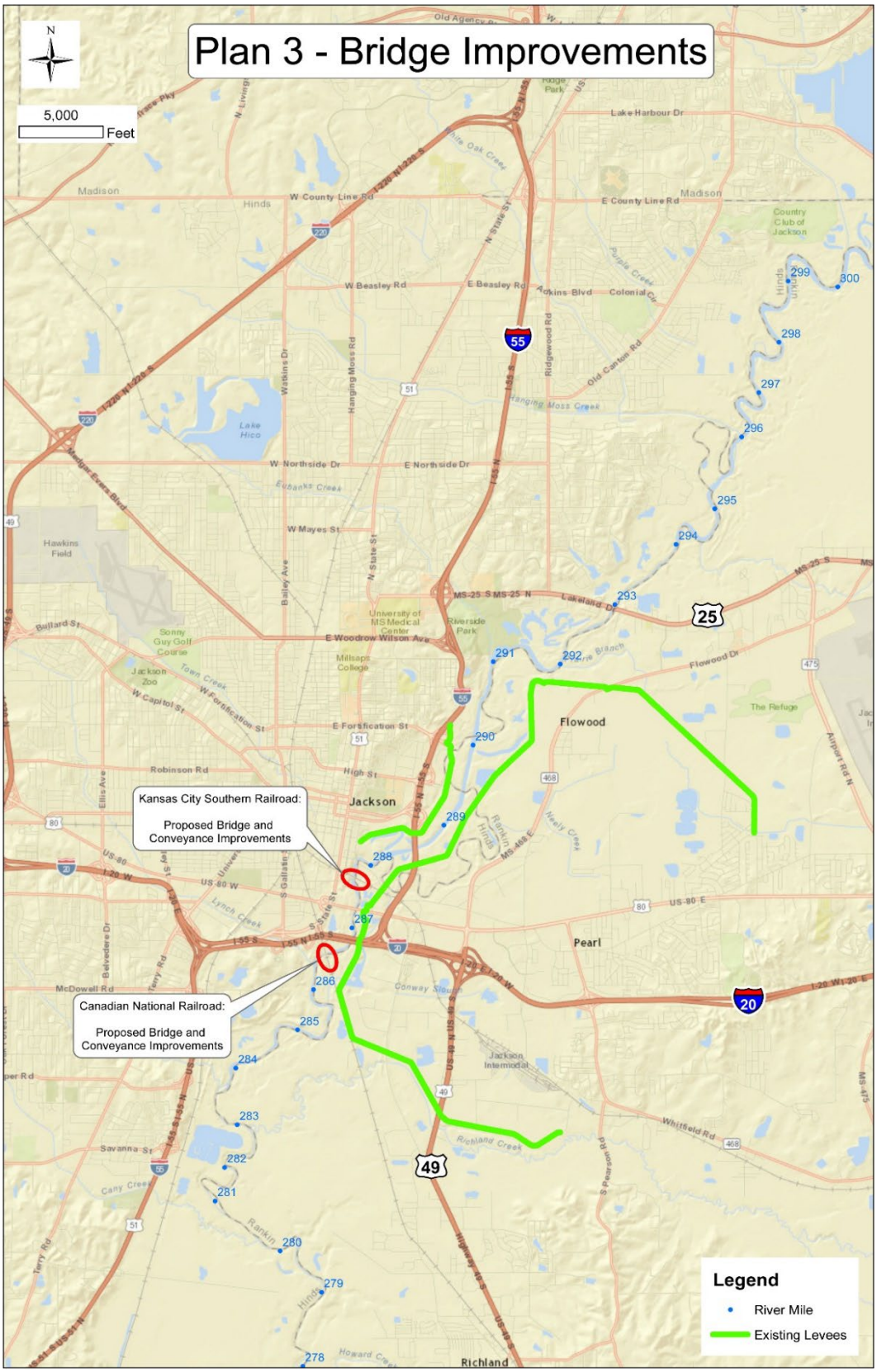


Figure 7-10. Bridge improvements and conveyance improvements within bridge areas.

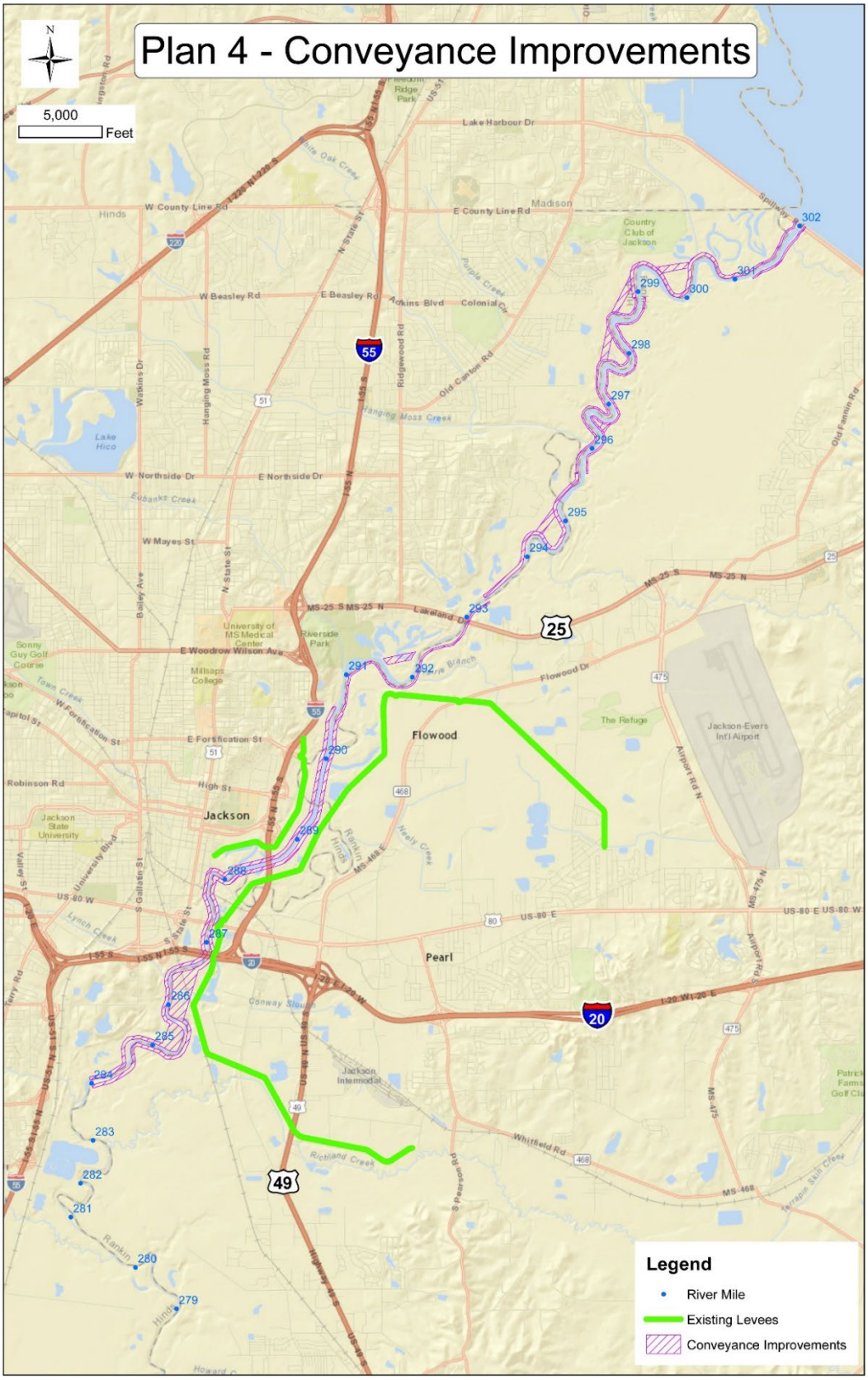


Figure 7-11. Conveyance improvements from RM 284 to RM 302.

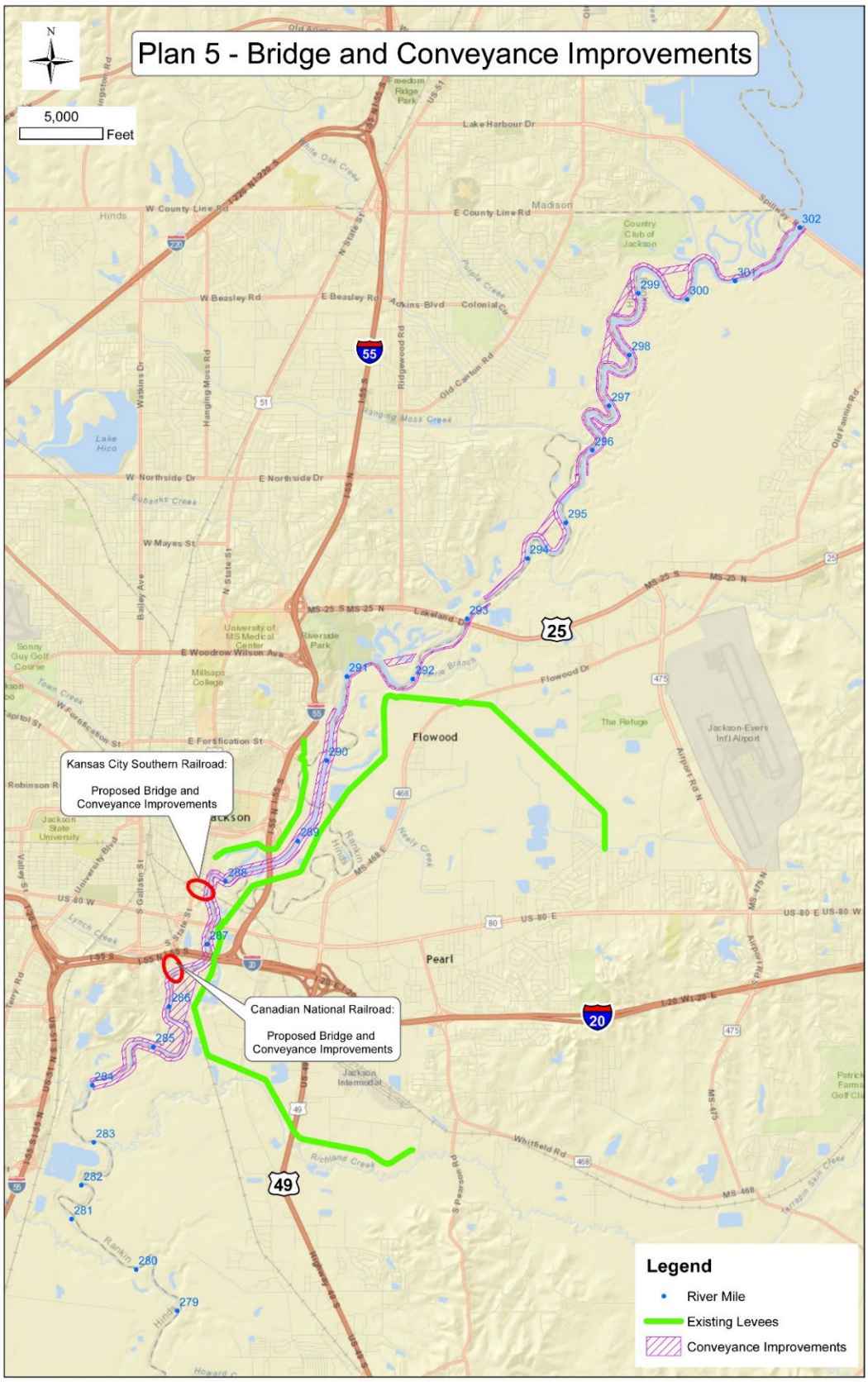


Figure 7-12. Conveyance and bridge improvements within the reach.

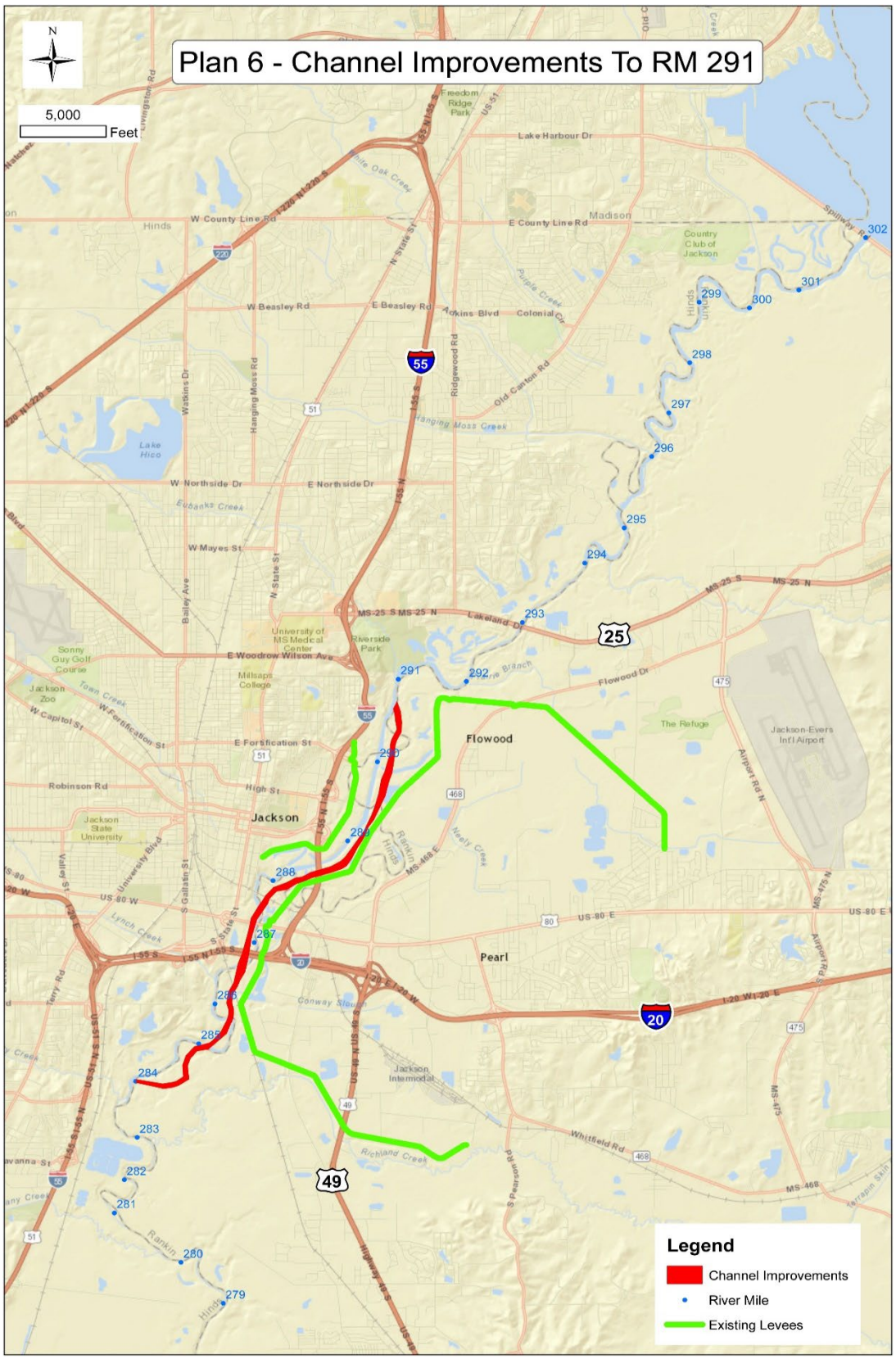


Figure 7-13. Channel improvements from RM 284 to RM 291.

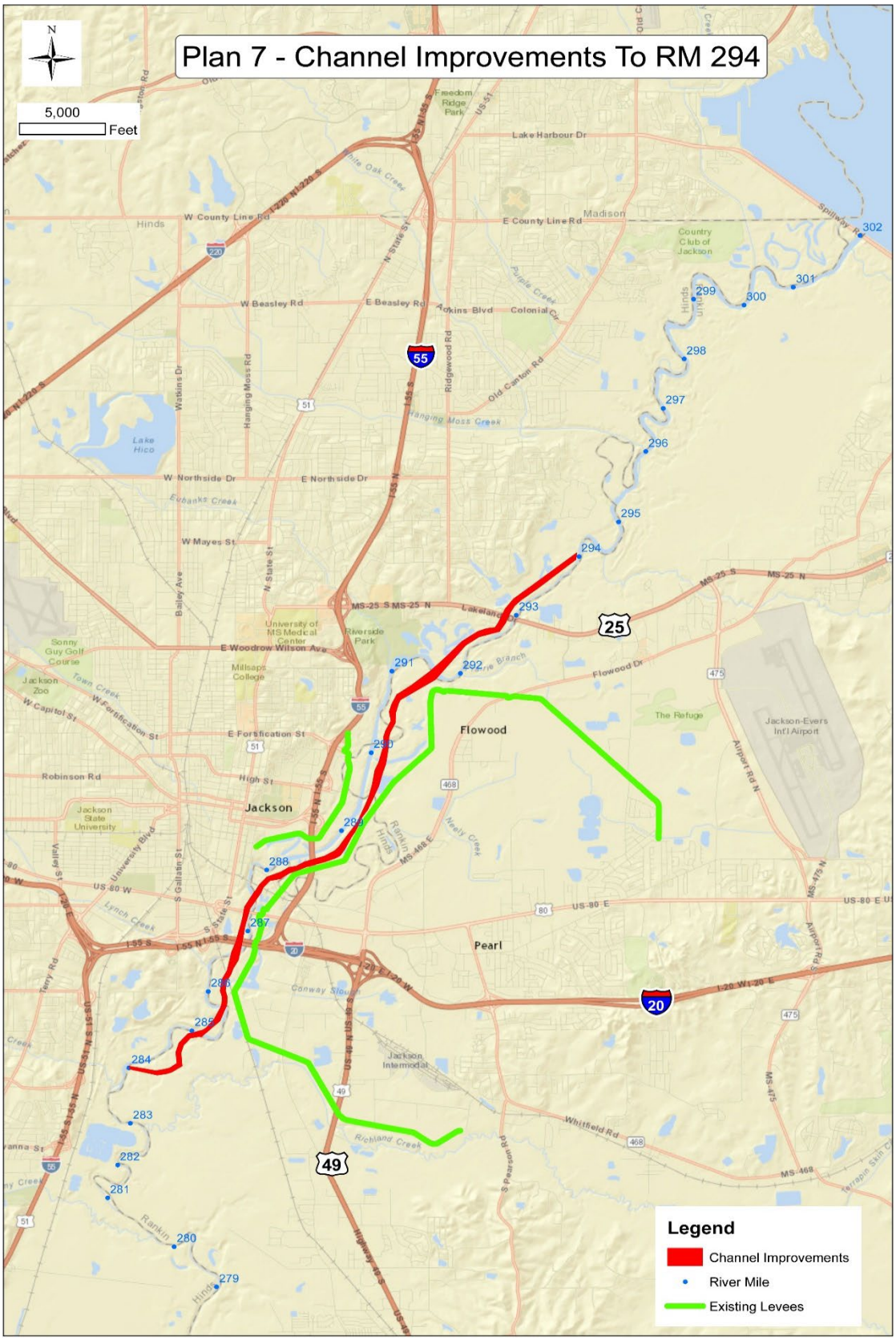


Figure 7-14. Channel improvements from RM 284 to RM 294.

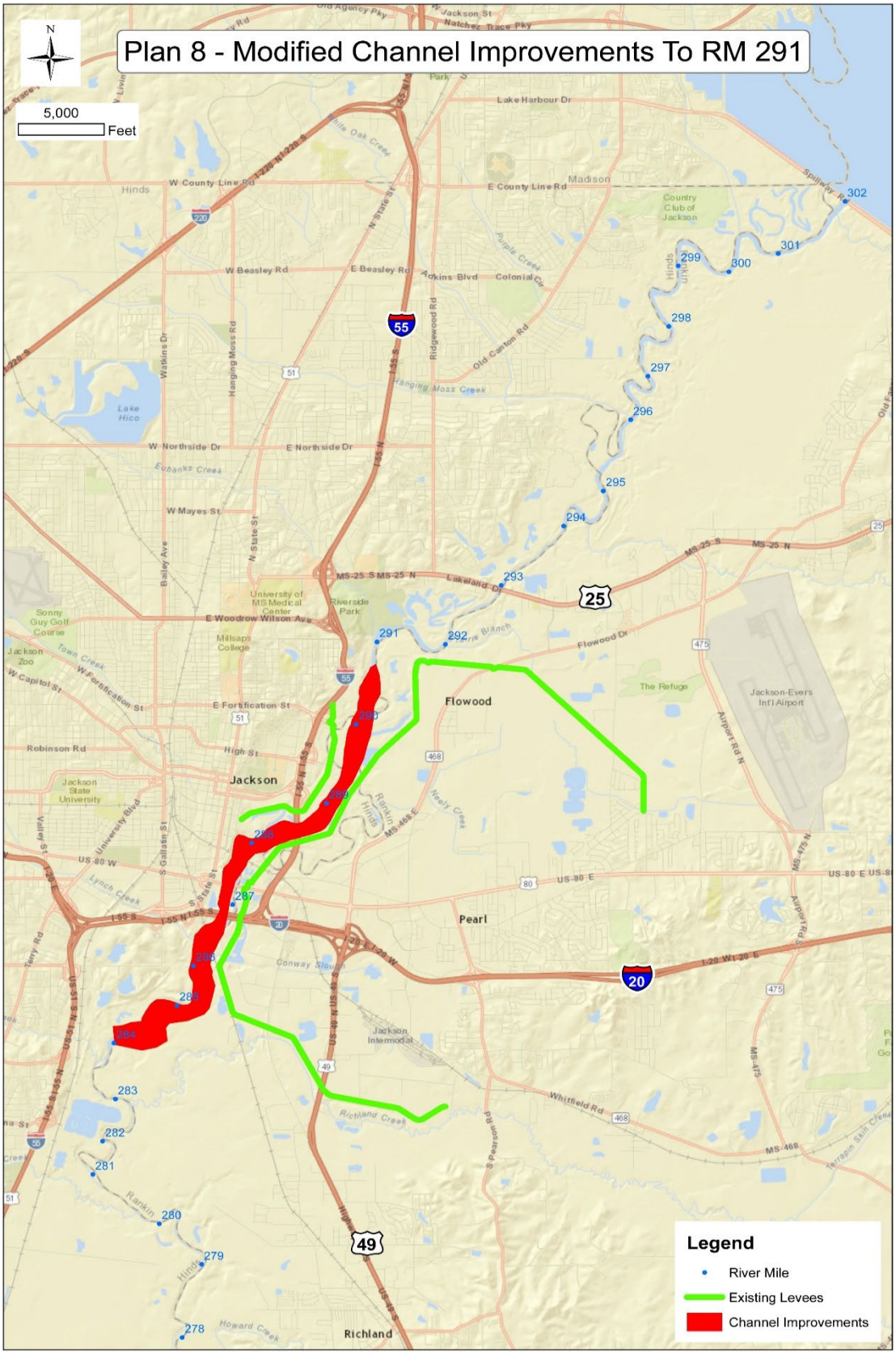


Figure 7-15. Channel improvements, with existing weir relocated to RM 284.

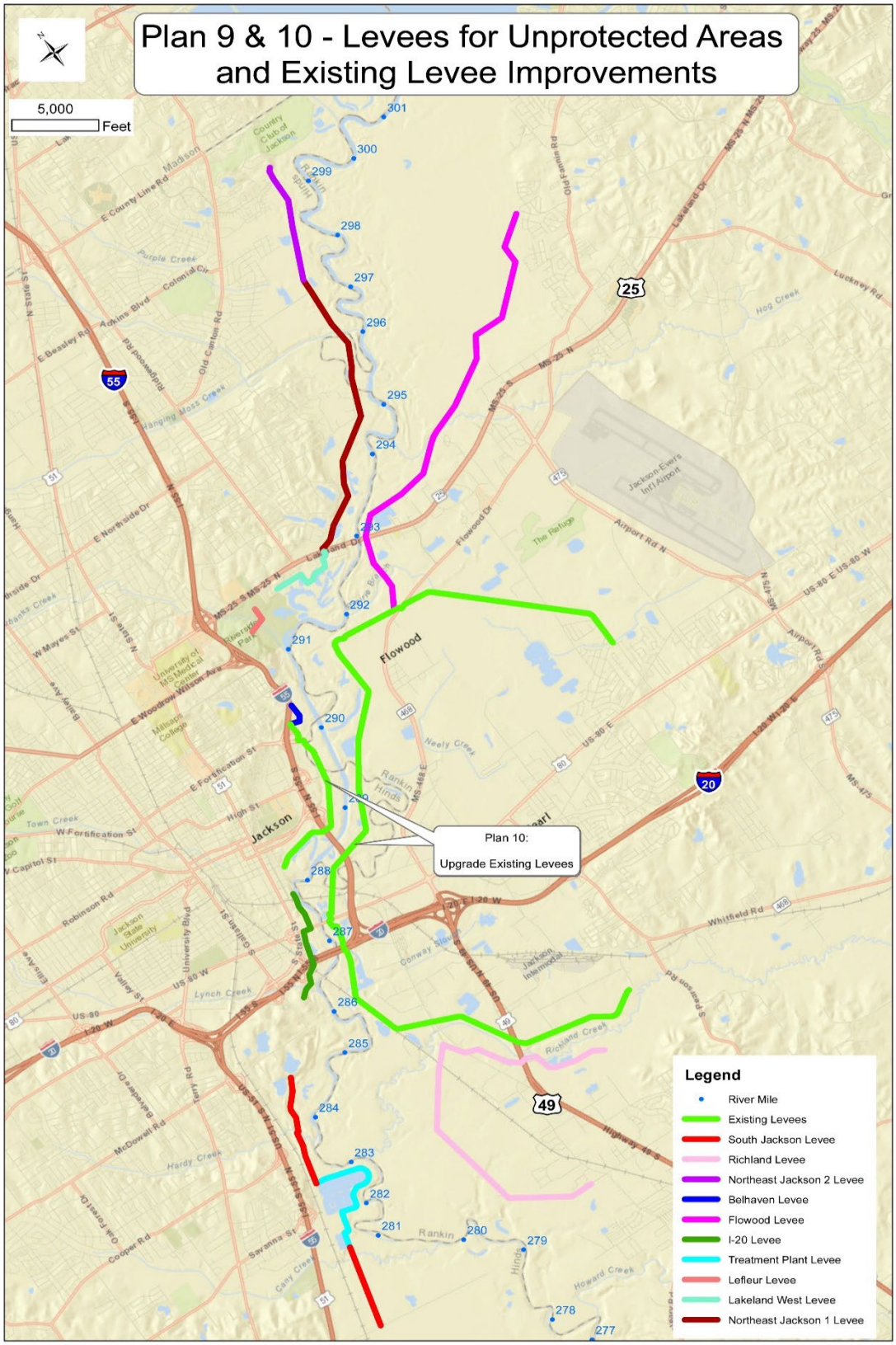


Figure 7-16. Plan 9 is levees for unprotected areas and Plan 10 adds improvements to existing levees.

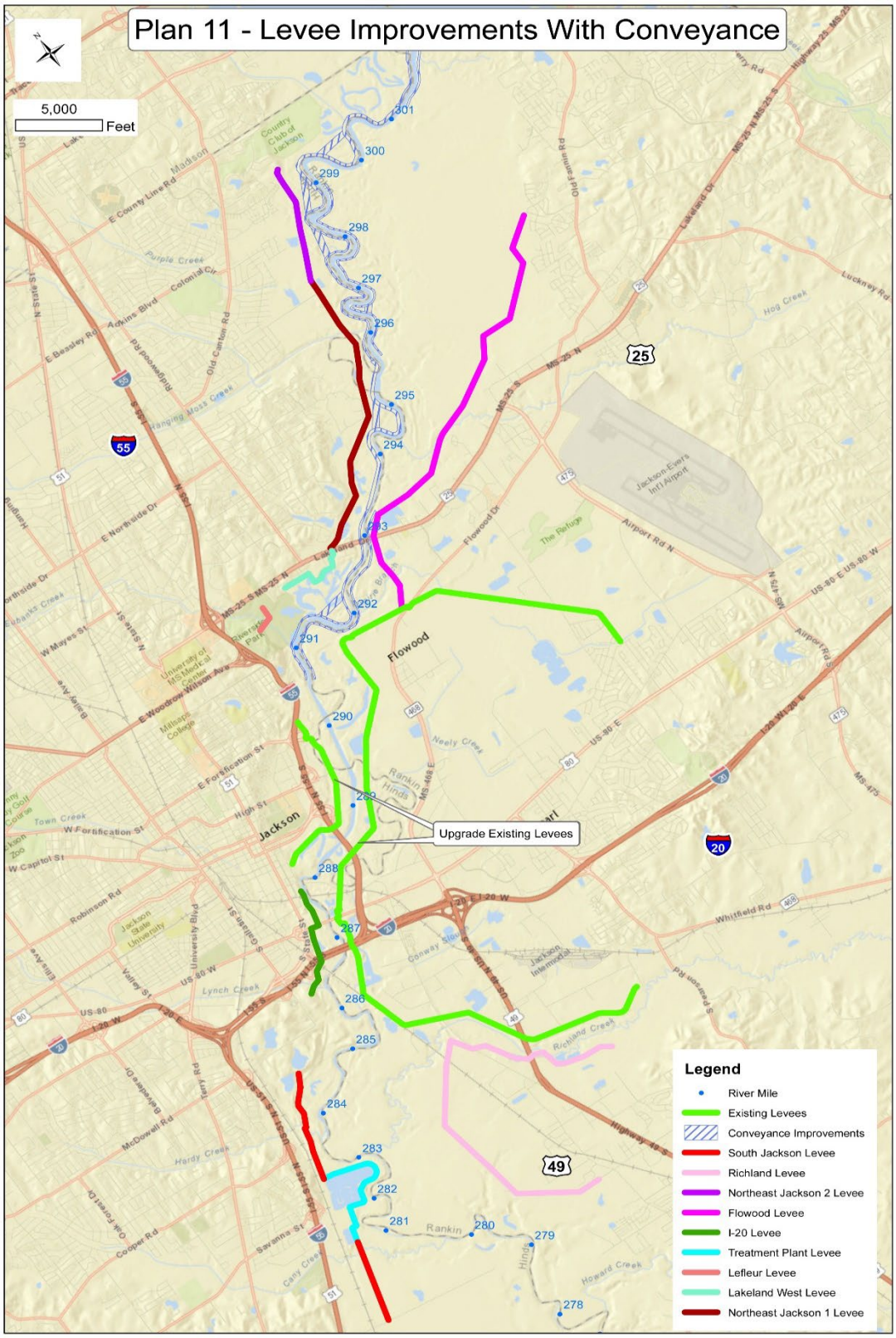


Figure 7-17. Additional levees and levee elevation improvements with conveyance improvements from RM 294 to RM 302.

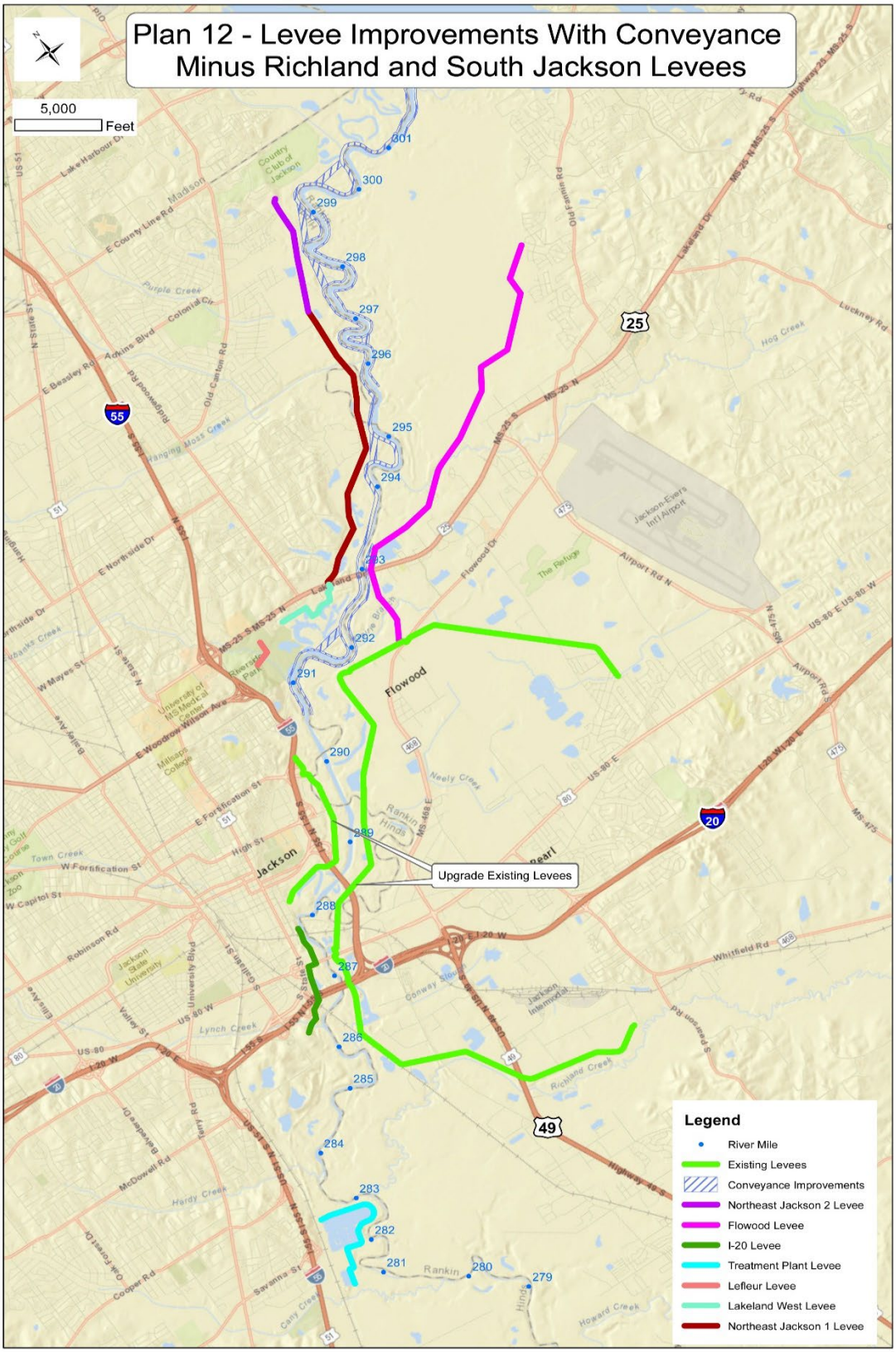


Figure 7-18. Similar to Plan 11, excluding Richland and South Jackson Levees.

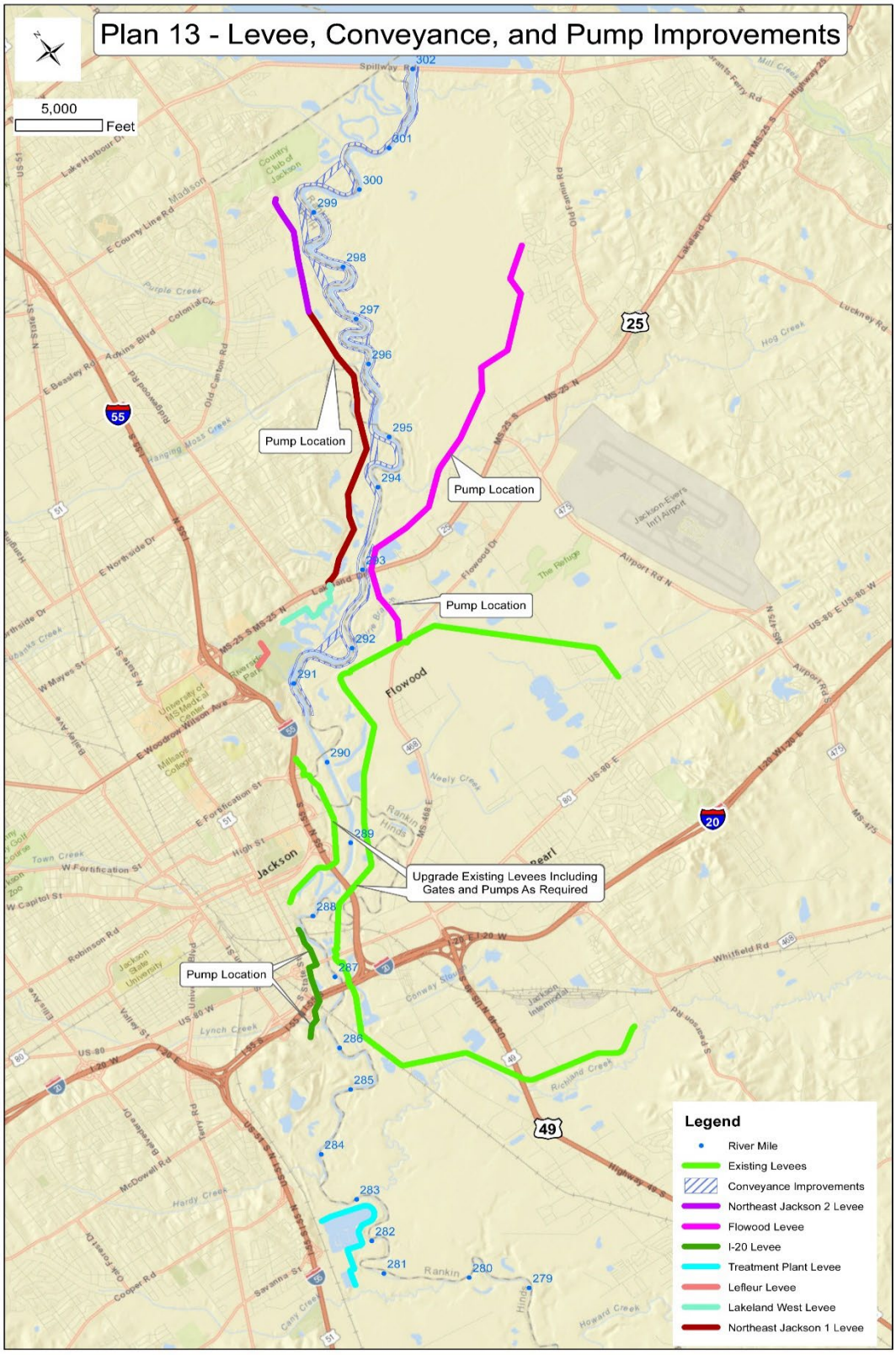


Figure 7-19. Additional levees and levee elevation improvements with conveyance improvements from RM 294 to RM 302, excluding Richland and South Jackson levees but including pumps and gates.

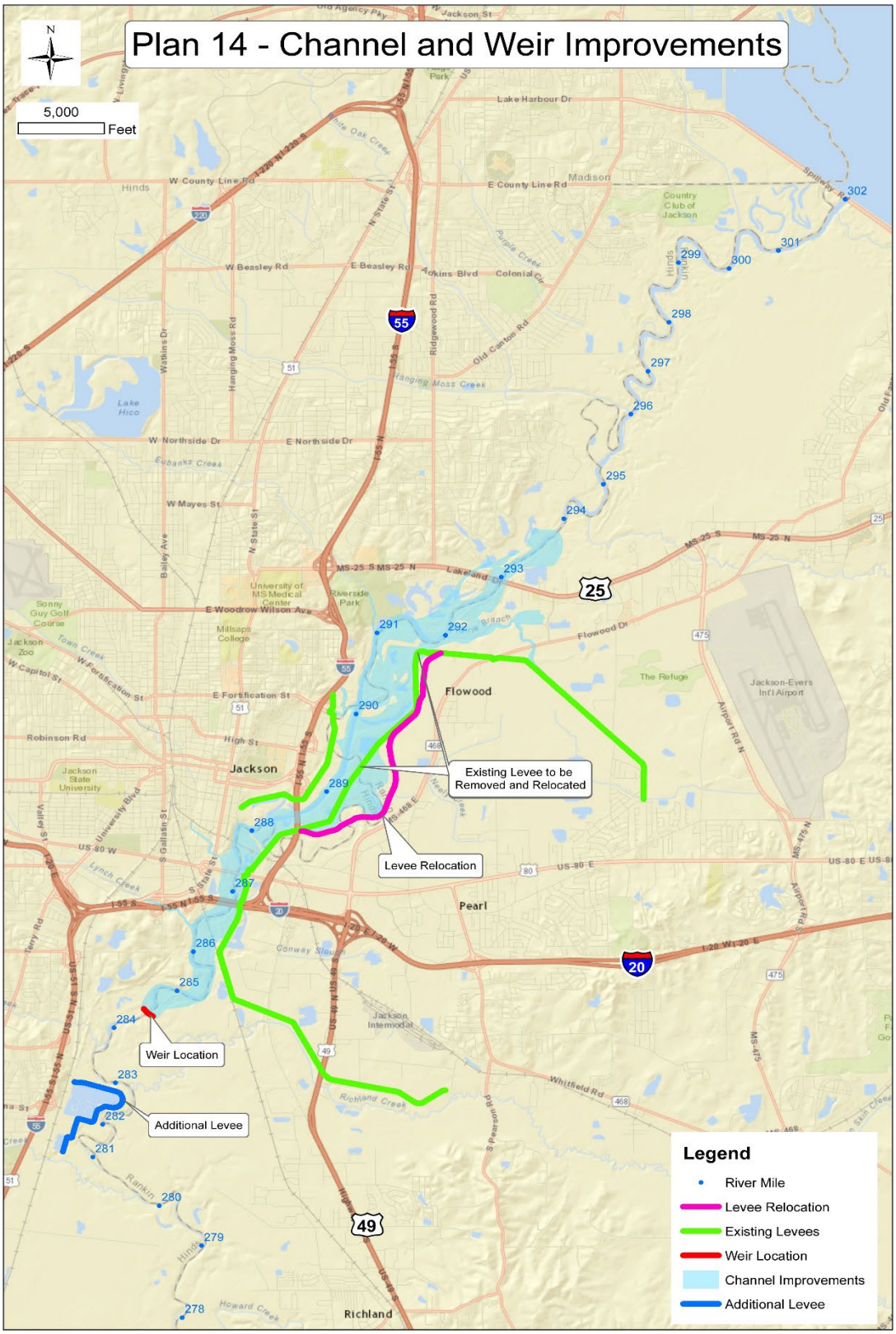


Figure 7-20. Channel improvements from RM 284 to RM 294, with weir relocation and additional levee around WWTP.

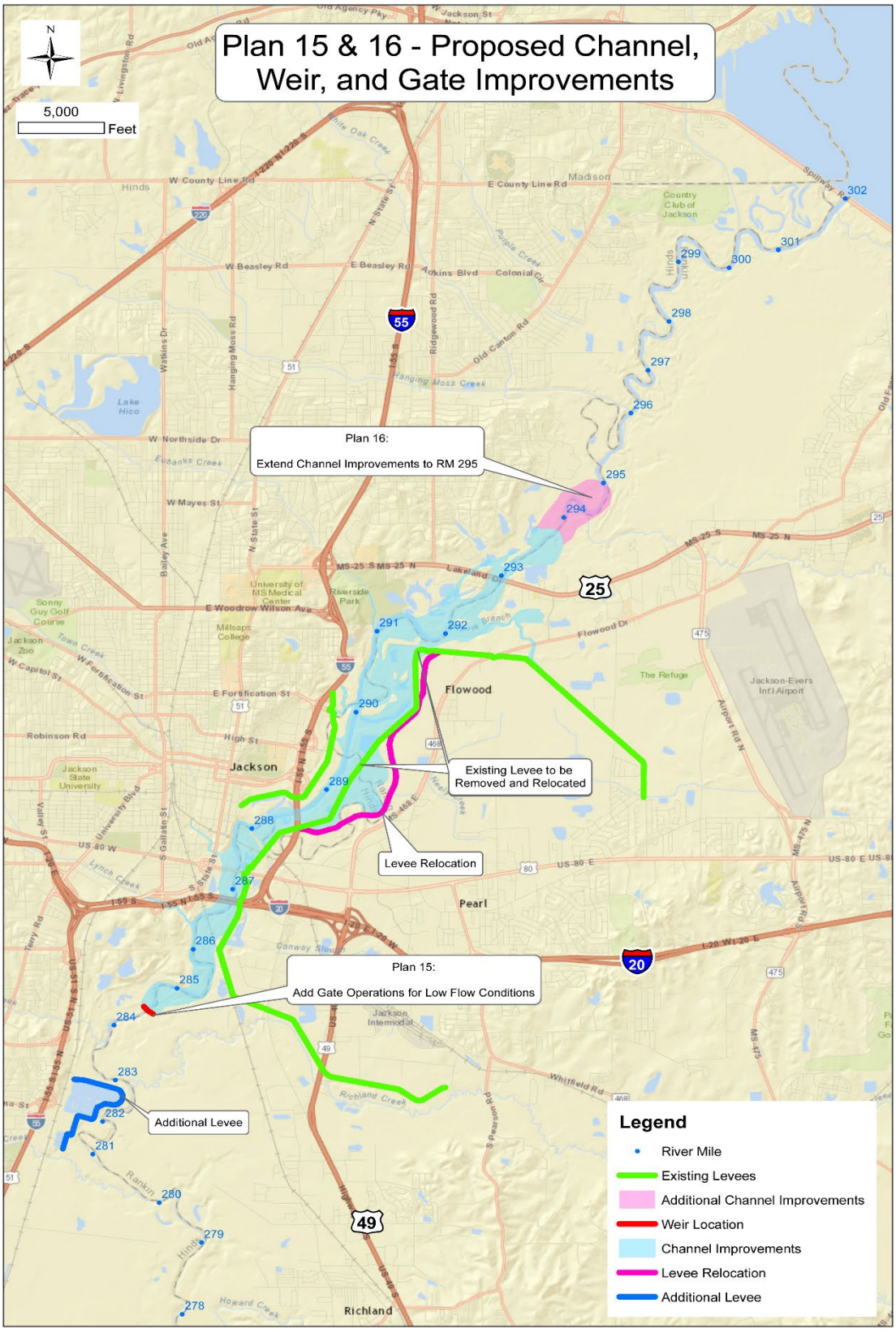


Figure 7-21. Similar to Plan 14, with the addition of gate operations at the weir (Plans 15 and 16) and the extension of channel improvements to RM 295 (Plan 16).

8.0 FOCUS ARRAY OF ALTERNATIVES

From the initial screening (Table 8-1) of 5 plans with non-structural measures and 16 plans with structural measures, a focus array was developed by combining non-structural and structural measures to create multiple options to carry forward. This focus array of alternatives was developed as a result of reviewing the goals and objectives, impacts to constraints, and screening criteria. Table 8-2 breaks down each plan into the component individual flood management measures. Table 8-3 is a summary of the plans no longer considered and the plans moved to the focus array.

Table 8-1: Screening Criteria Evaluation

Condensed Plan ID	**Screening Criteria** (5=High, 4=Medium High, 3=Medium,2=Medium Low, 1=Low)							Score	Recommendation
	Is this Alt Complete?	Is Alt Effective?	Is this Alt Acceptable?	Is this Alt Efficent?	Does Alt avoid Environmental Impacts?	Does this Alt have positive Social Effects	Is this Alt accepted by the local community?		
No Action	2	1	1	1	4	1	1	11	FOCUS ARRAY
NS Plan 1	1	3	1	1	4	1	1	12	Consider parts with other plans
NS Plan 2	1	1	1	1	5	1	1	11	Consider parts with other plans
NS Plan 3	1	1	1	1	5	1	1	11	Consider parts with other plans
NS Plan 4	1	1	1	1	5	1	1	11	Consider parts with other plans
Plan 1	4	4	1	1	2	1	1	14	
Plan 2	1	1	1	1	2	1	1	8	
Plan 3	1	1	1	1	4	1	1	10	
Plan 4	2	1	1	2	3	1	1	11	
Plan 5	2	1	1	1	3	1	1	10	
Plan 6	2	2	1	2	3	1	1	12	
Plan 7	2	2	1	1	3	1	1	11	
Plan 8	2	2	1	1	3	2	3	14	
Plan 9	2	3	1	1	4	3	1	15	
Plan 10	2	2	1	2	4	3	1	15	
Plan 11	2	3	1	2	4	3	2	17	
Plan 12	2	3	1	3	4	3	2	18	
Plan 13	3	4	2	2	4	4	2	21	FOCUS ARRAY
Plan 14	5	4	5	5	2	5	5	31	NO DUE TO POSSIBLE LOW FLOW
Plan 15	5	4	5	5	3	5	5	32	FOCUS ARRAY
Plan 16	5	4	5	5	3	5	5	32	FOCUS ARRAY

Table 8-2: Summary of Flood Management Measure Elements of the Alternative Plans

PLAN ID	MANAGEMENT MEASURES: Non-Structural: Relocation - Full acquisition buy-out	Relocation - Limited acquisition buy-out	Flood Warning Plans	Flood Insurance	Flood Plain Ordinances	Flood Storage	Conveyance Improvements	Bridge Conveyance Improvements	Channel Improvements	Structural: Levees	Floodwalls	Pumps	River Training Structures
No Action Alternative													
NS Plan 1	✓		✓										
NS Plan 2		✓	✓										
NS Plan 3		✓	✓										
NS Plan 4			✓	✓									
NS Plan 5			✓		✓								
Plan 1		✓	✓	✓	✓	✓							
Plan 2		✓	✓	✓	✓	✓							
Plan 3		✓	✓	✓	✓		✓	✓					
Plan 4		✓	✓	✓	✓		✓						
Plan 5		✓	✓	✓	✓		✓	✓					
Plan 6		✓	✓	✓	✓				✓				
Plan 7		✓	✓	✓	✓				✓				
Plan 8		✓	✓	✓	✓				✓				✓
Plan 9		✓	✓	✓	✓					✓	✓		
Plan 10		✓	✓	✓	✓					✓	✓		
Plan 11		✓	✓	✓	✓		✓			✓	✓		
Plan 12		✓	✓	✓	✓		✓			✓	✓	✓	
Plan 13		✓	✓	✓	✓				✓	✓	✓		
Plan 14		✓	✓	✓	✓				✓				✓
Plan 15		✓	✓	✓	✓				✓				✓
Plan 16		✓	✓	✓	✓								✓

Table 8-3: Initial Array Evaluation Summary

No Action	Required to move forward
NS Plan 1	Provides effective flood risk management benefits with a very high cost. Not efficient
NS Plan 2	Plan does not provide substantial effective flood risk reduction and is not acceptable. Considered with combination of other plans
NS Plan 3	Plan does not provide substantial effective flood risk reduction and is not acceptable. Considered with combination of other plans
NS Plan 4	Plan does not provide substantial effective flood risk reduction and is not acceptable. Considered with combination of other plans
NS Plan 5	Plan does not provide substantial effective flood risk reduction and is not acceptable. Considered with combination of other plans
Plan 1	Efficiency/Cost is high, plan is not acceptable, and from a planning consideration. Environmental Impacts are great
Plan 2	Plan does not provide effective flood risk reduction
Plan 3	Plan does not provide effective flood risk reduction
Plan 4	Plan does not provide effective flood risk reduction and violates constraints
Plan 5	Plan does not provide effective flood risk reduction and violates constraints
Plan 6	Plan does not provide effective flood risk reduction and violates constraints
Plan 7	Plan does not provide effective flood risk reduction and violates constraints
Plan 8	Plan does not provide effective flood risk reduction and violates constraints
Plan 9	Plan violates planning constraint
Plan 10	Plan violates planning constraint
Plan 11	Plan violates planning constraint
Plan 12	Plan violates planning constraint
Plan 13	Considered for further evaluation
Plan 14	Plan violates planning constraint
Plan 15	Considered for further evaluation
Plan 16	Considered for further evaluation

The focus array included 3 structural plans as presented below.

Plan 13: This plan is to provide additional levees for unprotected areas, increase existing levee protections by upgrading existing levee elevations, and add conveyance improvements upstream from RM 294 to RM 302. However, the existing available footprint is too limited to prevent interior flooding by water storage alone. Therefore, pumps and gates have been added behind levee structures for adequate dewatering of the Pearl River tributaries. While some previous plans did not include pumps, the damages due to interior flooding by constructing levees without pumps was considered too great. As noted by the USACE's Mobile District on page 57 of their 1985 report, levee improvements "would induce flooding outside the levee system during major floods because of the loss in hydraulic conveyance." Furthermore, the Mobile District noted it had to include large capacity pumps due to the limited ponding area availability. Other prior plans proposed multiple structures to be operated manually; however, these tributaries are flashy and sometimes peak in less than 12 hours. If transportation routes are inundated, access to these manually operated structures may be obstructed. When the Pearl River is at flood level, the risk of damage due to flooding without pumps to drain the interior would be quite high, and implementing this plan without pumps is believed to not be best engineering practice. Also, Engineering Regulation (ER) 1105-2-100 states on Page 3-12: "Remaining induced damages are to be accounted for in the economic analysis and the impacts should be displayed and discussed in the report." Therefore, if the interior flooding was not accounted for in the flood risk management measures, the damages from interior flooding would have to be accounted for in the damages and risk analysis and would negatively impact the benefit-cost ratio.

Plan 15: Channel, Weir and Gate Improvements. This plan includes channel improvements from RM 284 to 294, a "subsequent channel" for high flow conveyance, and the relocation of the existing weir to RM 284 to insure water supply. It also adds gate operations to the weir for low flow conditions and levee protection around the existing wastewater treatment plant. This plan also incorporates non-structural measures such as limited acquisition, voluntary buy-out.

Plan 16: Channel, Weir and Gate Improvements to RM 295. This plan is the same as plan 15, however the channel improvements will extend to RM 295.

To ensure NED benefits were maximized, a variation of Plans 15 and 16 was analyzed. Where Plan 16 considered a larger footprint than plan 15, this additional plan, referred to as Plan 15A, considered a smaller project footprint with dredging only up to RM 292. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) 9 Version 1.4 USACE-certified model was used to develop expected annual damages for existing conditions within the project area. Additionally, the model was used to evaluate

Table 8-4: Summary of Expected Annual Damages for Focused Array of Alternatives

Plan	Expected Damages		Damage Reduction (Flood Risk Management Benefit)
	Total Without Project	Total With Project	
Plan 13	$ 17,943.79	$ 7,050.84	$ 10,892.95
Plan 15	$ 17,943.79	$ 4,276.84	$ 13,666.95
Plan 16	$ 17,943.79	$ 4,054.31	$ 13,889.48
Plan 15A	$ 17,943.79	$ 8,702.71	$ 9,241.08

variations of the plans, like Plan 15A, to ensure expected annual damages were considered and benefits were maximized. This analysis indicated channel improvements must continue through at least RM 294 (upstream of Highway 25/Lakeland Drive) for the channel improvements to have significant flood risk management benefits.

With over 50% of the structural damages occurring upstream of RM 292, any plan with the aim to meet this study's goal and fulfill the planning objectives must provide significant floor risk management benefits to this area. As Table 8-4 shows, the damage reduction benefit is significantly reduced when flood risk management benefits are not extended upstream of RM 292. While the implementation cost of Plan 15A is less than that of Plan 15, the benefit from cost savings available with the smaller footprint of Plan 15A is offset by the concurrent loss of flood risk management benefits. Therefore, Plan 15A was not considered moving forward.

Upon further evaluation, Plan 16 was also no longer considered. Although Plan 16 provides for the greatest flood reduction benefits amongst plans within the focus array, this plan would likely have some impacts on the mitigation bank constraint and could encroach on possible turtle habitat. This alternative's costs associated with the additional dredging and the impacts to a planning constraint did not justify the additional benefits in Northeast Jackson. Therefore, channel improvement measures with larger footprints than Plan 16 were not considered moving forward.

Based on guidance from USACE, a standalone non-structural alternative was carried forward to the final array of alternatives to maintain compliance with Section 73 of WRDA 1974 which states that nonstructural measures will be considered by all Federal agencies in the survey, planning, or design of any flood risk management project. Furthermore, the USACE Planning Bulletin No. PB 2016-01 states "a minimum of one primarily nonstructural plan (Section 73 of the Water Resources Development Act of 1974) must be considered…". The non-structural buy-out plan is the only practical alternative since residential and commercial structures within this area cannot easily be raised without significant structural damage and cost. Therefore, the non-structural plan of total buy-out was carried forward for evaluation. During feasibility level design, further analysis on the non-structural features of the recommended plan will be conducted to determine the economic feasibility of the non-structural features.

9.0 FINAL ARRAY OF ALTERNATIVES (*NEPA REQUIRED*)

The final array of alternatives carried forward for consideration included the **No Action Alterative, Alternative A (non-structural), Alternative B (Plan 13), and Alternative C (Plan 15)**. Details of each plan are included in this appendix, while Appendices C, L, M, O, P, and Q present additional engineering details of each alternative. Additionally, some levee segments were removed at this time due to lack of economic justification. As a part of the

9.1 No Action (Future without-project condition)

Under the No Action Alternative, no flood risk reduction would occur. The area would continue to experience flooding caused by the headwaters of the Pearl River. As already presented in Section 1, impacts will continue to be great and could possibly increase as urban development continues to impact structures, infrastructure, transportation, and the existing WWTP.

9.2 Alternative A (Non-Structural)

The measure of relocating structures (buy out) allows for moving structures as part of the project and buying the land upon which the structures were located. The total number of structures to be relocated in this alternative would be numerous and include residential, commercial, schools, and hospitals. This does NOT include structures behind existing levees although, some probability of flood damage and risk in these areas will still exist.

As can be seen in Figure 9-2**,** many structures that impact quality-of-life and community cohesion are impacted in multiple sections within the Study Area. In addition to community impacts, major transportation routes, airports, and rail lines would still be impacted causing congestion and transportation impacts. The estimated cost for removal of the structures alone would surpass $2.0-billion. The cost of this alternative far exceeds economic justification; additionally, it does not meet the stated goals and objectives. Furthermore, risk would not be improved to existing structures being protected by existing levees, and no flood risk management benefits would be realized at the $300-million WWTP serving the area. Inclusion of a levee to protect the WWTP would further increase the already untenable estimated cost. Therefore, reference to this alternative in future discussions will be limited.

9.3 Alternative B (Levee Plan)

Approximately 13.5 miles of levees currently protect portions of the Jackson metropolitan area; however, much of the Jackson metropolitan area is unprotected, as previously discussed. This alternative consists of building new levees and expanding the existing levees and pumps. In some areas, floodwalls are needed due to right-of-way restrictions. Significant conveyance improvements would be constructed from RM 292 to RM 302 on the west bank to reduce flooding induced by new levees and reduce any impacts to the outlet structure of the Ross Barnett Reservoir.

Additional levees would improve flood risk reduction in unprotected areas and in already protected areas. Although flood risk management is improved, the risk of overtopping or failure in levee sections during extreme events will still exist. This alternative adds a significant number of structures and pumps requiring maintenance and operators during flood events with possible interior flooding. While not included in initial iterations of the levee plan, it quickly became clear that the construction of additional levees would require additional pumps and ponding areas. As noted by the USACE's Mobile District on page 57 of their 1985 report, levee improvements "would induce flooding outside the levee system during major floods because of the loss in hydraulic conveyance." With levees blocking the natural flow paths within the floodplain towards the river, pumps and ponding areas would be required to transport drainage over the levees or else flow would accumulate on the protected side of the new levees. Furthermore, the Mobile District noted it had to include large capacity pumps due to the limited ponding area availability and significant channel enlargement would be required to compensate for the loss of valley storage.

This plan would require significant clearing and maintenance of areas from RM 294 to RM 302 to insure no increase of flood elevations upstream of the project area near the Ross Barnett Reservoir. This conveyance improvement would be needed within a reach of the Pearl River that has not been

significantly alternated in the past. Similar levee plans have been recommended in the past but have failed to be implemented with lack of community and leadership support.

9.4 Alternative C (Channel Improvement/Weir/Levee Plan)

This alternative consists of significant channel modification from RM 284 to RM 294. Levees exist within much of this reach and would be relocated in some areas to reduce flood levels. The only pumping stations required for Alternative C to provide flood risk management benefits are already in place, i.e., this plan does not require the construction of any new pumping stations. This alternative would include excavating the overbanks of the channel. Excavation would be placed adjacent to existing levees. If the excavated fill is of suitable material for levee construction, the large amount of excavation needed would provide substantial land mass or expanded levee widths, providing additional protection and additional risk reduction. The weir currently located at RM 290.7 would be removed and relocated with a new weir near RM 284.3 of an improved design including a gate for low flows and a fish passage channel. The replacement weir would be modified to a higher elevation and expanded width, providing a larger body of water for flood risk reduction and recreation while reducing channel maintenance along with the future maintenance required of a larger, expanded channel improvement. Additional pumps would not be needed to provide protection behind levees except where pumps already exist. This plan further complies with the guidance in PB 2016-01 to combine structural and non-structural measures to "formulate complete plans" by incorporating non-structural measures with the inclusion of voluntary residential buy-outs. The non-federal sponsor will assess non-structural measures, such as voluntary acquisition of structures in both Hinds and Rankin counties that would otherwise continue to be located in flood prone areas, on its own upon completion of the Federal project.

As a part of the FS/EIS process, draft versions of this study have been extensively reviewed by both technical panels and by the public. Technical reviews were conducted by the USACE during Agency Technical Reviews (ATR) and by an independent technical reviewer in an Independent External Peer Review (IEPR). Public input was solicited during public comment periods and at meetings (further information about public participation in this process can be found in Section 7 of the report, as well as Appendices G and H). This review of the project included extensive incremental analyses of individual project measures as well as excavation lengths, widths, and depths, to ensure flood risk management benefits are maximized with the respect to the size of the project (the results of this analysis can be found in Appendix B, Attachment 1). The updated incremental analysis and hydraulic modeling indicated the amount of benefits gained by the reduction in water surface elevation from relocating the existing east levee did not exceed the increased environmental impacts and increased cost. The incremental analysis concluded that leaving the existing east levee in place (no relocation) would maximize the NED benefits and reduce the environmental impacts by up to 10%. As a result of this examination, the plan no longer includes relocation of the east levee (Figure 9-4). The proposed Alternative C includes excavation of the channel top banks from approximately RM 284.5 to approximately RM 294. The excavation will be of various widths from the existing top bank (no river excavation will be done) to be determined during the Preconstruction Engineering and Design Phase. Excavation depths will vary between 5-10 feet. Within the existing levee reach, all excavation will remain between the levees with no levees being removed or lowered.

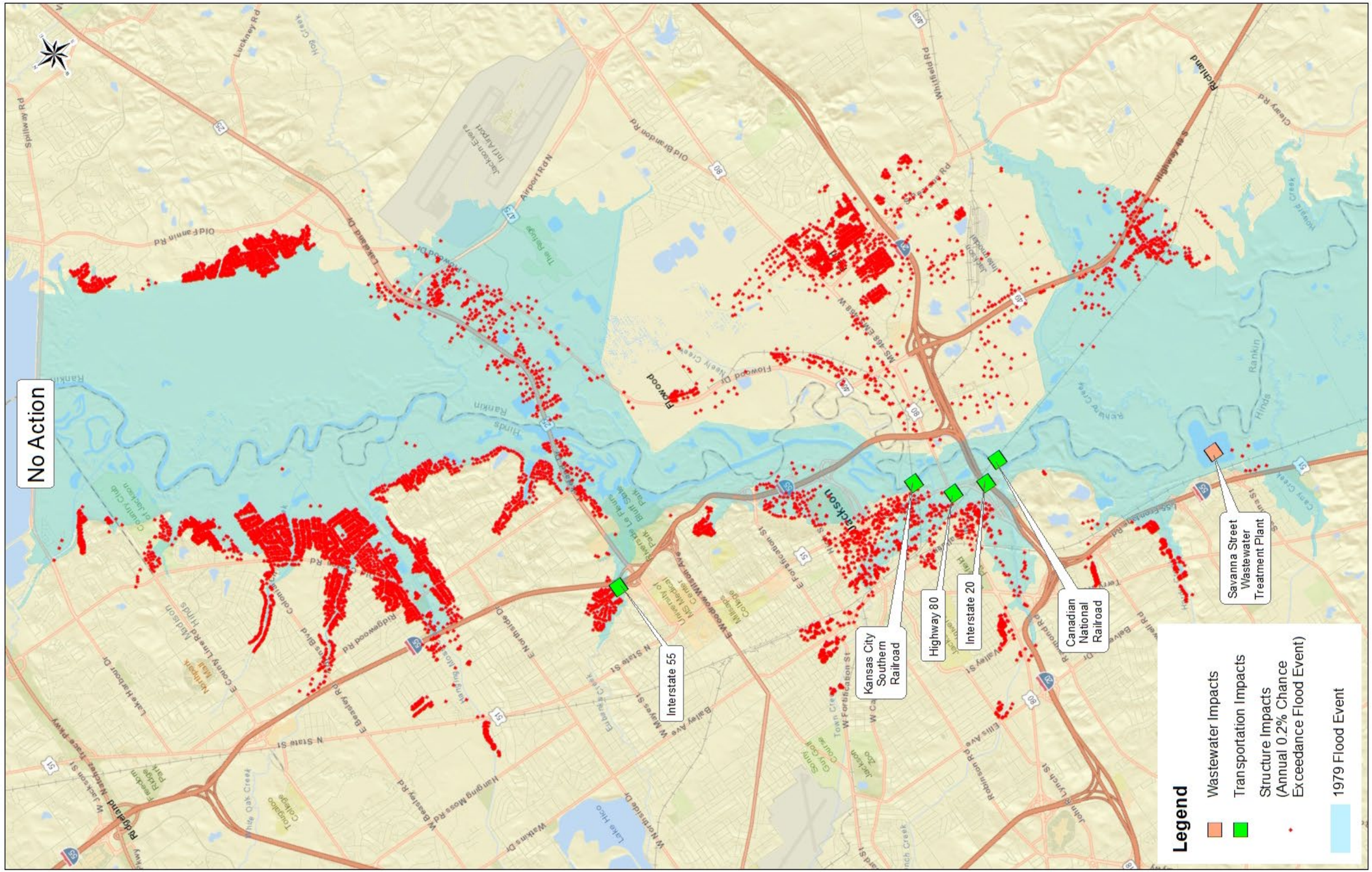


Figure 9-1. No Action Alternative

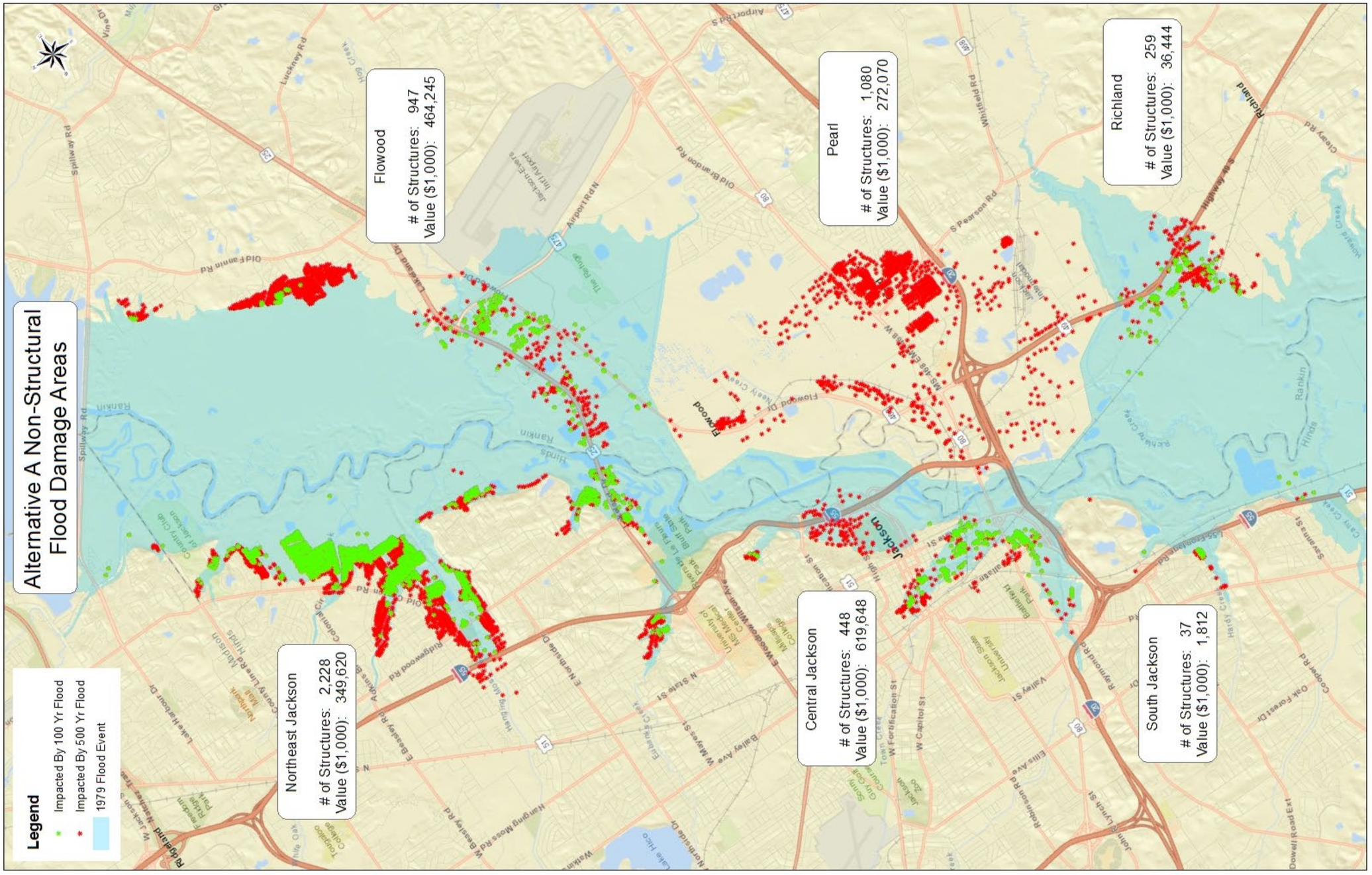


Figure 9-2. Non-Structural Locations

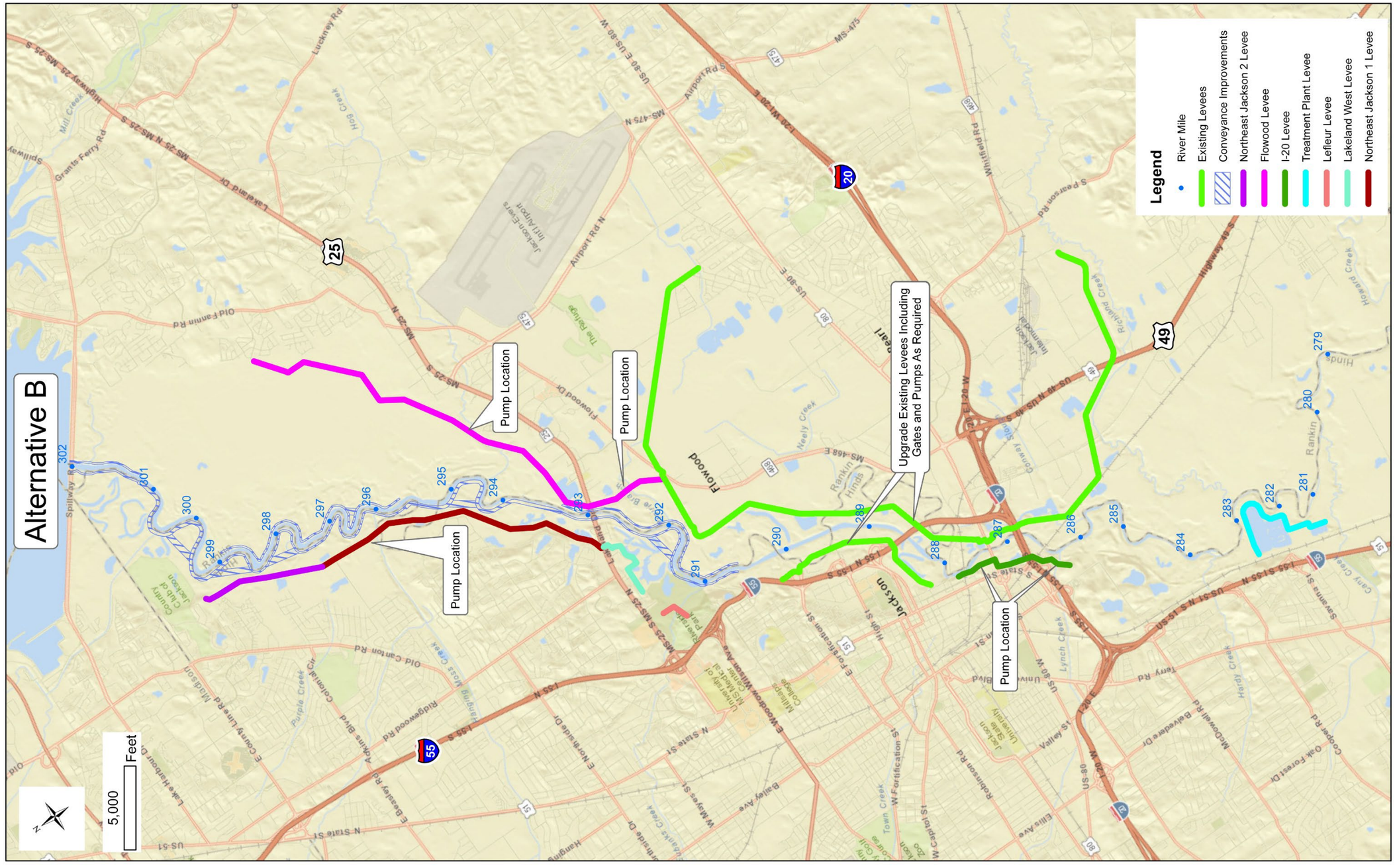


Figure 9-3. Alternative B

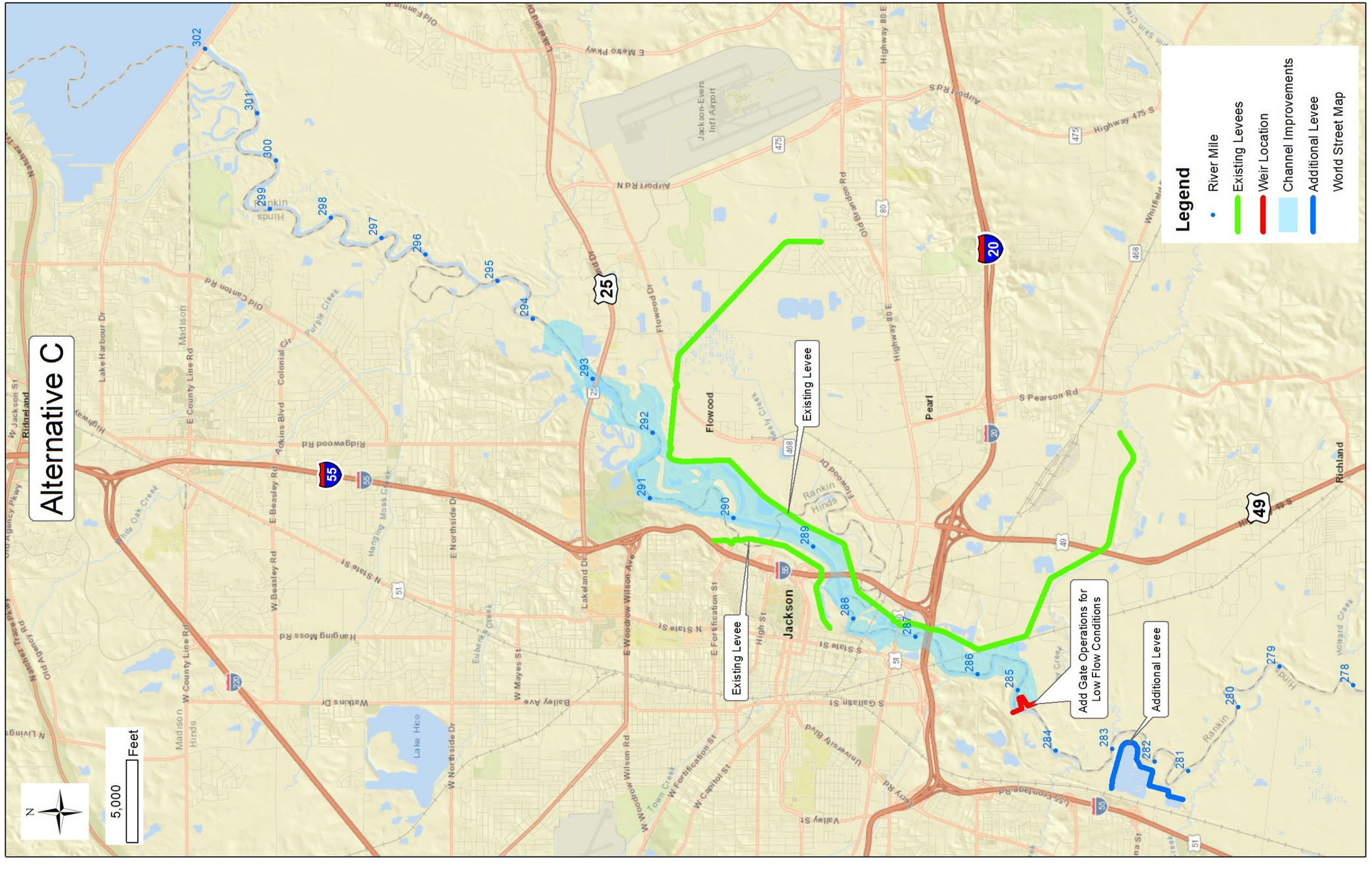


Figure 9-4. Alternative C

Attachment 1. Summary Matrix of Alternatives

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Summary Matrix of Alternatives Pearl River Watershed Flood Control

Resource Category	Alternative Description	Effectiveness	Completeness	Acceptability	Efficiency	Environmental Effects	Social Effects	Implementability	Community Support	Risk	Recommendation
Previous Lakes Plans	This alternative had 2 weirs and created 2 lakes from mile 284 to mile 302 at the base of the Ross Barnett Reservoir	The Previous Lakes Plan produced over 90% reduction in flood damages, effectively reducing flood risk in the Jackson metropolitan area, reducing loss of transportation routes, reducing the flood risk of critical infrastructure, while integrating environmental design features.	This alternative realized all four planning objectives.	This plan is acceptable.	The cost of this alternative is quite high, approaching or surpassing $1 Billion.	With such a large project footprint, this alternative would have significant environmental impacts. Additionally, a mitigation bank has been	Public safety would improve with the improved flood risk management benefits minimizing the risk of catastrophic flooding. The reduced flood risk would lead to continued regional growth. The risks to business would be lessened by the flood risk management benefits of the plan. Employment within the region would expand. Local transportation routes would not be impacted during flood events, remaining open and accessible to the public. Hospitals in Rankin County would not have to be evacuated and could continue normal operations. Furthermore, the recreational features included in this alternatives design would provide additional benefits to the public. The resulting social effects from the implementation of this project are clearly positive.	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented. However the cost is too high to be implemented and obtain funding and the environmental impacts with the new constraints being considered.	The local community has supported this alternative in the past due to the combined benefits of flood risk management, positive social effects, regional growth opportunities, and the recreation benefits from improved access to the Pearl River and its natural resources. Furthermore, this plan was acceptable in terms of applicable laws and regulations.	The flood risk management benefits provided by this alternative would be significant. Additional benefits would be obtained due to reduced risk from potential levee failure.	Due to the high cost, environmental impacts, and the new constraint of the MDOT mitigation area, this alternative will not longer be considered.
Previous Comprehensive Levee Plan	This alternative implements the Initial Levee Plan Alternative outlined in the USACE 2007 Feasibility Study Main Report.	This plan increases the water surface elevations between the levees. The plan does provide flood risk management benefits but only for the areas within the levee reaches. However, if implemented as previously proposed, the comprehensive Levee Plan will induce interior flooding, reducing ability to provide flood risk management benefits and reduce the risk to transportation and infrastructure. Pumps must be added.	This alternative does not realize all four of the planning objectives.	This plan is not acceptable without pumps due to induced interior flooding. With pumps, this plan is acceptable.	The cost of the levee alternative in the 2007 Draft report was presented as 234 Million. However, new levee guidance developed in the recent years will drive this cost up significantly from past studies. In addition, levee modifications to minimize impacts to the proposed Mississippi Department of Transportation mitigation area will lengthen levee segments as well as addition floodwall in areas developed since the 2007 draft report.	This alternative would have moderrnly high environmental impacts	Although the levees will provide additional protection, this could have a positive social effects. However, in some areas where interior drainage may cause some relocation, or reduced level of protection, social effects could be negative due to impacts of these areas behind levees. In addition, land would have to be acquired from numerous landowners.	As stated, levee plans have failed to gain funding and acceptability over the past 15 to 20 years. Plans have failed to gain local sponsor support as well as funding required for the local share match. It is not believed that the community or political leadership has changed enough to implement a stand-alone levee alternative. However, implementing some form of levees in areas could possibly be implemented. A stand-alone levee alternative has a moderately low level of being implemented.	Expanding the existing levee protection has be studied and reviewed prior to this study. There have been two levee plans that have failed to obtain funding. Although, expansion of the flood protection is needed and wanted by the community, levees have not gained the support needed to insure funding from the local community	Risk would be reduced from flooding where levees would provide protection of unprotected areas. However, some risk would still be applicable for extreme events due to risk of levee overtopping. In addition, risk will still be applicable where roads would still be inundated and within interior areas where flood risk still would exist. Risk levels for this alternative would be moderately low	Due to the impacts to the new constraint (MDOT mitigation area) this alternative will no longer be considered.
No Action	This alternative assumes no Federal project is implemented, and emergency measures currently employed in the project area would continue to be implemented as necessary due to flooding. These emergency measures include such actions as temporarily raising existing levees, evacuations, levee closures, re-routing of traffic, sandbagging, ring levees, and other temporary measures	The alternative does not provide consistent reliable long-term flood risk management for the Jackson Metropolitan area. The emergency measures are only temporary and are only beneficial for one-time events	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	A flood event similar to the 1979 event could exceed $1.0 billion in damages to the community. Average annual damages from all flood events could exceed $17 million from the most recent study. This alternative has extremely high cost to the local community	This alternative would continue to have moderate negative impacts	Flood fighting causes extreme impacts to the community. Businesses shut down, transportation routes including emergency routes are affected, and public and recreational facilities are negatively impacted. Over the long term, the flood risk makes the community less attractive for businesses than less flood-prone areas. Failure of emergency measures during a large flood results in lack of community cohesion, decreased public safety, and potential loss of life. The alternative would have highly negative impacts	This alternative represents the base condition in the absence of a Federal project. Legal and technical issues complicate implementation of emergency measures	This alternative is not an acceptable long-term solution for the local community or the Nation. Continued reliance of flood fighting and evacuations would continue to have adverse impacts on the community and the nation do to economic damages that would continue to occur. This alternative would continue to have a very low level of acceptability.	The community would continue to be at risk of flooding. The effectiveness of the emergency measures is not reliable during extreme events and many areas will be prone to flooding due to lack of flood protection. Roads, freeways, and infrastructure will continue to be inundated and the probability of loss of life exist. This alternative has extremely high risk	This alternative will be carried forward as the base "no action" alternative
Non Structural+A7:A13	Non-structural measures remove damageable property from flood waters rather than redirecting the flood waters away from the property. Non-structural measures include a variety of actions such as evacuating flood plains, flood proofing, relocating structures, flood warning systems, Flood Insurance, land acquisition, and elevating structures above the design flood level	Does provide flood risk management benfits but at high cost. Does not provide features for habitat conservation.	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	For the initial screening, stand-alone non-structural plans would be cost prohibited due to the large number of structures. The 500 year events impacts many structures with impacts in the Billions of dollars	This alternative would have moderately positive impacts	During flood events, evacuation would cause large disruptions to transportation and business for weeks. A large percentage of the structures in the study area would need to be either removed, relocated, or modified to achieve a standard level of protection, reducing community cohesion and changing entire neighborhoods and communities. Regional growth would be negatively affected because businesses would not want disruptions from the evacuations that would be necessary with this alternative This alternative would have a high negative social impact	The project would be very difficult to implement because it directly affects an enormous number of property owners. Forcing the public to raise structures may not be possible, reducing the overall effectiveness of the plan. There would be legal issues as to what authorities would be used to force people to modify their structure. It would take a great deal of time to implement the project due to large number of structures begin modified. This alternative would have a low level chance of being implemented.	The necessary modifications of thousands of individual structures would be extremely controversial and would be politically difficult resulting in little support from the local communities. Community cohesion would be disrupted during the implementation of this alternative and there could be long term issues with frequent flooding what would limit access to many structures during flood events. This alternative would have a low level of acceptability	The risk of flooding infrastructure would remain and evacuation routes would continue to be flooded and businesses still impacted. During flood events the population could be required to be evacuated due to possible looting and property damage would be a concern the properties modified would be protected up the design event but there would be a residual risk of flood damage above that event. The alternative has a moderate level of risk reduction	Due to the high cost and number of structures, this alternative will no longer be considered as a stand alone alternative. However, it is recommended be this considered as a feature of another alternative
Previous Flood Storage Plan Plan1,2	Flood storage involves both preserving natural floodplain areas and also building dams and other water retention facilities to hold water during flood events. These facilities would be need to be located in the Pearl River watershed upstream of the Jackson Metro to provide any flood risk reduction	Provides flood risk management benefits. Does not provide environmental design features for habitat conservation.	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	Cost in 1986 for this project were approximately $8 million in annual cost with a B/C ratio of 1.05. Based on today's land values, construction cost, relocation cost, and mitigation cost, it is believed this project in today's dollars was exceed $500 million. This alternative would have a low level of cost acceptance	At the time of the study, the mitigation in kind within the project area resulted in minimal environmental impacts. However, it is not believed the same impacts could be mitigated on site today.	The Shoccoe Dam project stated in the 1986 report that it would contribute to community health and safety. Large amounts of land would be necessary to implement a flood storage similar to Shoccoe. Although most flood storage projects would provide benefits in the local area, it was perceived that the benefits of this project was mainly for the Jackson Metropolitan area, while the rural areas were providing the necessary land for the project. This alternative had positive social impacts for the City of Jackson and negative social impacts for citizens upstream of the proposed dry dam in counties outside of Rankin and Hinds County. In the case of Shoccoe, lack of benefits for the upstream communities was a reason for low level of acceptability	As stated, the proposed Shoccoee Dam project was controversial and did not garner support from upstream citizens nor the State Legislature and was never funded. It is not believed that the citizens' concerns have changed, nor will change in regards to any dry storage upstream of the Ross Barnett. In addition, the now local *Sponsor of Rankin-Hinds does not have the authority to fund a project outside of the two counties*. Low level of impleminability	This project was only accepted to the local interest in Jackson. The plan was opposed by interest in Leake County and other communities upstream where most of the real estate for the project would have been acquired with no benefits. In addition, in that area, approximately 64 families would have to been relocated, Mississippi Highway 43 bridge would have to be raised, relocation of 8 miles of the Natchez Trace Parkway, would have to be relocated This alternative has a low level of acceptability	Risk would be reduced allowing for protection within the Jackson metropolitan area. However, added risk to areas upstream of the proposed dam would be increased due to inundation of areas not typically inundated. This alternative has a low risk for the Jackson Metropolitan area and moderately high risk level for areas upstream of the dam site	With even less support than during the original authorization, It is not believed to be anymore accepted or able to implement than in the past and still remains a controversial project. Therefore, this alternative will no longer be considered.

Resource Category	Alternative Description	Effectiveness	Completeness	Acceptability	Efficiency	Environmental Effects	Social Effects	Implementability	Community Support	Risk	Recommendation
Clearing Plan Plan4	This alternative clears debris and vegetation in both the channel and overbanks to increase flow potential from the Water Treatment Plant at River Mile 282.7 through Ross Barnett Reservoir. This alternative similar to the clearing plan from the 1986 COE report (Shoccoe Alternatives)	Provides minimal flood risk management benefits - not effective as stand-alone alternative. Does not provide environmental design features for habitat conservation.	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	Cost of this alternative would be much less than most other structural alternatives, however, due to its lack of effectiveness, and the flood reduction benefits are so low, that any cost for this as a stand-alone alternative would not be cost beneficial	This alternative would have negative impacts	Due to lack of effectiveness, during flood events, evacuation would be required causing large disruptions to transportation and business for weeks. Regional growth would continue to be negatively affected. This alternative would have a high negative social impact	Due to the lack of effectiveness of this alternative, this alternative would have a very low level of being implemented.	Due to the lack of effectiveness of this alternative, this alternative would have a very low level of acceptability	The community would continue to be at risk of flooding. The effectiveness of the emergency measures is not reliable during extreme events and many areas will be prone to flooding due to lack of flood protection. Roads, freeways, and infrastructure will continue to be implemented	Due to the relatively minor decreases expected for flood control , this alternative as a stand alone alternative will not be considered for additional study.
KCS and CN Railroad Improvements Plan5	This alternative appends on the KCS railroad improvements by also raising the low chord and decreasing pier numbers utilizing longer spans at the existing CN Bridge River Mile 286.5.	Provides minimal flood risk management benefits - not effective as stand-alone alternative. Does not provide environmental design features for habitat conservation.	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	Non determined due to lack of effectiveness,	Non determined due to lack of effectiveness,	Non determined due to lack of effectiveness,	Non determined due to lack of effectiveness,	Non determined due to lack of effectiveness,	The community would continue to be at risk of flooding	Due to the minor decreases expected for flood control, this alternative will not be considered for additional study.
Subsequent Channel Plan6,7	This alternative dredges a secondary channel within the Pearl River overbanks to help convey flow as a relief channel. The dredging range is from RM 284.3 through Ross Barnett Reservoir.	Does not provide adequate flood risk management benefits. Does not provide environemtal habitat conservation features.	This alternative does not realize all four of the planning objectives.	This plan is acceptable.	Cost of this alternative would be much less than most other structural alternatives, however, due to its lack of effectiveness, and the flood reduction benefits are so low, that any cost for this as a stand-alone alternative would not be cost benefic	This alternative would have negative impacts	During flood events, evacuation would be required causing large disruptions to transportation and business for weeks. Regional growth would continue to be negatively affected. This alternative would have a high negative social impact	Due to the lack of effectiveness of this alternative, this alternative would have a very low level of implemented	Due to the lack of effectiveness of this alternative, this alternative would have a very low level of being imp limited	The community would continue to be at risk of flooding. The effectiveness of the emergency measures is not reliable during extreme events and many areas will be prone to flooding due to lack of flood protection. Roads, freeways, and infrastructure will continue to be implemented	Due to the relatively minor decreases expected for flood control , this alternative will not be considered for additional study as a stand alone alternative.
Modified Levee Plan9,13	This alternative implements the Initial Levee Plan Alternative outlined in the USACE 2007 Feasibility Study Main Report. The one modification is constructing the east proposed levee upstream of Lakeland Drive outside of the existing MDOT Wetland Bank.	This plan increases the water surface elevations between the levees. The plan does provide flood risk management benefits but only for the areas within the levee reaches. However, if implemented as previously proposed, the comprehensive Levee Plan will induce interior flooding, reducing ability to provide flood risk management benefits and reduce the risk to transportation and infrastructure. Pumps must be added.	This alternative does not realize all four of the planning objectives.	This plan is not acceptable without pumps due to induced interior flooding. With pumps, this plan is acceptable.	The cost of the levee alternative in the 2007 Draft report was presented as 234 million. However, new levee guidance developed in the recent years will drive this cost up significantly from past studies. In addition, levee modifications to minimize impacts to the proposed Mississippi Department of Transportation mitigation area will lengthen levee segments as well as addition floodwall in areas developed since the 2007 draft report. In addition pumps were not proposed in the 2007 draft report. If pumps are added to new levee alignments, cost will surpass $500 Million. Pumps would typically make the alternative more effective, however this will drive the cost up considerably	This alternative would have modernly high environmental impacts	Although the levees will provide additional protection, this could have a positive social effects. However, in some areas where interior drainage may cause some relocation, or reduced level of protection, social effects could be negative due to impacts of these areas behind levees. In addition, land would have to be acquired from numerous landowners.	As stated, levee plans have failed to gain funding and acceptability over the past 15 to 20 years. Plans have failed to gain local sponsor support as well as funding required for the local share match. It is not believed that the community or political leadership has changed enough to implement a stand-alone levee alternative. However, implementing some form of levees in areas may be possible if other alternatives are not feasible. A stand-alone levee alternative has a moderately low level of implemented.	Expanding the existing levee protection has be studied and reviewed prior to this study. There have been two levee plans that have failed to obtain funding. Although, expansion of the flood protection is needed and wanted by the community, levees have not gained the support needed to insure funding from the local community	Risk would be reduced from flooding where levees would provide protection of unprotected areas. However, some risk would still be applicable for extreme events due to risk of levee overtopping. In addition, risk will still be applicable where roads would still be inundated and within interior areas where flood risk still would exist. Risk levels for this alternative would be moderately low	Although an increase in water surface elevation is expected, protection from the existing and proposed levees make this alternative a viable option for additional study. It should be noted that existing structures not protected from proposed levees might be inundated due to the increase in predicted base flood therefore other features or alternatives should be studied as additional alternatives (Conveyance or additional levees)
Modified Levee Version 2 Plan9,13	This alternative mirrors the Modified Levee Alternative except the east proposed levee upstream of Lakeland Drive wraps back to high ground at Lake Drive at RM 295.84 instead of continuing northward along the proposed alignment.	This plan increases the water surface elevations between the levees. The plan does provide flood risk management benefits but only for the areas within the levee reaches. However, if implemented as previously proposed, the comprehensive Levee Plan will induce interior flooding, reducing ability to provide flood risk management benefits and reduce the risk to transportation and infrastructure. Pumps must be added.	This alternative does not realize all four of the planning objectives.	This plan is not acceptable without pumps due to induced interior flooding. With pumps, this plan is acceptable.	The cost of the levee alternative in the 2007 Draft report was presented as 234 million. However, new levee guidance developed in the recent years will drive this cost up significantly from past studies. In addition, levee modifications to minimize impacts to the proposed Mississippi Department of Transportation mitigation area will lengthen levee segments as well as addition floodwall in areas developed since the 2007 draft report. If pumps are added to new levee alignments, cost will surpass $500 Million. Pumps would typically make the alternative more effective, however this will drive the cost up considerably	This alternative would have modernly high environmental impacts	Although the levees will provide additional protection, this could have a positive social effects. However, in some areas where interior drainage may cause some relocation, or reduced level of protection, social effects could be negative due to impacts of these areas behind levees. In addition, land would have to be acquired from numerous landowners.	As stated, levee plans have failed to gain funding and acceptability over the past 15 to 20 years. Plans have failed to gain local sponsor support as well as funding required for the local share match. It is not believed that the community or political leadership has changed enough to implement a stand-alone levee alternative. However, implementing some form of levees in areas could possibly be implemented. A stand-alone levee alternative has a moderately low level of being implemented.	Expanding the existing levee protection has be studied and reviewed prior to this study. There have been two levee plans that have failed to obtain funding. Although, expansion of the flood protection is needed and wanted by the community, levees have not gained the support needed to insure funding from the local community	Risk would be reduced from flooding where levees would provide protection of unprotected areas. However, some risk would still be applicable for extreme events due to risk of levee overtopping. In addition, risk will still be applicable where roads would still be inundated and within interior areas where flood risk still would exist. Risk levels for this alternative would be moderately low	Although lands behind the levee would be protected from the flood events, too many existing structures upstream of Lakeland would not be protected from the 0.73' increase in predicted WSE. Therefore, a levee alternative should be considered for additional study.

Resource Category	Alternative Description	Effectiveness	Completeness	Acceptability	Efficiency	Environmental Effects	Social Effects	Implementability	Community Support	Risk	Recommendation
Channel Improvements / Weir Version 1 Plan14	This alternative implements a 1500' overflow weir at RM 284.30 and dredges the Pearl River overbanks to create additional storage from RM 284.30 to RM 293.26 (approx. 0.52 mile upstream of Lakeland Drive).	This plan increases the water surface elevations between the levees. The plan does provide flood risk management benefits but only for the areas within the levee reaches. However, if implemented as previously proposed, the comprehensive Levee Plan will induce interior flooding, reducing ability to provide flood risk management benefits and reduce the risk to transportation and infrastructure. Pumps must be added.	This alternative realized all four planning objectives.	This plan is acceptable.	A smaller footprint from the original plan presented in 2007 report would reduce cost significantly The cost of this alternative is believed to be less than $500 million and have a modestly high level of cost acceptance	This alternative would have modernly high environmental impacts	The reduced flood risk would lead to continued regional growth, public safety would improve as the risk of catastrophic flooding would be largely minimized, employment would continue to grow with the region and business would not need to provide support for emergency measures, recreational features would be included along project that would benefit public. Local transportation would not be impacted during flood events and Hospitals in Rankin County would not have to be evacuated. During flood events local transportation and evacuation routes would remain open and accessible to the public., No residence relocation would be required. This alternative would have high positive social effects	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented. The legislative has not supported other alternatives in the past due to lack of community and political support. However, this alternative is supported unanimous not only through the Local sponsor, but the supporting community which it would benefit. In addition, due to the potential regional and national location benefits, this alternative provides a means to support the funding needed	The local community has supported this alternative or similar alternatives in the past due to the positive social effects along with the regional growth opportunities and the recreation benefits for improved access to the Pearl River and its natural resources. This alternative would have a high level of acceptability within the project area	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented	Due to the decreases expected for Flood Control and high acceptability, this alternative will be considered for additional study.
Channel Improvements / Weir Version 2	This alternative implements the original Channel Improvements / Weir Alternative except dredging ends at RM 292 (approx. 1 mile downstream of Lakeland Drive).	The provides flood risk managmeent benefits from Highway 80 to Lakeland Drive, effectively reducing flood risk in the Jackson metropolitan area, reducing loss of transportation routes, reducing the flood risk of critical infrastructure, while integrating environmental design features.	This alternative realized all four planning objectives.	This plan is acceptable.	A smaller footprint from the original plan presented in 2007 report would reduce cost significantly The cost of this alternative is believed to be less than $500 million and have a moderately high level of cost acceptance	This alternative would have modernly high environmental impacts	The reduced flood risk would lead to continued regional growth, public safety would improve as the risk of catastrophic flooding would be largely minimized, employment would continue to grow with the region and business would not need to provide support for emergency measures, recreational features would be included along project that would benefit public. Local transportation would not be impacted during flood events and Hospitals in Rankin County would not have to be evacuated. During flood events local transportation and evacuation routes would remain open and accessible to the public., No residence relocation would be required. This alternative would have high positive social effects	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented. The legislative has not supported other alternatives in the past due to lack of community and political support. However, this alternative is supported unanimous not only through the Local sponsor, but the supporting community which it would benefit. In addition, due to the potential regional and national location benefits, this alternative provides a means to support the funding needed	The local community has supported this alternative or similar alternatives in the past due to the positive social effects along with the regional growth opportunities and the recreation benefits for improved access to the Pearl River and its natural resources. This alternative would have a high level of acceptability within the project area	Flood Risk would be reduced significantly for the project area. Additional risk reduction would be obtained due to reduction of levee failure possibilities	Although this alternative decreases flood elevation, It does not have significant impacts upstream of Lakeland Drive. This alternative will not be considered for additional study.
Channel Improvements / Weir Version 3	This alternative implements the original Channel Improvements / Weir Alternative except dredging ends at RM 291 (approx. 2 miles downstream of Lakeland Drive at the low head dam weir). This alternative would protect Mayes Lake from construction activities.	The provides flood risk managmeent benefits from Highway 80 to Lakeland Drive, effectively reducing flood risk in the Jackson metropolitan area, reducing loss of transportation routes, reducing the flood risk of critical infrastructure, while integrating environmental design features.	This alternative realized all four planning objectives.	This plan is acceptable.	A smaller footprint from the original plan presented in 2007 report would reduce cost significantly The cost of this alternative is believed to be less than $500 million and have a moderately high level of cost acceptance	This alternative would have modernly high environmental impacts	The reduced flood risk would lead to continued regional growth, public safety would improve as the risk of catastrophic flooding would be largely minimized, employment would continue to grow with the region and business would not need to provide support for emergency measures, recreational features would be included along project that would benefit public. Local transportation would not be impacted during flood events and Hospitals in Rankin County would not have to be evacuated. During flood events local transportation and evacuation routes would remain open and accessible to the public., No residence relocation would be required. This alternative would have high positive social effects	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented. The legislative has not supported other alternatives in the past due to lack of community and political support. However, this alternative is supported unanimous not only through the Local sponsor, but the supporting community which it would benefit. In addition, due to the potential regional and national location benefits, this alternative provides a means to support the funding needed	The local community has supported this alternative or similar alternatives in the past due to the positive social effects along with the regional growth opportunities and the recreation benefits for improved access to the Pearl River and its natural resources. This alternative would have a moderately high level of acceptability within the project area	Flood Risk would be reduced significantly for the project area. Additional risk reduction would be obtained due to reduction of levee failure possibilities	Although this alternative decreases flood elevation, It does not have significant impacts upstream of Lakeland Drive. This alternative will not be considered for additional study.
Channel Improvements / Weir Version 4 Plan16	This alternative implements the original Channel Improvements / Weir Alternative except dredging ends at RM 295		This alternative realized all four planning objectives.	This plan is acceptable.	A smaller footprint from the original plan presented in 2007 report would reduce cost significantly The cost of this alternative is believed to be less than $500 million and have a moderately high level of cost acceptance	This alternative would have modernly high environmental impacts	The reduced flood risk would lead to continued regional growth, public safety would improve as the risk of catastrophic flooding would be largely minimized, employment would continue to grow with the region and business would not need to provide support for emergency measures, recreational features would be included along project that would benefit public. Local transportation would not be impacted during flood events and Hospitals in Rankin County would not have to be evacuated. During flood events local transportation and evacuation routes would remain open and accessible to the public., No residence relocation would be required. This alternative would have high positive social effects	Because this alternative has a high rate of flood reduction along with a high level of acceptability it seems to have the community support thus gives a much stronger case to be implemented. The legislative has not supported other alternatives in the past due to lack of community and political support. However, this alternative is supported unanimous not only through the Local sponsor, but the supporting community which it would benefit. In addition, due to the potential regional and national location benefits, this alternative provides a means to support the funding needed	The local community has supported this alternative or similar alternatives in the past due to the positive social effects along with the regional growth opportunities and the recreation benefits for improved access to the Pearl River and its natural resources. This alternative would have a high level of acceptability within the project area	Flood Risk would be reduced significantly for the project area. Additional risk reduction would be obtained due to reduction of levee failure possibilities	Although this alternative decreases flood elevation more than the any other channel improvement alternative, it does not avoid the MDOT mitigation area and is believed to impact that constraint too much and will no longer be considered as an alternative.

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Attachment 2. *Pearl River Basin Interim Report on Flood Control and Environmental Impact Statement* (1985) Alternative Plans Section

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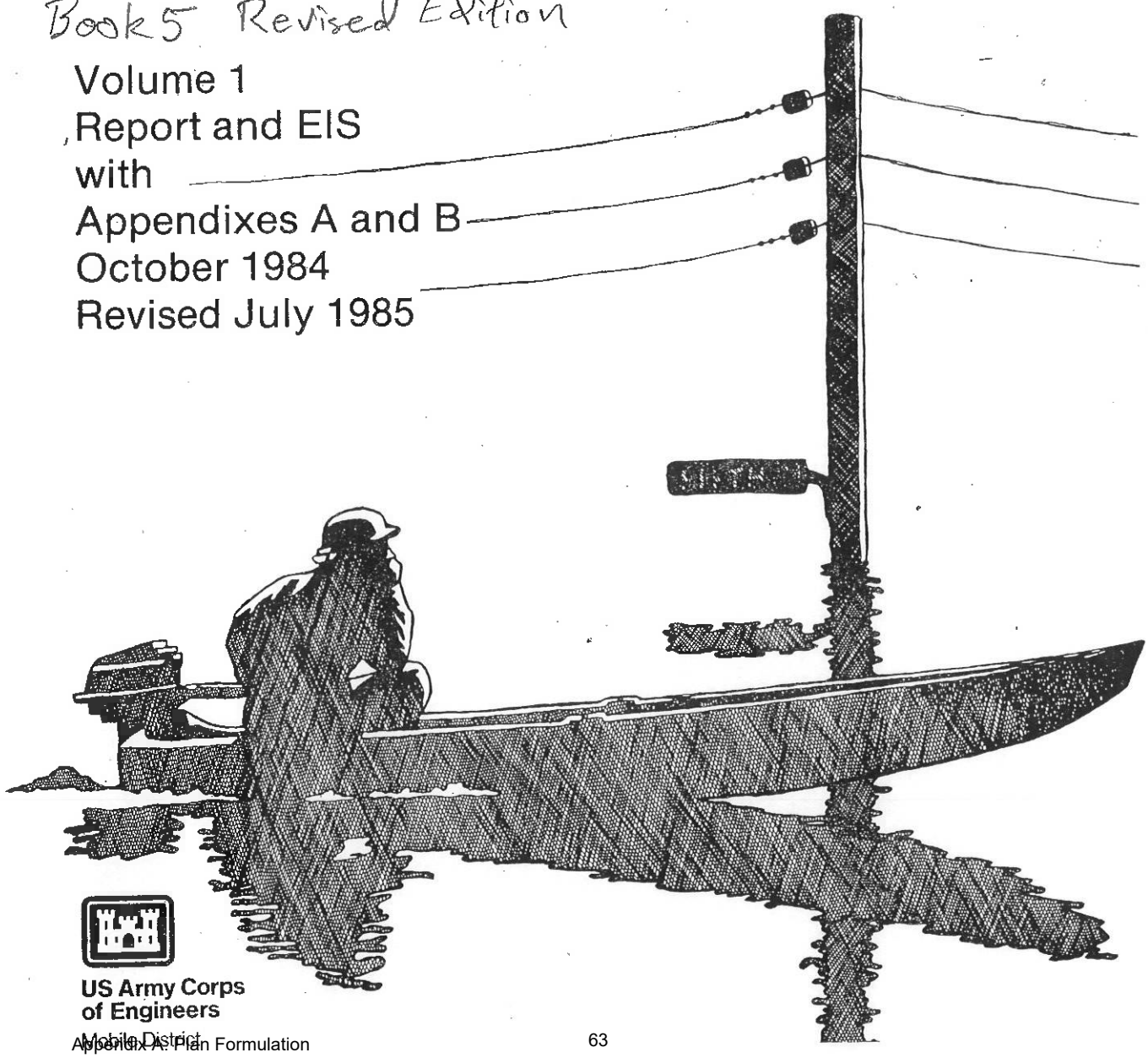
COESAM/PD-A-84/002

PEARL RIVER BASIN INTERIM REPORT ON FLOOD CONTROL AND ENVIRONMENTAL IMPACT STATEMENT

Book 5 Revised Edition

Volume 1
Report and EIS
with
Appendixes A and B
October 1984
Revised July 1985



US Army Corps
of Engineers
Mobile District

presented in this report. The cost of these alternatives far exceeded the potential benefits developed by the Mobile District. Harza Engineering Company completed a Shoccoe Dam appraisal report in June 1983. That study consisted of a thorough evaluation of the preliminary design of the Shoccoe project plan developed by the Mobile District. A few of the suggestions from that report were incorporated in the final Shoccoe design; however, the overall conclusions in that report did not have a significant impact on the basic design concept. Harza also prepared a report in 1982 on the possibility of upgrading the Barnett project for flood control. That study is consistent with the Corps' findings documented in the "Alternative Plans" section of this report. Noblin Research Company completed a land ownership study of properties in the Shoccoe pool in May 1983. That study identified the property owners, provided a legal description, and listed the assessed value of every parcel of land in 58,000 acres (the maximum pool area being considered in preliminary formulation studies). That report also assimilated this data by county, elevation, and category of ownership, i.e., public, private, roads, streams and lakes, etc. This information was extremely useful in developing easement and fee values for real estate and in identifying impacted landowners during the public involvement program.

103. Summary of the Scope of Investigations. This report marks the cumulation of an extensive evaluation by an interdisciplinary team. The 5 years of investigations cost approximately $4,500,000 and involved about 82 man-years of effort by Mobile District Office personnel alone. The major disciplines and the amount of effort expended are as follows: Registered Professional Engineers (primarily Civil, Hydrologic, Structural, and Mechanical), 20 man-years; environmentalists (primarily biologists, environmental engineers, and archeologists), 6 man-years; economists (primarily economists and social scientists), 6 man-years; Real Estate Specialists (primarily appraisers and foresters), 2 man-years; supporting staff (primarily engineering technicians, draftsmen, graphic artists, clerk typists, surveyors, and other technicians), 44 man-years. These man-years of effort represent a large number of individuals. For example, the 20 man-years of engineering effort represents the input of about 50 different engineers.

ALTERNATIVE PLANS

GENERAL

104. Variations in Alternative Plan Economics. As in any comprehensive water resources study, the cost, benefits, and resulting benefit-to-cost ratios for the various alternatives are modified and refined during the course of the study effort. This normally leads to the early formulation cost and benefit estimates for an alternative being different (sometimes significantly) from the late stage formulation estimates. This was especially true on this study primarily because of legislative actions midway in the formulation process--namely the passage of the Fiscal Year 1983 Supplemental Appropriations Bill and the Fiscal Year 1984 Appropriations Bill. These laws authorized and appropriated monies for construction of the "Four Point Plan." This Congressional action was based on a preliminary plan which had not been formulated under administrative guidance. This put the District in the posture of not knowing what the future existing conditions would be while the various alternatives for this comprehensive plan were being evaluated. To complicate matters, the Committee report on the supplemental bill contained wording which directed the Corps of Engineers to add all the costs and all the benefits for both the "Four Point Plan" and the comprehensive plan in calculating the benefit-to-cost ratio for the comprehensive plan. This is contrary to the administrative guidance requirement to evaluate alternatives on a last added basis. Attempting to formulate a plan under these circumstances presented numerous problems. To resolve this matter, the early and mid-formulation studies of alternatives were evaluated on a first added basis. The screening of alternatives was done in such a manner that all potentially viable alternatives were not eliminated. In some cases, this allowed some economically unfavorable alternatives to be carried forward to the final array of plans. This procedure also caused the benefit-to-cost ratios for most of the alternatives to be substantially different in the initial and final formulation studies--especially since a test case on mitigation requirements and an experienced bid on construction work was available for late stage formulation studies. The balance of the section on "Alternative Plans" itemizes the economics of the alternatives developed in the

early and mid-formulation stages. The final economics of the plans carried forward into the final array are shown in brackets with an asterisk referring to this paragraph and Table 32.

NO ACTION

105. This alternative is not desirable because of the extensive flooding experience in the past is expected to continue in the future. This would result in continued flood damage, trauma, and serious disruptions to human endeavors in the Capitol city of Jackson and associated impacts to the entire State of Mississippi.

LEVEES

106. Raising the Existing Levees. During early formulation studies, the revised stage-frequency relationships at the Jackson gage showed that the stage for the 100-year flood was higher than the stage used to design the existing levees. However, construction of the "Four Point Plan" restored the freeboard for the 100-year flood to about 2.5 feet instead of the planned 3 feet. The profiles of the Fairgrounds and East Jackson levees are shown on Plate 10. Consideration was first given to raising the levees to protect against the Standard Project Flood (SPF). This would require the addition of about 5 feet of height plus 3 feet of freeboard, on the average, and extension of the East Jackson Levee for a considerable distance upstream to tie into higher ground. When the costs of these features and other extensive modifications required were reviewed in the light of the benefits obtainable, it was apparent that protection to the SPF level would not be economically feasible. Raising the levees to protect against floods up to the magnitude of the April 1979 flood with 3 feet of freeboard was found to be more practical since the levees would have to be raised only 3 to 4 feet. This work could be accomplished for $986,000 and would have large benefits from rare floods. This work appears attractive since the benefits for this work would be about $1,120,000 per year based on 1981 conditions. However, this work would induce flooding outside the levee system during major floods because of the loss in hydraulic conveyance.

This would necessitate channel enlargement on the main stem of the Pearl River in order to mitigate for the induced damages. This would be a major undertaking because of the restricted floodway between the levees and the meanders in the river downstream of the levees. Early formulation estimates indicated that this work would cost at least 20 to 25 million dollars. Therefore, this alternative was estimated to have a maximum benefit-to-cost ratio of 0.6. The overbank clearing work accomplished between 1981 and 1983 would further reduce this benefit-to-cost ratio to less than 0.5 on a last added basis. This alternative was therefore eliminated from consideration.

107. Additional Levees. A series of nine different levee systems along with associated interior drainage facilities and main stem channelization necessary to mitigate the increase of river flood stages outside the levee system was evaluated during early formulation studies. The same basic design concepts used in the construction of the East Jackson and Fairgrounds levees were used to develop the early formulation estimates for each of the nine levee systems. The level of protection selected for these levees was a 200-year flood (April, 1979 flood level) plus three feet of freeboard. The levee embankments would have a 10-foot top width and side slopes of 3.0 feet horizontal (H) on 1-foot vertical (V). The side slopes of the levees would be well vegetated to prevent erosion. For the levee systems requiring channelization, the typical channel section would have an average bottom width of 150 feet with 2-foot H on 1-foot V side slopes. About 2/3 of the excavated material from this channelization would be used in the levee construction. Floodway clearing would consist of a 325-foot strip on both sides of the centerline of the new channel. The interior drainage facilities would consist of gated gravity flow structures, pumping capacity and facilities sized on a proportionate basis with the existing East Jackson facilities, and varied bottom width interior drainage channels with 2.0 H on 1.0 V foot side slopes. A parking lot and electrical substation site would be constructed adjacent to each of the pumping stations. The locations of these levee systems are shown on Plates 11 and 15. Each of the individual levee systems is described below.

a. North Jackson Levee. The North Jackson levee would extend from the Jackson Country Club area near County Line Road, cross the Pearl River near river mile 300, and then extend southward along the east bank of the Pearl River, until it recrosses the Pearl River near river mile 295 to tie into high ground south of Hanging Moss Creek. The levee would be about five miles in length and have an average height of about 17 feet. The levee would be situated primarily on the east bank of the river to provide an adequate interior drainage ponding area. This is similar to the design concept used on the existing East Jackson levee. Ponding area easements would have to be purchased on an estimated 2,140 acres of land. Interior drainage facilities would consist of two 8 by 10-foot gated box culverts and a pumping station having a capacity of 383,300 gallons per minute (GPM). These facilities were sized to remove the interior drainage waters for a 100-year flood. The channelization required for this levee alignment would consist of excavating a 25,900-foot-long cutoff channel between river miles 301.3 (just south of Ross Barnett) and 293.4 (about 1 mile north of Lakeland Drive).

b. Prairie Branch Levee. The Prairie Branch levee would originate on high ground near Thompson Field and extend southwesterly for 4.2 miles crossing Highway 475, Fannin Road, Lakeland Drive (twice), and Prairie Branch to tie into the existing East Jackson levee. The average height of the levee would be 13.5 feet. This alignment would require seven sandbag or stoplog closures across the existing roads and a railroad crossing. Interior drainage facilities would consist of two 8 by 6-foot gated box culverts, a pumping station with a capacity of 433,100 GPM, and about 10,000 feet of interior drainage channels. These extensive interior drainage facilities would be necessary with this plan because of the limited ponding area of only 275 acres. The channelization of the Pearl River necessary to offset the loss in valley storage would consist of a cutoff channel 2,940 feet in length between Lakeland Drive and the ICG railroad crossing.

c. Eubanks Creek Levee. The Eubanks Creek levee would have an average height of 18.7 feet. It would begin on high ground about one mile south of Hanging Moss Creek and extend southward for 3.1 miles to tie into high ground

in the Mayes Lake area just south of Lakeland Drive. This alignment would require one sandbag or stoplog closure at the Lakeland Drive crossing. Interior drainage facilities would consist of one 8 by 12-foot gated box culvert, a pumping station with a capacity of 73,625 GPM, and a 430-foot-long interior drainage channel with a 10-foot bottom width. The ponding area would be 296 acres. Channelization of the Pearl River required for this levee would be the same as the work included for the Prairie Branch levee.

d. Belhaven Creek Levee. The Belhaven Creek levee would originate near the waterworks plant just south of the ICG railroad and extend southerly for 0.7 mile to tie into the northern end of the existing Fairgrounds levee. The average height of the levee would be 18.5 feet. Interior drainage facilities would consist of one 4 by 4-foot gated box culvert, a 200-foot outlet channel, a pumping station with a total capacity of 37,000 GPM, and two interior drainage channels--one 750 feet long with a 10-foot bottom width and one 200-foot-long with a 40-foot bottom width. The ponding area would contain 63 acres. The nominal channel work required on the Pearl River to compensate for the loss in valley storage was not included in the cost estimate.

e. Town Creek Levee. The Town Creek levee would extend from high ground near the ICG Railroad bridge over the Pearl River, cross the Town Creek channel, and tie into high ground on the U.S. Highway 80 bridge abutment. The levee would be about 1.1 mile long and have an average height of 22 feet. This alignment would require three sandbag or stoplog closures at the ICG Railroad, South State Street, and South West Street. The interior drainage facilities would consist of two 8 by 6-foot box culverts with an 800-foot-long outlet channel and a pumping station with a total capacity of 1,600,000 GPM. This large pumping capacity was necessitated because of the large drainage area of Town Creek and the small ponding area of 114 acres. The channel enlargement required on the Pearl River would consist of a cutoff channel 3,160 feet in length with a bottom width of 190 feet between Interstate 55 and U.S. Highway 80.

f. South Jackson Levee. The South Jackson levee would originate at the U.S. Highway 80 bridge abutment and extend southerly, crossing the Pearl River, to tie into high ground at the Jackson Wastewater Treatment Plant levees. The levee would be about 2.5 miles long and have an average height of 19.3 feet. This alignment would require one stoplog closure at the ICG Railroad crossing. The levee was aligned partially on the east side of the Pearl River to provide a large ponding area to accommodate the drainage from Lynch, Three Mile, and Hardy Creeks. The interior drainage facilities would consist of two 8 by 10-foot gated box culverts, a pumping station with a total capacity of 80,000 GPM, and a 4,760-foot-long interior drainage canal having a 40-foot bottom width. The ponding area would be 793 acres. The required channel improvement work on the Pearl River would consist of a cutoff channel 18,460 feet in length from U.S. Highway 80 to Caney Creek.

g. Richland Levee. The Richland levee would be "U" shaped around the city of Richland. It would originate on high ground east of U.S. Highway 49, and extend northwesterly until it intersects the ICG Railroad, then westerly until it intersects Richland Creek, and then southerly until it ties into high ground near Howards Creek. The levee would be 6.0 miles long and have an average height of 9.7 feet. This alignment would necessitate sandbag or stoplog closures at U.S. Highway 49 and the ICG Railroad. Interior drainage facilities would consist of two 6 by 8-foot gated box culverts, a pumping station with a total capacity of 261,300 GPM and three interior drainage channels, the Richland Creek channel and two additional channels having total lengths of 13,920 feet with a 20-foot bottom width and 6,760 feet with a 10-foot bottom width. The ponding area would be 621 acres. The channel enlargement necessary to mitigate for the loss in valley storage would be the same as the channelization work accompanying the South Jackson levee.

h. Cany Creek Levee. The Cany Creek levee would also be "U" shaped around the development in South Jackson. The levee would originate at the southern limits of the Jackson Wastewater Treatment Plant levees and extend southeast crossing the Pearl River, Cany Creek, and Eldon Road until it ties into high ground near U.S. Highway 55 just south of Eldon Road. The levee would be 2.5

miles long and have an average height of 15.0 feet. There would be sandbag closures at Eldon Road and the ICG Railroad. Interior drainage facilities would consist of one 8 by 10-foot gated box culvert and a pumping station with a total capacity of 381,500 GPM. The ponding area would be 378 acres. No channel improvement works were considered with this alternative because of the relatively undeveloped broad flood plain and the minimal backwater effects in Jackson.

i. Byram Levee. The Byram levee would be a "U" shaped around the community of Byram. Both the upper and lower ends of the levee would tie into high ground midway between the ICG Railroad and U.S. Highway 59. The levee would be 1.6 miles long and have an average height of 7.1 feet. There would be three sandbag or stoplog closures required at Old and New Byram Roads and the ICG Railroad. Interior drainage facilities would consist of one 36-inch diameter gated culvert, a pumping plant with a total capacity of 37,700 GPM, and a 2,240 feet long interior drainage channel with a 10-foot bottom width. The ponding area would be 29 acres. It would not be necessary to enlarge the Pearl River to compensate for the loss in valley storage due to the relatively small encroachment.

108. A summary of the estimated lengths and costs of the nine levee systems is given in Table 11.

Table 11

Summary of Costs for Additional Levee Systems

Levee	Length of levee (miles)	Rechanneli-zation (miles)	First Cost	Operation & maintenance
North Jackson	4.7	4.9	$56,712,000	$330,000
Prairie Branch	4.2	4.9	26,008,000	323,000
Eubanks Creek	3.1	0.6	31,341,000	258,000
Belhaven Creek	0.7	0.0	8,858,000	172,000
Town Creek	1.1	0.6	46,034,000	290,000
South Jackson	2.5	3.5	47,324,000	224,000
Richland Creek	6.0	3.5	18,217,000	270,000
Cany Creek	2.5	0.0	16,564,000	277,000
Byram	1.6	0.0	7,801,000	158,000

109. Benefits for Additional Levees. The number of structures which would be protected by the individual levee systems are as follows: North Jackson, 1,150; Prairie Branch, 300; Eubanks Creek, 270; Belhaven Creek, 50; Town Creek, 250 which are mostly commercial and industrial; South Jackson, 300; Richland Creek, 420; Cany Creek, 180; Byram, 18. The average annual benefits, costs, and the resulting benefit-to-cost ratios are summarized in Table 12.

Table 12

Evaluation of Levee Systems

Levee	Total Annual Cost[1/]	Benefits	B/C
North Jackson	$5,798,000	$2,104,000	0.36
Prairie Branch	2,831,000	610,000	0.22
Eubanks Creek	3,280,000	816,000	0.25
Belhaven Creek	1,026,000	20,000	0.02
Town Creek	4,729,000	2,375,000	0.50
South Jackson	4,787,000	1,202,000	0.25
Richland Creek	2,026,000	93,000	0.05
Cany Creek	1,874,000	93,000	0.05
Byram	910,000	2/	

1/ Based on 3-year construction time.
2/ Protects 18 structures; no benefits were computed.

110. The early stage formulation studies indicated that there were only two of the levee systems which could conceivably be modified to produce an economically viable project--the Town Creek levee with a BCR of 0.50 and the North Jackson levee with a BCR of 0.36. A series of Town Creek levee plans was thoroughly analyzed in a 1970 survey report prepared by the District. An evaluation of that information indicated that further studies for levee protection along Town Creek were not warranted. This left only the North Jackson levee to be analyzed further.

111. North Jackson Guide Levee. A guide levee extending from County Line Road to Lakeland Drive on the west side of the Pearl River was considered as a possible alternative to the North Jackson Levee (see Plate 16). This levee would not be tied into high ground on the lower end; therefore, river backwater would extend up and into the area behind the levee. However, this plan would significantly reduce the overall cost for a levee plan and provide limited stage reductions in the northern portion of the area behind the levee which is a high damage area. The stage reductions for the 100-year flood would range from zero at the lower end of the levee to about two feet in the northern section. The resulting average annual benefits would be about $650,000. The first cost of this work is estimated to be $11,300,000. Adding operation and maintenance cost, the plan would have an average annual cost of $980,000. This would yield a benefit-to-cost ratio for the plan of 0.66.

112. East Jackson Parkway Levee Plan. In early 1985, Michael Baker and Associates developed a preliminary plan for a proposed parkway/levee in northeast Jackson at the request of the city of Jackson. This parkway/levee is very similar to the guide levee discussed in the previous paragraph with the exception, of course, that the city's proposal contains a roadway on top of the levee. The parkway levee would originate at County Line Road and extend southward on the west side of the river connecting at Lakeland Drive. The lower end of the parkway would not be connected to higher ground and, in effect, would be a guide levee. This plan also included an interior drainage channel to carry the runoff from Hanging Moss and Purple Creeks back to the main stem of the Pearl River at Lakeland Drive. The plan also calls for enlarging the opening at Lakeland Drive to compensate for the loss in flood plain conveyance caused by construction of the parkway levee. At the specific request of the city of Jackson, the Mobile District evaluated this plan in April of 1985. The conclusions were that the parkway levee would reduce stages of the 100-year flood event from 0.3 feet immediately upstream of Lakeland Drive to 2.1 feet at Hanging Moss Creek. The remedial work at Lakeland Drive would essentially reduce the stages outside the levee system to pre-project conditions. The average annual benefits from flood damage reduction for this work was estimated at $500,000. This is somewhat lower than the guide levee's benefits discussed

in the previous paragraph because of the differences in the level of protection provided--200-year flood compared to 100-year flood. The consultant estimated the cost of the parkway to be from 10 to 15 million dollars, according to the width of the roadway. It is possible that the Corps of Engineers could participate in the construction of the parkway levee if there were enough transportation benefits to make the project economically justified. This possibility has been shelved for the time being, pending future developments.

113. Other Variations of Northeast Jackson Levee. In March 1985 the Board of Engineers for Rivers and Harbors (BERH) forwarded their preliminary assessment of plan evaluation to the District. In that document it was requested that the District evaluate a single levee system and a two-levee system on the west side of the Pearl River to complement one of the more effective clearing plans, 1-G (see paragraphs 134 through 136 and Plate 21). The alignments of these levee plans are shown on Plate 17.

114. Single Levee System. The single levee system suggested would provide flood protection for the high damage area in Northeast Jackson. To determine the economic feasibility of that levee, the following preliminary design, cost estimates, and benefits were developed. The cost and benefits for the plan are outlined in Tables 13 and 14.

Pertinent Data

- o Length - 22,000 feet
- o Average Height - 20 feet
- o Level of Protection - 100-year flood level & 3 feet of freeboard
- o Side slopes - 1 on 3 (same as existing levees)
- o Crown width - 10 feet
- o Drainage outlet structure - 2 8 by 10-foot gated box culverts (designed to pass 100-year flow)
- *o Pumping station capacity - 600,000 gpm
- o Ponding area capacity - 12,600 acre-feet

*The pumping station capacity is based on a design for a similar levee system plan developed for Town Creek in studies made in 1970. Plan No. 2 in that report closely approximates this plan in that there is similar terrain and land cover, has a ponding area capacity of 13,460 acre-feet, has a drainage area of 35.7 square miles, and is 22,830 feet long.

Table 13

Cost Estimate for the Modified Northeast Jackson Levees

Item	Quantity	Unit	Unit Cost	Total Cost
Real estate (levee)	100	ac	$ 5,000	$ 500,000
Clearing	100	ac	1,200	120,000
Compacted fill	1,144	cy	4	4,576,000
Building acquisition	Lump Sum		1,700,000	1,700,000
Utility relocations	Lump Sum		500,000	500,000
Road relocations	5	ea	10,000	50,000
Drainage outlet structures	2	ea	1,500,000	3,000,000
Seeding	100	ac	600	60,000
Real estate easements (ponding area)	1,260	ac	1,250	1,575,000
Pumping station	Lump Sum			4,941,000
			Subtotal	$17,022,000
Contingencies 20%				3,404,000
E&D and S&A 15%				2,553,000
			Total Cost	$22,979,000
Average Annual Cost $22,979,000 (.085279) =				$ 1,960,000

Table 14

Economics for the Modified Northeast Jackson Levees

	Flood Control	Trauma	Total
Existing Damages with Clearing Plan 1-G in place			
Upper NE Jackson	$1,534,000	$194,000	$1,728,000
Lower NE Jackson	289,000	22,000	311,000
Total	$1,823,000	$216,000	$2,039,000
Residual Damages with levee added to Clearing Plan 1-G			
Upper NE Jackson	$ 835,000	$ 64,000	$ 901,000
Lower NE Jackson	225,000	8,000	233,000
Total	$1,060,000	$ 72,000	$1,134,000
Benefits for addition of levee to Clearing Plan 1-G			
Upper NE Jackson	$ 699,000	$130,000	$ 827,000
Lower NE Jackson	64,000	14,000	78,000
Total	$ 763,000	$144,000	$ 905,000

Benefit-to-Cost Ratio

$$\frac{\$\ 905{,}000}{\$1{,}960{,}000} = 0.5$$

115. It should be mentioned that the modified Northeast Jackson levee discussed in the two previous paragraphs would have a benefit-to-cost ratio which would approach unity on a first added basis. On a first added basis the modified levee plan would pick up benefits that would have been credited to Clearing Plan 1-G in Northeast Jackson. The increase in benefits would be in the order of $800,000 annually. Thus, the resulting benefit-to-cost ratio would be 0.9. This alternative was not carried into the final array of alternatives, because the benefit estimate contained in this paragraph reflects the adjusted and updated final estimates used to evaluate the final array of alternatives.

116. Two-Levee System. The location of the two-levee system is shown on Plate 17. As illustrated in Table 14, the average annual benefits for protecting the lower Northeast Jackson area is only $78,000. For this reason, any levee system designed to provide flood protection for this area alone would be far from being economically justified.

117. A levee system protecting the upper portion of the northeast Jackson area would have a high benefit potential and appears to be a very attractive alternative on the basis of the only mapping which was available to the BERH review team. Unfortunately, the terrain on the southern end of such a levee does not lend itself to tying into high ground. As pointed out by BERH, the levee would have to extend westward along Hanging Moss Creek for about two miles to tie into elevation 286 feet NGVD. This would require extensive real estate cost since the levee would be on the fringe of dense urbanization. More importantly, from a cost point of view, such a levee or flood wall would cross White Oak Creek very near its mouth. This creek has a drainage area of 8.35 square miles, with an exceptionally fast runoff due to the dense urbanization. There would be about 20 acres available for a pumping station and primary ponding area with literally no secondary ponding area. This would require a pumping station with a total capacity of 1,500,000 to 2,000,000 gpm. The annual cost of the pumping plant alone ($2,000,000 to $2,500,000) would exceed the average annual benefits of $827,000 for the plan.

118. Summary of Findings for Various Levee Plans. All of the levee plans investigated for this report were found to lack economic justification, with the exception of the modified Northeast Jackson levee plan. On the basis of the final economics, that plan would have a benefit-to-cost ratio of 0.9. The modified plan would also have implementation difficulties because of the very localized flood protection provided. For these reasons, none of the levee plans investigated were carried into final plan formulation array.

CHANNEL MODIFICATIONS

119. Comprehensive Channel Modification Plan. In the very early stage of plan formulation, a comprehensive channel enlargement plan was evaluated primarily to respond to questions from local interests. That plan was sized to provide protection from the record flood of April 1979, a 200-year flood event. This conceptual channel would have channel widths ranging 400 to 1,500 feet with 1 on 2 side slopes. The channel would extend from Ross Barnett Reservoir southward to the Mississippi-Louisiana state line. The preliminary cost for this work was conservatively estimated at $1,816,000,000. A 31-mile-long channel through the Jackson floodway alone providing a 200-year degree of flood protection was conservatively estimated to cost $640,000,000.

120. The constriction between the levees and the enormous amount of water which accompanies major floods makes effective channel enlargement work a momentous undertaking. For example, the channelization done on the Pearl River to accommodate the existing levees has a bottom width of 190 feet with 1 on 2 side slopes. To reduce the April 1979 flood level by a foot or so would require extending that section for 6.1 miles at a depth of 20 feet (same as channel work accompanying levee plans shown on Plates 11 and 13). That would require about 6,000,000 cubic yards of excavation. A study done by Michael Baker, Jr., Incorporated, in 1981 indicated that a 71 million dollar channel would have to be constructed in the Jackson floodway to reduce the flood stages of the 1979 flood by an average of two feet. These initial stage studies clearly indicated that any comprehensive channel enlargement alternative would

be far from economically feasible. Therefore, such plans were eliminated in early formulation studies.

121. The Riverbend Cutoff. The riverbend cutoff would be located in South Jackson at the Jackson Sanitary Landfill between river miles 284 and 286. The location of the cutoff is shown on Plate 18. The now inactive Jackson Sanitary Landfill, which creates an obstruction in the floodway, consists of three mounds of material occupying about 70 acres in a bend of the river. Cutoffs were designed for this and one other bend, to shorten the river and lessen the obstruction to flow created by the landfill. Initially, a raised cutoff channel was proposed in order to maintain flows in the bendway. However, this was not considered engineeringly feasible because of the tendency for sediment to block the lower, old river channel. Consequently, the cutoff was evaluated with the invert at the same elevation as the river channel.

122. The considered channel would be approximately 3,200 feet long with a bottom width of 120 feet. Channel side slopes would be covered with riprap. A 35-acre disposal area would be developed on the west side of the channel to receive all the excavated material from the landfill. This material would then be covered with a 3-foot, compacted clay cover to inhibit leaching through the material.

123. To prevent the complete closure of the bendways by sediment deposits, the upstream ends of the old bendways would be closed with earth barriers and the downstream ends would be partially closed. This arrangement would allow flushing of the bendways during overbank flooding, and during normal river stages would allow entry of water at the downstream ends, where the partial closures would concentrate flows to prevent the buildup of bars. Conway Slough, which enters Pearl River from its east bank in the more upstream of the bends, would be rerouted to enter Pearl River above the bend closure to protect water in the bendway from pollution entering from that source. An economic evaluation of the cutoff plan on a first added basis is summarized in Table 15.

Table 15

Evaluation of Riverbend Cutoff

First Cost	Total Annual Cost 1/	Benefits	B/C
$16,546,000	$1,530,000	$2,066,000	1.4 (0.6) 2/

1/ Based on a two-year construction time.
2/ Final adjusted BCR. See Table 32 and paragraph 104.

124. Summary of Channel Modification Plans. All of the comprehensive channel modification plans were far from being economically justified. Therefore, these plans were dismissed from further consideration. The riverbend cutoff through the abandoned Jackson Sanitary Landfill between river miles 284 and 286 would be economically justified on a first added basis and was, therefore, carried to the final array of alternatives.

CLEARING IN THE FLOODWAY

125. Overbank Clearing Plans. To improve floodwater conveyance of the river overbanks at Jackson, an alternative was investigated to cut all trees and brush, providing a cleared floodway varying from 1,800 to 4,000 feet in width. To evaluate the effectiveness of various limited, as well as extensive, clearing plans, eight different reaches were initially examined. These reaches extended as far upstream as Ross Barnett Dam and as far downstream as Cany Creek. The limits of all clearing plans are shown on Plate 19.

126. For each reach examined, a plan was considered in which all trees and brush would be cut. Riprap would be placed at bridge crossings to prevent erosion at piers and fills due to increased velocities. All plans would require annual clearing to maintain the project. The individual plans are listed below by their designated numbers and described with their limits identified by land features and river miles (RM):

a. Plan 1 - Sanitary Landfill (RM 285.05) to Creosote Slough (RM 289.60). This, the shortest of the original eight plans, would require the acquisition and clearing of 636 acres and erosion protection for six highway and two railroad bridges. Areas filled for the construction of the U.S. 80 and I-20 Highways would not be cleared above the record flood elevation.

b. Plan 2 - Sanitary Landfill (RM 285.05) to the Most Upstream of the Three Illinois Central Gulf Railroad Bridges (RM 290.58). This represents the extension of plan 1 about 1 mile upstream. The acquisition and clearing of 910 acres and protection for six highway and three railroad bridges would be required. The embankment at the most upstream railroad bridge would not be cleared above the record flood elevation.

c. Plan 3 - Sanitary Landfill (RM 285.05) to State Highway 25 Bridge (RM 292.63). This represents the extension of plan 2 about 1 mile upstream. The acquisition and clearing of 1,390 acres and protection for eight highway and three railroad bridges would be required.

d. Plan 4 - Richland Creek (RM 282.54) to State Highway 25 Bridge (RM 292.63). This represents the extension of plan 3 about 2.5 miles downstream. The acquisition and clearing of 2,000 acres and protection for eight highway and three railroad bridges would be required.

e. Plan 5 - Cany Creek (RM 278.83) to State Highway 25 Bridge (RM 292.63). This represents the extension of plan 4 about 3.5 miles downstream, providing a better conveyance for flows from Richland and Cany Creeks. The acquisition and clearing of 2,687 acres and protection for eight highway and three railroad bridges would be required. Below mile 278.83 the flood plain continues to widen, causing a drop in flood elevations, and clearing would not be as effective there.

f. Plan 6 - Cany Creek (RM 278.83) to Purple Creek (RM 296.25). This represents the extension of plan 5 about 3.5 miles upstream, providing a better conveyance for flows from Purple and Hanging Moss Creeks. The acquisition and

clearing of 3,600 acres and protection for eight highway and three railroad bridges would be required.

g. Plan 7 - Sanitary Landfill (RM 285.05) to Ross Barnett Dam (RM 301.80). This plan tests the effectiveness of clearing in the most upstream reach of the river at Jackson. The acquisition and clearing of 3,570 acres and protection for eight highway and three railroad bridges would be required.

h. Plan 8 - Cany Creek (RM 278.83) to Ross Barnett Dam (RM 301.80). This plan extends between the farthest upstream and downstream limits considered for clearing. The acquisition and clearing of 4,790 acres and protection for eight highway and three railroad bridges would be required.

127. A 650-foot-wide cleared strip from RM 285.3 to 290.58, currently maintained along the river channel in connection with the existing levee project, is not included in the estimated costs for acquisition, clearing, or maintenance. Project lands are considered to be acquired in fee, since the cost of easements would approximate the cost of fee purchase in this case. Costs for the initial eight clearing plans are summarized in Table 16 and economic evaluations are presented in Table 17. Net benefits are listed so that the various plans can be compared on that basis.

128. Environmental Impacts and Mitigation Plans. Detailed studies of environmental impacts were not undertaken during the preliminary phase of study. Detailed studies were accomplished for four clearing plans during the final phase and the results were considered representative of all the plans. Consequently, the impacts attributed to the clearing plans are more accurate for the plans evaluated in the final phase than for those evaluated in the preliminary phase.

129. Evaluation of Original Clearing Plans. Evaluation of environmental impacts showed that while clearing would not result in significant fishery losses, all clearing plans would result in significant losses to wildlife. The limited impact on the fishery is explained by the fact that the effect on water

quality is minimal and the length of stream involved is relatively short. Losses to wildlife result from the loss of bottomland hardwood habitat, which supports a relatively large and diverse wildlife population. The clearing plans were all formulated to clear only those areas where clearing would be hydraulically efficient in reducing flood stages. The unavoidable losses would require mitigation. Mitigation costs and acreages computed for the eight clearing plans evaluated in the preliminary phase of study are listed in Tables 16 and 17, respectively.

Table 16

Summary of Costs for Original Clearing Plans

Plan	Length (RM)	Construction	Mitigation	Total First Cost	Project Maintenance
1	4.5	$ 3,058,000	$ 373,000	$ 3,431,000	$ 94,000
2	5.5	4,875,000	1,041,000	5,916,000	131,000
3	7.6	7,171,000	1,886,000	9,057,000	201,000
4	10.1	8,726,000	2,986,000	11,712,000	284,000
5	13.8	10,526,000	4,243,000	14,769,000	377,000
6	17.4	15,891,000	5,549,000	21,440,000	520,000
7	16.7	14,572,000	5,500,000	20,072,000	516,000
8	23.0	20,793,000	7,386,000	28,179,000	692,000

Table 17

Evaluation of Original Clearing Plans

Plan	Project Area (acres)	Mitigation Area (acres)	Total Annual Cost[1/]	Benefits	B/C	Net Benefits
1	636	300	$ 398,000	$2,254,000	5.7	$1,856,000
2	910	840	656,000	2,378,000	3.6	1,722,000
3	1,390	1,490	1,004,000	2,871,000	2.9	1,867,000
4	2,000	2,400	1,364,000	3,292,000	2.4	1,928,000
5	2,687	3,420	1,739,000	4,625,000	2.7(1.1)[2/]	2,886,000(372,000)[2/]
6	3,600	4,470	2,498,000	4,631,000	1.9	2,133,000
7	3,570	4,430	2,367,000	3,418,000	1.4	1,051,000
8	4,790	5,950	2,291,000	4,631,000	2.0	2,340,000

[1/] Based on 1-year construction time for plans 1 through 3 and 2 years for plans 4 through 8.

[2/] Final adjusted numbers. See Table 32 and paragraph 104.

130. Variations of Clearing Alternatives. The economics of the clearing plans shown in Tables 16 and 17 were developed prior to local interests removing the siltation at the Highway 25 bridge. This work favored overbank clearing plan 1 since it was immediately downstream of Highway 25. Further, the combination of clearing plan 1 and the Highway 25 work would significantly reduce the flood stages in the high damage areas in northeast Jackson and along Highway 25 at a very low cost. Thus, overbank clearing plan 1 had the greatest net benefits. Following the authorization of the "Four Point Plan" in the Fiscal Year 1983 Supplemental Appropriations Act, plan 1 was refined in an effort to reduce environmental impacts while retaining the approximate same flood stage reductions. The resulting alternative designs, designated 1A through 1E, considered a project of reduced size, eliminating 392 acres of clearing at the upstream end of the area. These alternatives are discussed in the following subparagraphs. Costs and economic evaluations for these alternatives are given in Tables 18 and 19. These alternatives are also shown on Plate 20.

a. This further refinement of clearing plans introduced a new concept in overbank clearing--partial or canopy clearing. All of these partial or canopy plans call for leaving only trees 18 inches in diameter or greater and maintaining a density of 80 trees per acre. Further, all limbs on remaining trees would be trimmed up to 15 feet above natural ground.

b. 1A and 1B Sanitary Landfill (RM 285.30) to Old Brandon Road (RM 287.55). Plan 1A was designed with partial clearing throughout the reach to test the economic efficiency of a plan minimizing both the acreage cleared and the degree of clearing. The acquisition and clearing of 244 acres and protection for five highway and two railroad bridges would be required. Plan 1B tests the efficiency of completely totally clearing the same area.

c. 1C, 1D, and 1E About 1 Mile Below the Sanitary Landfill (RM 284.25) to Old Brandon Road (RM 287.55). Plan 1C was formulated with partial clearing throughout the reach to test the economic efficiency of extending plan 1A about 1 mile farther downstream. The acquisition and clearing of 353 acres and

protection for five highway and two railroad bridges would be required. Plan 1D tests the efficiency of the same area with complete clearing above RM 285.3 and partial clearing below. Plan 1E tests the efficiency of completely clearing the entire area.

Table 18

Summary of Costs for Modified Clearing Plans

Plan	Length (RM)	Construction	Mitigation	Total First Cost	Project Maintenance
1	4.5	$ 3,058,000	$ 373,000	$ 3,431,000	$ 94,000
1A	2.2	1,920,000	128,000	2,048,000	40,000
1B	2.2	1,856,000	152,000	2,008,000	35,000
1C	3.3	2,211,000	152,000	2,363,000	57,000
1D	3.3	2,148,000	404,000	2,552,000	52,000
1E	3.3	2,119,000	630,000	2,749,000	50,000

Table 19

Evaluation of Modified Clearing Plans

Plan	Area (acres)	Mitigation Area (acres)	Total Annual Cost[1/]	Benefits	B/C	Net Benefits
1	636	300	$ 398,000	$2,254,000	5.7	$1,856,000
1A	244	100	222,000	919,000	4.1	697,000
1B	244	120	213,000	1,262,000	5.9	1,049,000
1C	353	120	267,000	977,000	3.7	710,000
1D	353	120	278,000	1,856,000	6.7(18.4)[2/]	1,578,000 (2,838,000)[2/]
1E	353	230	294,000	2,235,000	7.6	1,941,000

[1/] Based on 1-year construction time.

[2/] Final adjusted numbers. See Table 32 and paragraph 104.

131. Overbank clearing plan 1D was initially selected for recommendation as part of the Four Point Plan (interim plan) because it was the alternative with the highest net benefits which minimized losses to the natural environment. As it turned out, plan 1D was closer to the NED Plan than the listing in Tables 18

and 19 would indicate. This was because of some last minute changes in fish and wildlife mitigation requirements. In negotiations with U.S. Wildlife Service, the District was persuaded to increase the mitigation lands from 120 to 320 acres. A proportionate increase in plans 1 and 1E would sharply decreases the net benefits for these alternatives below the values shown in Table 19.

132. The ultimate construction of the interim plan (i.e., clearing plan 1D and the Highway 25 work) had a major impact on the plan formulation process. There were three primary reasons for this impact. First, there was a favorable construction bid which necessitated revising the cost estimates downward for all the clearing plans. Secondly, the negotiations with Fish and Wildlife Service established mitigation requirements which necessitated revising the cost estimates for mitigation upward for all the clearing plans. Although these two factors have a tendency to offset each other, it completely altered the relative ranking of all the clearing plans. Finally, including the interim plan in the without- project conditions dramatically changed the incremental analysis of the benefit-to-cost ratios for all the plans. This was especially significant because of the relatively high benefits of $2,136,000 (later adjusted to $3,001,000) achieved by the interim plan.

133. The factors cited in the previous paragraph necessitated a complete reevaluation of the array of overbank clearing alternatives. Clearing plans 1, 2, and 3 were no longer economically viable since most of their potential benefits were obtained by the construction of clearing plan 1D. Plans 6, 7, and 8 were no longer economically viable because of the large amount of mitigation lands required for those alternatives. The only remaining alternatives were plans 4, 5, and other variations of plan 1. Since plan 5 was far superior to plan 4, it was evaluated in more detail in lieu of plan 4.

134. New Clearing Alternatives. Since mitigation costs for the long reaches of overbank clearing were high, an alternate to plan 5 was developed. This plan, designated 5A, included work in the same reach as plan 5 but consisted of

partial or canopy clearing in the reach. This variation of plan 5 would reduce the mitigation requirement from 4,500 acres to 2,300 acres.

135. After the construction of the interim plan, other variations of plan 1 were evaluated. The extension of the interim clearing plan downstream was found to be the most viable alternative. The extension of the partial clearing downstream was designated plan 1F. The area in plan 1F was then evaluated with complete clearing, designated plan 1G. Plans 1F and 1G extend from Cany Creek (RM 279.83) to Old Brandon Road (RM 287.55) (see Plate 21). The acquisition and clearing of 1,630 acres would be required. This represents the clearing of 1,277 acres in addition to that cleared for the authorized plan. Plan 1G also includes the total clearing of the 109-acre partially cleared area included in the constructed interim plan. Mitigation lands in addition to those included in the authorized plan would be 1,700 acres for plan 1F and 3,500 acres for plan 1G. An incremental analysis of clearing plans 1F and 1G is presented in Table 20.

Table 20

Incremental Analyses of Plans 1F and 1G

	Hwy. 25 & Plan 1D (interim plan)	Add Plan 1F	Add Plan 1G
Benefits	$2,136,000	$1,300,000	$2,079,000
Costs	293,000	994,000	1,350,000
Net benefits	1,843,000	306,000	729,000
Net benefits (Final)		(312,000)[1/]	(908,000)[1/]

[1/] Final adjusted net benefits. See Table 32 and paragraph 104.

136. The evaluations presented above show that plans 1F and 1G are both economically justified and that plan 1G has the greater net benefits. For comparison, the eight original clearing plans evaluated as last added increments to the authorized plan are presented in Table 21.

Table 21

Incremental Analyses of Original Clearing Plans

Plan	Benefits	Costs	Net benefits
1	$ 118,000	$ 120,000	$ - 2,000
2	242,000	378,000	- 136,000
3	735,000	726,000	9,000
4	1,156,000	1,086,000	70,000
5	2,489,000	1,461,000	1,028,000
6	2,495,000	2,220,000	275,000
7	1,282,000	2,089,000	- 807,000
8	2,495,000	2,013,000	482,000

137. Plan 5 shows the greatest net benefits of the eight plans and is the only plan showing greater net benefits than plan 1G. In order to evaluate plans 1G and 5 on a comparable basis, plan 5 was reformulated using the same mitigation evaluation methodology used with plans 1F and 1G. After reformulation, plan 5 was also evaluated with partial clearing throughout and designated 5A. These two plans are presented in Table 22.

Table 22

Incremental Analyses of Plans 5 and 5A

	Hwy 25 & Plan 1D (interim plan)	Add Plan 5	Add Plan 5A
Benefits	$2,136,000	$2,671,000	$1,309,000
Costs	293,000	2,489,000	2,112,000
Net benefits	1,843,000	182,000	-803,000
Net benefits (Final)		(372,000)[1/]	(-846,000)[1/]

[1/] Final adjusted net benefits. See Table 32 and paragraph 104.

138. Final Array of Overbank Clearing Alternatives. The overbank clearing alternatives carried to the final array of alternatives were plans 1F, 1G, 5, and 5A. Plan 5A was carried to the final array of alternatives despite the fact that it was not economically justified. This was done in the event that there would be final adjustments in the project economics which may favor a longer reach of clearing, which was more environmentally acceptable.

UPSTREAM IMPOUNDMENTS

139. General. The locations of the upstream impoundments evaluated for this report are shown on Plate 6. These upstream impoundments include: the Edinburg, Carthage, and Ofahoma sites previously evaluated in the early 1970's; variations of 14 small upstream impoundments previously studied by the Soil Conservation Service; the existing Ross Barnett impoundment, and the Shoccoe Dam site.

140. Edinburg Lake. The original Edinburg project provided for a dam and reservoir for flood control, water quality control, general recreation, fish and wildlife enhancement, and area redevelopment. The dam would consist of a compacted earth-fill and concrete structure 7,154 feet long, including the spillway section and retaining walls. The top of dam elevation would be 412.5 feet NVGD with a maximum height of 54 feet above the existing streambed. Top width of dam would be 32 feet. The gated spillway would have a length of 292 feet with the crest at elevation 375. Flow over the crest would be regulated by 6 tainter gates, 42 feet long and 23 feet high. To provide for maximum releases of about 594 cfs for all pool levels of conservation storage, two sluices would be provided in the right abutment of the spillway. The reservoir at maximum pool elevation 395.6 (100-year flood pool) would have a pool area of 27,000 acres and a total reservoir storage capacity of 486,000 acre-feet. Of this amount, normal sedimentation storage would be 40,600 acre-feet; water quality, 90,200 acre-feet; recreation, 69,000 acre-feet; and flood control, 286,200 acre-feet. Normal pool elevation 282.0 would result in a 16,000 acre pool during the recreation season.

141. Reporting on Edinburg Lake. The comprehensive basin study report by the Corps of Engineers that was submitted to the Congress in 1972 identified Edinburg Lake as a project having potential for flood control at Jackson. The Edinburg Dam site, 2 miles east of the town of Edinburg, is on the Pearl River about 130 miles upstream of Jackson. With a drainage area of 827 square miles, the dam would control 26.7 percent of the drainage area above Jackson. The primary project purposes considered were flood control and recreation. Phase I design memorandum planning studies, authorized and funded by the Water

Resources Act of 1974, showed that the project was no longer economically justified for the following reasons:

a. Topographic maps used in the survey study were incorrect, showing considerable more storage capacity than was actually available based on updated USGS maps.

b. EPA withdrew its support for including water quality control storage (benefits) in the project, because EPA determined this was no longer a need.

c. Flood control benefit computation methods and claimable categories underwent a drastic change in the 1970's which resulted in a lowering of flood control benefits.

d. Detailed relocation studies disclosed a perimeter roadway system that would require extensive and costly changes if the lake was built.

e. The computation of recreation development changed producing a reduction in the user days at the project (benefits).

f. Unit price levels escalated significantly during the mid-1970's with inflationary rates.

142. Evaluation of Edinburg Lake. The Edinburg site was completely reevaluated for this report. The most important change, beyond those cited in previous paragraph, in the evaluation of the site was the difference in design standards between 1970's and today. In the early 1970's the rainfall from Hydrometeorologic Report 33 of the National Weather Service was used to develop the design storm. Today's standards are based on the National Weather Service's Hydrometerological Report 51. The application of this new standard resulted in roughly a doubling of the peak flow for the design storm. This new design standard was especially critical at the Edinburg Dam site. An additional number of large tainter gates had to be included in the design to prevent the probable maximum flood pool from flooding the town of Philadelphia, Mississippi, which is located a few miles upstream of the dam site.

143. The Edinburg project was evaluated as a dry dam and as a multi-purpose project. Table 23 presents the economics of the various scenarios evaluated.

Table 23

Evaluation of Edinburg Lake

Plan	Annual Benefits by Purpose	Total Annual Benefit	First Cost	Total Annual Cost[1/]	B/C
Two-purpose					
Flood control	$4,577,000				
Recreation	902,000				
		$5,479,000	$197,000,000	$21,000,000	0.26
Three-purpose					
Flood control	4,577,000				
Recreation	902,000				
Hydropower	2,035,000				
		7,514,000	222,300,000	23,900,000	0.31
Three-purpose impact benefits					
Flood control	4,577,000				
Recreation	902,000				
Hydropower	2,035,000				
Recreation/ tourism	600,000				
		8,114,000	222,300,000	23,900,000	0.34
Dry Dam	-	4,500,000	186,000,000	19,800,000	0.23

[1/] Based on a 5-year construction time.

144. Carthage and Ofahoma Reservoirs. The comprehensive basin study that identified Edinburg Lake as having potential for flood control also investigated two smaller reservoir projects--Carthage, on Lobutcha Creek, which would control a drainage area of 226 square miles and Ofahoma, on the Yockanookany River, which would control a drainage area of 469 square miles. Their locations are shown on Plate 6. In the comprehensive study, these were considered as multiple-purpose projects and found to be economically infeasible. For the purposes of this study, they were reevaluated in combination as dry reservoirs and individually as dry dams and single purpose flood control dams. Cost

estimates for the two reservoirs were obtained by updating construction cost data from the comprehensive study and deleting recreation facilities for the dry reservoirs. The economic evaluation of the Carthage and Ofahoma sites is summarized in Table 24.

Table 24

Evaluation of Carthage and Ofahoma Reservoirs

Plan	First Cost	Annual Cost	Annual Benefits	BCR
		DAMS WITH PERMANENT POOLS		
Carthage	$ 72,000,000	$ 7,100,000	$2,000,000	0.28
Ofahoma	142,000,000	14,000,000	3,800,000	0.27
		DRY DAMS		
Carthage	62,000,000	6,600,000	2,000,000 1/	0.30
Ofahoma	123,000,000	13,100,000	3,800,000 1/	0.29
Carthage & Ofahoma	171,200,000	18,900,000	5,800,000 1/	0.31

1/ Maximum possible flood control benefits.

145. U.S. Soil Conservation Service Reservoirs. The 14 upstream reservoir sites selected for evaluation would control a total of 965 square miles of drainage area. The reservoirs, whose locations are shown on Plate 6, were planned by the SCS in the preliminary stage of this study under the authority of PL-83-566 and are larger than could be constructed under that authority. Cost estimates are by the SCS and are for structures based on a 100-year frequency flood pool elevation and built to SCS standards. The system of reservoirs, evaluated by the Corps of Engineers as dry dams with uncontrolled spillways, would control 32 percent of the drainage area above Ross Barnett Dam and reduce average annual damages at Jackson by 55 percent. Benefits, which include urban benefits at Jackson and agricultural benefits downstream of Jackson, were computed by the Corps of Engineers. In an effort to improve the plan economics, an alternative was developed that included only the nine most effective reservoirs. This plan would reduce average annual damages at Jackson by about 50 percent. Evaluation of the two plans is presented in Table 25. If the minimal rural and urban benefits for flood damages reduced in areas upstream of Jackson were included, the better of the two plans would still be

only marginally economical. Final design to Corps of Engineers standards would increase the cost to the extent that the plan would not be economically feasible.

Table 25

Evaluation of SCS Upstream Reservoirs

Alternative	First Cost	Total Annual Cost 1/	Benefits	B/C
14 reservoirs	$72,800,000	$6,813,000	$5,080,000	0.75
9 reservoirs	47,200,000	4,415,000	4,615,000	1.05

1/ Based on 1-year construction time. Includes $25,000 O&M cost each.

146. Upgrading Ross Barnett to Provide for Flood Control Storage. One of the alternatives considered in the Pearl River flood control study was upgrading the Ross Barnett project to current Corps of Engineers design standards for flood control dams. The Ross Barnett project was designed for a maximum flow of 250,000 cfs, while the current probable maximum flood at the site would be about 515,000 cfs. For comparative purposes, the scope of the work required and costs for upgrading Ross Barnett to control an April 1979 flood (same capacity as Shoccoe Dam) are presented in Tables 26 and 27.

Table 26

Work Required to Upgrade Ross Barnett for Comprehensive Flood Control Storage

Flood Control Storage to Elevation 311.5
Raise Main Dam to Elevation 319.5 (Now 308.0)
Raise Fuse Plug with New Dam Section
Increase Spillway Capacity by Adding New Gates
Raise Marina Dikes to Elevation 317.5 (Now 302.0)
Purchase Real Estate to 316.5' Contour

Table 27

Cost of Upgrading Ross Barnett for Comprehensive Flood Control Storage

Task	Cost
Dam	$102,400,000
Other Costs	17,000,000
Lands and Damages to Elevation 311.5'	239,000,000
Subtotal	$358,400,000
Additional Lands and Damages Between Elevation 311.5' and 316.5'[1/]	60,200,000
Total Cost	$418,600,000

1/ Under Corps policy, lands would be purchased to five feet above flood control pool elevation.

147. Dam at Head of Ross Barnett Reservoir. To demonstrate the effectiveness of a floodwater retention structure controlling most of the drainage area above Jackson, a dry dam was evaluated on the Pearl River at the head of Ross Barnett Reservoir. This plan, known as Shoccoe Dam, would have an earthfill dam about 2.8 miles long controlling a drainage area of 2,700 square miles, about 87 percent of the 3,100-square-mile drainage area of the Pearl River at Jackson. The dam would regulate floods up to the magnitude of the design flood (level of protection), discharging river flows through an ungated service spillway. Preliminary design and estimate for the plan produced a benefit-cost ratio of 0.7. The dam's location is shown on Plate 6 and conceptual and real estate drawings are shown on Plates 22 and 23.

148. In the intermediate phase of project formulation, optimization studies were conducted on the site selection, level of protection, and service spillway designs. From an engineering point of view, the Shoccoe Dam site is ideal. There is a natural knoll on the east abutment of the dam alignment on which to perch the emergency spillway, thereby minimizing costs. If the dam site were moved upstream, the substantial drainage from Fannegusha Creek would not be controlled, thereby significantly decreasing the flood reduction benefits in Jackson. If the dam site were moved downstream, there would be a substantial

increase in cost because the broad, flat flood plain would require a much longer dam which could also impact lakefront development at the head of Ross Barnett Reservoir. The District evaluated three levels of protection--a 100-year, a 500-year (the 1979 flood of record), and a SPF. The optimum level was by far the 500-year design. There were three alternative plans considered for the service spillway--an open uncontrolled slot, a gated slot, and a culvert outlet similar to the design of Lake Bodcau in Shreveport, Louisiana. The best two alternatives were the open and gated slot. The gated service spillway plan reduced the residual damages in Jackson from the 91 percent for the ungated service spillway to 96 percent. However, the benefits due to this additional 5 percent reduction in residual damages could not support the costs involved with adding gates. Further, results from the public involvement program indicated that there was very strong opposition from upstream residents to the gated service spillway. These publics perceived the installation of gates in the service spillway as a firm control on flooding which would greatly increase upstream damages. For these reasons, the gated service spillway was not chosen for final project formulation.

149. Reduction in Cost for Shoccoe Dam Alternative. As previously mentioned, the benefit-to-cost ratio for Shoccoe Dam was 0.7 in early formulation studies. The cost at that time was $122,000,000 compared to the current cost estimate of $80,100,000. There were two primary reasons for this decrease in cost resulting from subsequent reevaluation studies--real estate costs and a decrease in dam construction cost. Initially, the preliminary real estate cost considered the fee purchase of most of the land in the Shoccoe pool. Detail studies revealed that damages to the mostly timber land would be minimal. Adjusting the real estate cost by obtaining a flood easement estate in lieu of fee purchase reduced the real estate cost by about $13,000,000. The original estimate of $122,000,000 was also based on the assumption that the emergency spillway would have to be set at the elevation of the SPF. On 13 September 1983, an issue resolution conference on the design aspects of Shoccoe Dam was held with representatives of the Office of the Chief of Engineers and the South Atlantic Division. At that conference, it was decided that the elevation of emergency spillway could be set below SPF level as long as the dam itself was structurally designed to withstand the probable maximum flood with coincidental wind

Table 28

Historical Shoccoe Dam Cost Estimates
($1,000)

		December 81	August 83	September 83	Current Estimate July 1985
01.	Lands and Damages[1/]	$ 30,690.0	$17,280.0	$12,013.0	$15,730.0
02.	Relocations	4,530.0	5,130.0	5,130.0	8,780.0[2/]
93.	Reservoir (Boundary Line Surveys)	2,150.0	2,430.0	2,430.0	900.0
04.	Dam[1/]	50,350.0	34,200.0	31,100.0	35,030.0
06.	Fish and Wildlife Facilities	-0-	-0-	-0-	235.0
08.	Roads	920.0	1,040.0	1,040.0	620.0
18.	Cultural Resources	530.0	600.0	600.0	300.0
19.	Buildings, Grounds & Utilities	80.0	90.0	90.0	75.0
20.	Permanent Operating Equipment	80.0	90.0	90.0	40.0
30.	Engineering and Design	4,150.0	3,700.0	3,300.0	3,300.0
31.	Supervision and Administration	4,150.0	3,200.0	2,500.0	3,300.0
	Subtotal	$ 97,630.0	$67,760.0	$58,293.0	$68,310.0
	Contingency	24,370.0	16,940.0	14,607.0	11,790.0
	TOTAL	$122,000.0	$84,700.0	72,900.0	80,100.0

1/ Paragraph 149 discusses these changes.
2/ This increase resulted from a reassessment of the cost of the work for the Natchez Trace Parkway.

driven waves. This change in the adopted design, coupled with a reconfiguration of the emergency spillway, reduced the cost of the dam by about $14,000,000. The real estate cost again declined by about $5,000,000, since the real estate guide taking line is set by the elevation of the emergency spillway crest. This relatively large reduction in cost resulted from the fact that a large percentage of the land between the SPF and the 500-year elevations was either in agriculture or developed, whereas the land below the 500-year level is mostly timberland. The historical changes in the Shoccoe Dam cost estimate are summarized in Table 28.

150. Benefits for Shoccoe Dam. The primary benefits for Shoccoe Dam would result from the reduction in urban flood damages in the greater Jackson area. It is estimated that the Shoccoe project would reduce flood stages by an average of 6.1 feet for a 200-year flood. This would protect 2,525 houses and 889 businesses. The total damage reduction for that flood would be $496,500,000. The project would reduce average annual urban damages by 88 percent. A tabulation of preliminary project economics of the Shoccoe project is presented in Table 29. The economics for the comprehensive plan address the economic consideration under the Congressional directive contained in the Committee Report accompanying the Fiscal Year 1983 Supplemental Appropriations Act which stated that all the costs and benefits for the interim plan should be added to those for Shoccoe in the comprehensive plan.

Table 29

Economics of Shoccoe Dam

		SHOCCOE DAM	
	Interim Plan (Hwy. 25 & Plan 1D)	Last Added	Comprehensive
Benefits	$2,136,000	$ 6,204,000	$8,340,000
Costs	163,000	7,272,000	7,435,000
Net Benefits	1,973,000	-1,086,000	905,000
BCR	13.1 (18.4)[1/]	0.97 (1.3)[1/]	1.1 (1.7)[1/]

[1/] Final adjusted figures. See Table 32 and paragraph 104.

151. Summary of Upstream Impoundment Alternatives. Of all of the upstream impoundments considered, only the Shoccoe Dam alternative has a viable benefit-to-cost ratio. For this reason, only Shoccoe Dam was carried into the final array of alternatives.

NONSTRUCTURAL ALTERNATIVES

152. Nonstructural Planning. Previous experience by the Mobile District in nonstructural planning indicates that the 10-year flood plain provides a good initial test for economic feasibility. Structures in the 10-year flood plain at Jackson are mostly along Town and Lynch Creeks, where 45 residences and 36 commercial establishments are found. Flood proofing and relocation of occupants were considered the two most effective measures for reducing damages. Flood proofing in these areas could, typically, be accomplished by raising residential structures and providing temporary closures for commercial structures. When viewed in the light of flood depths and frequencies, closures were not considered appropriate; the depth of flooding is about 3 feet for the 20-year event and about 7 feet for the 100-year event, and the existing commercial structures, generally, would not withstand the hydrostatic pressures in this range of depths. Some of the residential structures could be raised in place, but this was not considered desirable because it would contribute to the condition of isolation and perpetuate local government's responsibility for emergency evacuation. Relocation of occupants and/or structures was considered an appropriate measure. In an initial test, benefits were computed for flood damages prevented by relocation of the residences and commercial structures. For the residences, it was assumed the occupants would be evacuated from the flood plain and the structures demolished. Benefits were computed for flood damage reduction and savings in flood insurance administrative costs less insurance premiums and insurance deductible costs. Average annual costs were computed on the cost of land and structures plus demolition costs. Salvage values and site restoration costs, which are relatively small and tend to cancel one another, were not included. For the commercial structures, benefits include only the flood damages reduced, because flood insurance administrative costs, insurance premiums, and deductible costs were more difficult to estimate for commercial properties in a preliminary assessment. Average annual costs

were computed on the cost of land and structures only. Evaluation of a total plan is summarized in Table 30.

Table 30

Evaluation of Nonstructural Plan

First Cost	Total Annual Cost	Benefits	B/C
$9,672,000	$859,000	$450,000	0.52

153. This plan alone would directly benefit only a few families and businesses and do relatively little to solve the flood problem at Jackson. The addition of other measures--with the exception of raising the existing levees and modifications at State Highway 25 Bridge--would reduce flooding on these properties and capture benefits needed to justify the nonstructural plan. The city of Jackson applied for Federal funds to purchase six properties in the flood plain in northeast Jackson under Section 1362 of Public Law 90-448. All the owners subsequently decided not to sell.

154. Nonstructural measures, in addition to flood proofing buildings and relocating occupants from the flood plain, include flood warning systems and emergency evacuation. An enhanced flood warning (forecasting) system is operated by the Jackson-Hinds Emergency Operations Center. Flood warnings are issued by the National Weather Service. Local governments are responsible for evacuation. In Jackson, the Police Department is the lead agency in evacuation efforts. In the other municipalities, emergency procedures are handled by the mayors' offices. Flood plain management ordinances in all the communities in the Jackson area meet Federal standards.

OTHER ALTERNATIVES CONSIDERED

155. There are two additional types of structural flood control works which were evaluated in the early stages of project formulation--stream diversion and removing encroachment in the floodway. Costs were estimated for a channel linking the Pearl River above Ross Barnett with the Big Black River. Two

routes were examined, and the most economical one showed a cost of $250,000,000. Since the benefits are not available to support a project of this magnitude, the plan was not developed beyond the preliminary stage. The District also evaluated the possibility of modifying highway and railroad crossings of the Pearl River at Jackson to reduce the backwater effect. The only modification which was found economically favorable was the work at Lakeland Drive which has already been constructed.

FINAL ADJUSTMENTS IN BENEFITS

ADJUSTMENTS IN PROJECT BENEFITS

156. In April 1985, the BERH review team conducted an on-site survey of the Pearl River study area. That team expressed concern over the fact that the urban damages in Jackson may be understated in the report. At their request, the Mobile District dispatched a team of specialists to completely update the urban damages in Jackson. For the most part, that survey verified the field information presented in this report. However, there were a few adjustments made in the average annual damage calculations. These adjustments are summarized in Table 31.

Table 31

Adjustments to Average Annual Damage Calculations

Adjustment	Value	Percent of Total
Change value of some property	$ 9,175,000 9,143,000 $ 32,000	1.9
Change 1st floor elevation of some property in Northeast Jackson	$ 9,360,000 9,175,000 $ 185,000	10.9
Add new development in Northeast Jackson and Lakeland Drive Areas	$ 9,409,000 9,360,000 $ 49,000	2.9
Increase in depth vs. % damaged due to long duration of flooding	$ 9,645,000 9,409,000 $ 236,000	13.9
Shift gage stations to more nearly represent average condition of reach	$10,838,000 9,645,000 $ 1,193,000	70.4
Total of all changes	$ 1,695,000	100.0

157. The first three items in Table 31 are self explanatory and their values are rather minor. The increase in flood damages due to increased flood durations is normally not considered in average depth versus damage relationships.

However, in the greater Jackson area even minor floods stay up several days. Major floods do not completely recede for 10 to 14 days. The long duration slightly increases flood damages because of increased incidents of doors and door casings becoming warped and to a lesser extent increased damages to foundations, hardwood floors, warping of wood moldings and additional cleanup. These increase damages were conservatively estimated to be $236,000 annually or about 2 percent of the direct physical damage. The most significant increase resulted in the shifting of the flood reference points used to evaluate damages in several reaches. The most significant shift was the Northeast Jackson gage. Early in project evaluation, a reference point at the geographical center of the reach near Hanging Moss Creek was selected to represent the flood stages for the various floods in the reach. As illustrated on Table 14, about 85 percent of the damages in Northeast Jackson are concentrated in the upper part of the reach. Therefore, new reference points were selected for both the upper and lower parts of Northeast Jackson. This change showed that the flood stages for the different frequency floods should be about 3/4 of a foot higher. Consideration of the fact that there are 1,041 houses in the 100-year flood plain in this area, substantiates the large increase in average annual flood damages of $1,193,000.

ADDITIONAL CATEGORIES OF BENEFITS

158. There are seven additional categories of benefits that are not included in the economics appraisal of the various alternatives presented in the previous portion of this report. These categories were not previously included because of the effort which would be required to quantify them for literally scores of alternatives involved. Further, it was not felt that these additional benefits would affect the relative ranking of alternatives nor would they exclude potentially viable alternatives. A brief description of these additional categories of benefits follows. Details on the various categories are contained in the Benefit Analysis Appendix.

a. Rural Flood Damages. The urban flood damages previously cited included only the urban damages in metropolitan Jackson. These additional benefits are obtained from a reduction in agricultural damages and a reduction in urban

damage in Monticello, Columbia, and other small communities outside of the Jackson area.

b. Human Cost (Trauma). There was a very extensive study done by the Institute of Water Resources (IWR) to quantify the phycological trauma associated with frequent flooding. Social scientists agree that the repeated flooding in Jackson causes a great deal of trauma--the difficulty is quantifying these benefits. This is the reason the Mobile District retained IWR to conduct the comprehensive study. It should be pointed out that a trauma cost was added to the Shoccoe cost estimate to account for the trauma of upstream residents.

c. Evacuation-Reoccupation. This category is especially significant in Jackson, since the floodwaters do not recede for several days to two weeks. This benefit is simply a measure of the reduction in the cost of living expenses which are incurred while an individual's home is flooded or is being repaired--i.e., hotel bills, eating out, etc. Several adjustments were made to these benefits to account for normal meal expenses and for individuals who would stay with relatives.

d. Insurance Program. If flooding were eliminated there would be a savings in the Federally subsidized flood insurance program. However, current policy dictates that the savings in subsidies cannot be counted as a project benefit. Accordingly, the benefits for this category are limited to the savings in the administrative costs associated with the program.

e. Interest on Uninsured Losses. This category of benefits is very similar to flood damages prevented. It represents savings of the amount of interest which is paid on loans made to repair flood damages not covered by insurance (the principal has already been accounted for in the reduced flood damage estimates). For the purpose of this report, it was assumed that everyone within the 100-year flood zone would have total coverage under the flood insurance program. It was also assumed that individuals located above the 100-year flood plain would not have flood insurance coverage because it is not legally mandatory and the rates are considerably higher since these rates are

not subsidized. It is the District's judgment that these two assumptions will offset each other--i.e., the few individuals above the 100-year flood plain with flood insurance will be offset by those below the 100-year flood who do not have flood insurance, or are underinsured and must pay the deductible involved. The interest rate used is 8-3/8 percent, a mean between the low Small Business Administration rate and interest rates in the private sector.

f. Restoration of Residential Lot Values. As the name implies, this category of benefits would result from the restoration of depressed residential property values to their pre-flood values. An evaluation of real estate trends in Northeast Jackson revealed a substantial (as much as 40 percent) drop in real estate values after the floods of 1979 and 1983. Studies of area conditions prior to the 1983 flood indicated that real estate values rose over time but never reached their pre-flood value. It is the District's judgment that the long-term value of residential property will stablize at 85 percent of the pre-flood value of the land in constant dollars. If the flood threat is removed, those properties will regain the 15 percent loss, because Northeast Jackson is a very desirable residential neighborhood. It should be mentioned that the urban damages previously calculated accounted for damages to the homes themselves and their contents, but not for the property itself. Therefore, this category is not double counting.

g. Land Enhancement. This category of benefits results from the increase in property value for undeveloped land associated with removing the flood risk. The benefits for this category were assumed to be the lesser of the increased value of the land or the cost to fill the land up to the 100-year flood elevation. The amount of land enhancement claimed was further constrained by the current policy requirement to establish that future development will definitely take place in the flood plain in lieu of alternative flood-free sites. This is especially difficult to prove in a city like Jackson which is completely surrounded by rural areas. In accordance with this policy, land enhancement was taken only on lands which already have development infra structures in place--i.e., roads, utilities, etc.

FINAL ARRAY OF ALTERNATIVES

159. The final array of alternatives consists of overbank clearing plans 1F, 1G, 5, and 5A, the riverbend cutoff and Shoccoe Dam. Table 32 summarizes economic data for each of these on a last added basis to the interim plan (overbank clearing plan 1D and the Highway 25 work). The final adjustments in benefits discussed in paragraphs 156 through 158 have been included in Table 32 for the first time in this report. For this reason, these figures will differ from those presented in the "Alternatives Considered" section of this report.

Table 32

Economics of Final Array of Alternatives

Plan	Annual Benefits	Annual Cost	Net Benefits	BCR
Highway 25 and ID	$3,001,000	$ 163,000	$2,838,000	18.4
ADDED TO INTERIM PLAN				
1-F	1,256,000	944,000	312,000	1.3
1-G	2,258,000	1,350,000	908,000 2/	1.7
5	2,861,000	2,489,000	372,000	1.1
5A	1,266,000	2,112,000	-846,000	0.6
Riverbend Cutoff	845,000	1,530,000	-685,000	0.6
Shoccoe Dam	9,294,000	7,272,000	2,022,000	1.3
1/Comprehensive Plan	12,295,000	7,435,000	4,860,000	1.7

1/ Considering Shoccoe Dam with the Highway 25 work and Clearing Plan 1D.
2/ Net Benefits without human impairment benefits are $788,000. The BCR is 1.6.

160. On the basis of the economics presented in Table 32, overbank clearing plans 1F, 5, and 5A, and the riverbend cutoff were eliminated from further consideration. Plan 5A and the riverbend cutoff were included in the final array of alternatives for comparative purposes. The environmental impact of clearing plan 5A was included in the EIS, while the riverbend cutoff was deleted from the EIS during final preparation.

COMPARISON OF MOST FAVORABLE PLANS

161. Economics of Most Favorable Plans. Table 33 contains a comparison of the economics of Plan 1G and Shoccoe Dam with a breakdown of the added categories of benefits. Table 34 presents a comparison of benefits and residual damages for plan 1G and Shoccoe Dam. Table 35 presents a comparison of the benefits and the number of homes and businesses protected from a reoccurrence of the record flood (April, 1979) for plan 1G and Shoccoe Dam. Table 36 contains a comparison of the stage reductions for the record flood with plan 1G and Shoccoe Dam.

Table 33

Economics of Plan 1G and Shoccoe Dam

Benefit Category	Plan 1G	Shoccoe Dam
Urban Damage Reduction	$1,845,000	$7,043,000
Rural Damage Reduction	-0-	350,000
Human Impairment (Trauma)	120,000	522,000
Evacuation-Reoccupation	30,000	129,000
FIA Program	37,000	104,000
Interest on Uninsured Losses	74,000	336,000
Restoration of Lot Values	21,000	296,000
Land Enhancement	131,000	514,000
TOTAL	$2,258,000	$9,294,000

Table 34

Urban Benefits and Residual Damages for Plan 1G and Shoccoe Dam

	Residual Damages	Benefits
No Action	$10,838,000	$ -0-
Interim Plan	8,297,000	2,541,000
Plan 1G[1/]	6,452,000	1,845,000
Shoccoe Dam[1/]	1,254,000	7,043,000

1/ Last added to Interim Plan. Shoccoe Dam residual damages are $10,838,000 - $2,541,000 - $7,043,000 = $1,254,000.

Table 35

Damages Prevented From Record Flood (April 1979)[1/]

	Damages Prevented	Homes Protected	Businesses Protected
Plan 1G	$146,000,000	307	86
Shoccoe Dam	$496,500,000	2,525	889

Table 36

Stage Reductions for Record Flood (April 1979)[1/]

Plan	LOCATION	
	MS Hwy. 25 (feet)	U.S. Hwy. 80 (feet)
Plan 1G *	1.6	1.7
Shoccoe Dam *	6.7	5.8

[1/] For actual flows at Jackson gage in 1979 after the flood was regulated by Ross Barnett Reservoir.

* Includes the effects of the modifications at Highway 25 and Clearing Plan 1D.

162. Late Stage Public Involvement. In July the Mobile District conducted an extensive late stage public involvement program to explain the results of the study and obtain input from those impacted. A 39-page Public Information Fact Sheet and Announcement of Public Workshops was mailed to slightly less than 10,000 interested individuals and groups. This effort was followed by a series of 51 meetings on the Pearl River Study in the greater Jackson area as follows:

a. Formal public workshops in the cities of Carthage, Canton, Brandon, Forest, Columbia, Monticello, and Jackson. These meetings were attended by a total of 1,200 individuals.

b. Informal briefings with the Boards of Supervisors in Attala, Neshoba, Madison, Leake, Scott, Rankin, Hinds, Lawrence, and Marion Counties.

c. Twenty-two informal question and answer sessions open to the general public.

d. Briefings for the Mississippi State Senate, the House of Representatives, local mayors, elected officials, and the business community.

e. Numerous briefings for selected interest groups, such as hunting clubs, farmers, homeowners, and representatives of the poultry industry.

Discussions at these meetings mostly concerned the dry reservoir plan, Shoccoe Dam. The views expressed can be characterized as upstream and downstream. Upstream from the Shoccoe Dam site there is strong opposition to the dry dam, primarily because of perceived damages to the city of Carthage and to the timberland in the temporary ponding area. Other concerns expressed were for the relocation of homes--especially Ratliff's ferry, a community on the river about two miles upstream from the dam site--impacts on hunting and fishing, siltation, the lack of positive flood control measures for the upstream interests, the loss in tax base, the lost ability to acquire agricultural loans or insurance, and a strong sentiment that rural Mississippi should not have to be flooded to protect the people of Jackson who built in the flood plain and continue to build in the flood plain. Downstream from the dam site, support varies from strong to neutral. The strong support came from 1,935 families who were the flood victims in 1979 and the downtown business district where 775 businesses were flooded. There is moderate to neutral support from the Jackson area not flooded and the downstream counties.

163. Levels of Protection. Comparisons on the basis of the level of protection are not applicable for flood control measures, such as an ungated retention reservoir. These measures do not completely eliminate flooding for the smaller floods, even though they may be very effective for the larger floods. Also, the level of protection may vary widely within a single damage area. This is illustrated by the fact that the level of total protection provided by Shoccoe Dam would range between the 8-year and 50-year flood frequencies in northeast Jackson while the project would eliminate about 88 percent of the damages in that area on an average annual basis.

164. Clearing plan 1G and Shoccoe Dam are evaluated and compared on the bases of significant impacts and specified criteria in Tables 37 and 38 to assist in

Table 37 - Evaluation of Significant Impacts for Flood Control Alternatives

Impacts	No action plan	Clearing plan 1G	Shoccoe Dam
1. National Economic Development			
a. Positive	None.	An additional $2,258,000 average annual flood damages reduced.	An additional $9,294,000 average annual flood damages reduced.
b. Negative	$10,838,000 average annual flood damages will continue.	An additional $1,350,000 average annual cost.	An additional $7,272,000 average annual cost.
2. Environmental Quality			
a. Beneficial	None.	None.	None.
b. Adverse	None.	Complete clearing of 1,277 acres in addition to the area cleared in the interim flood control plan, plus complete clearing of 109 acres which will have already been partially cleared in the interim plan. (Although the bottomland hardwoods are an irreplaceable resource, this would be mitigated by the acquisition in perpetuity of 3,500 acres for management for wildlife.)	Mitigation in kind within the project area results in a zero impact.
3. Regional Economic Development			
Beneficial	None.	Increases value of properties on which flood hazard is reduced.	Same as plan 1G.
		Contributes to economic security not reflected in NED benefits.	Same as plan 1G.
4. Other Social Effects			
a. Beneficial	None.	Contributes to community health and safety.	Same as plan 1G.
b. Adverse	None.	None.	None.

Table 38 - Evaluation of Alternatives by Specified Criteria

Criteria	No action plan	Clearing plan 1G	Shoccoe Dam
Completness	N/A	No additional actions or investments are necessary to achieve plan outputs.	Same as plan 1G.
Effectiveness	N/A	Plan is effective as an interim measure to reduce flood damages while awaiting implementation of a more comprehensive solution. Does not provide the degree of protection needed and desired as a comprehensive solution.	Plan is effective as a comprehensive solution to the problem of flooding at Jackson.
Efficiency	N/A	Plan has the greatest net benefits of all the clearing plans.	Plan is the most cost-effective means of providing a comprehensive solution to flooding at Jackson. Has the greatest net benefits and is the NED Plan.
Acceptability	Plan is not acceptable to local interests.	Plan lacks wide acceptance by local interests. Environmental interests are opposed to clearing in general.	Plan is acceptable to local interests at Jackson. Plan is opposed by upstream interests where some of the real estate for the project would be acquired but where no benefits would accrue. Plan is favored over Plan 1G by U.S. F&W Service and EPA.

making the selection of a comprehensive plan for flood damage prevention at Jackson or making a modification to the clearing plan constructed as an interim flood control measure. The evaluations in Table 38 show that clearing plan 1G is effective as an interim plan but not as a comprehensive plan. They show that Shoccoe Dam is effective and acceptable at Jackson as a comprehensive plan, but is opposed by interests in Leake County.

165. Rationale for Selecting the Recommended Plan. Shoccoe Dam was selected over clearing plan 1G for the following reasons:

a. Shoccoe has the maximum net benefits and is therefore the NED Plan.

b. Shoccoe Dam achieves the planning objective of providing effective protection against floods, including the larger floods, while plan 1G does not.

c. Shoccoe Dam has the support of local interests in the Jackson area, while plan 1G does not.

d. Shoccoe Dam is favored over plan 1G by the environmental community.

DESCRIPTION OF THE SELECTED PLAN

PLAN COMPONENTS

166. General. The location of the Shoccoe Dam site is shown on Plate 6. An artist's conception of the dam is shown on Plate 22. The Shoccoe pool area, together with various relocations needed for construction and the site of the greentree reservoir, are shown on Plate 23. Engineering details on the Shoccoe Dam are shown on Plates C-96 through C-98 of the Engineering Appendix.

167. Description of Shoccoe Dam. The project structures would consist of an earth dam across the Pearl River at RM 329 at the head of Ross Barnett Reservoir, an emergency spillway in the left abutment, a saddle dike between the dam and the emergency spillway, and a fixed-crest service spillway with associated approach and outfall channels. The dam would be approximately 14,600 feet long; the crest would be 14 feet wide and about 45 feet above the valley floor. The upstream side slope of the dam for 9 feet below its crest would be protected by 24 inches of riprap over 9 inches of bedding material. The remainder of the dam would be protected by grass cover. Side slopes of the dam vary between 1 vertical on 2 horizontal and 1 vertical on 4.5 horizontal. Approximately 1 mile of slurry trench under the centerline of the dam would control seepage. A 950-foot-long saddle dike with a height of about 13 feet would be required between the ridge knoll forming the east abutment for the dam and the right side slope of the emergency spillway cut. The saddle dike's 1 vertical on 3 horizontal slopes would be protected like those of the main dam. The service spillway, located between the Natchez Trace Parkway and the Pearl River channel, would be a concrete structure with a 120-foot-long fixed-crest below the normal water surface of the stream. The approach to the service spillway would be a channel approximately 1,000 feet long. The outfall channel would be approximately 2,700 feet long. The channels would have 1 vertical on 2 horizontal side slopes and bottom widths of 110 feet. The emergency spillway, located in the ridge which forms the east dam abutment, would have a 20-foot-wide crest approximately 3,000 feet long. The downstream outfall would slope to natural ground at 1 vertical on 100 horizontal. The dry reservoir measures approximately 49,000 acres at the elevation of the crest of the

PEARL RIVER BASIN

MISSISSIPPI AND LOUISIANA

SCALE IN MILES 10 0 10 20

VICINITY MAP

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

PEARL RIVER BASIN STUDY

BASIN MAP

PLATE 1

1000 0 2000 4000
SCALE IN FEET

N

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

PEARL RIVER BASIN STUDY

LIMITS OF 1979 FLOOD

PLATE 2

ROSS BARNETT RESERVOIR

MADISON COUNTY

HINDS COUNTY

RANKIN COUNTY

RM 301

RM 300

RM 299

RM 298

RM 297

LIMITS OF 1979 FLOOD

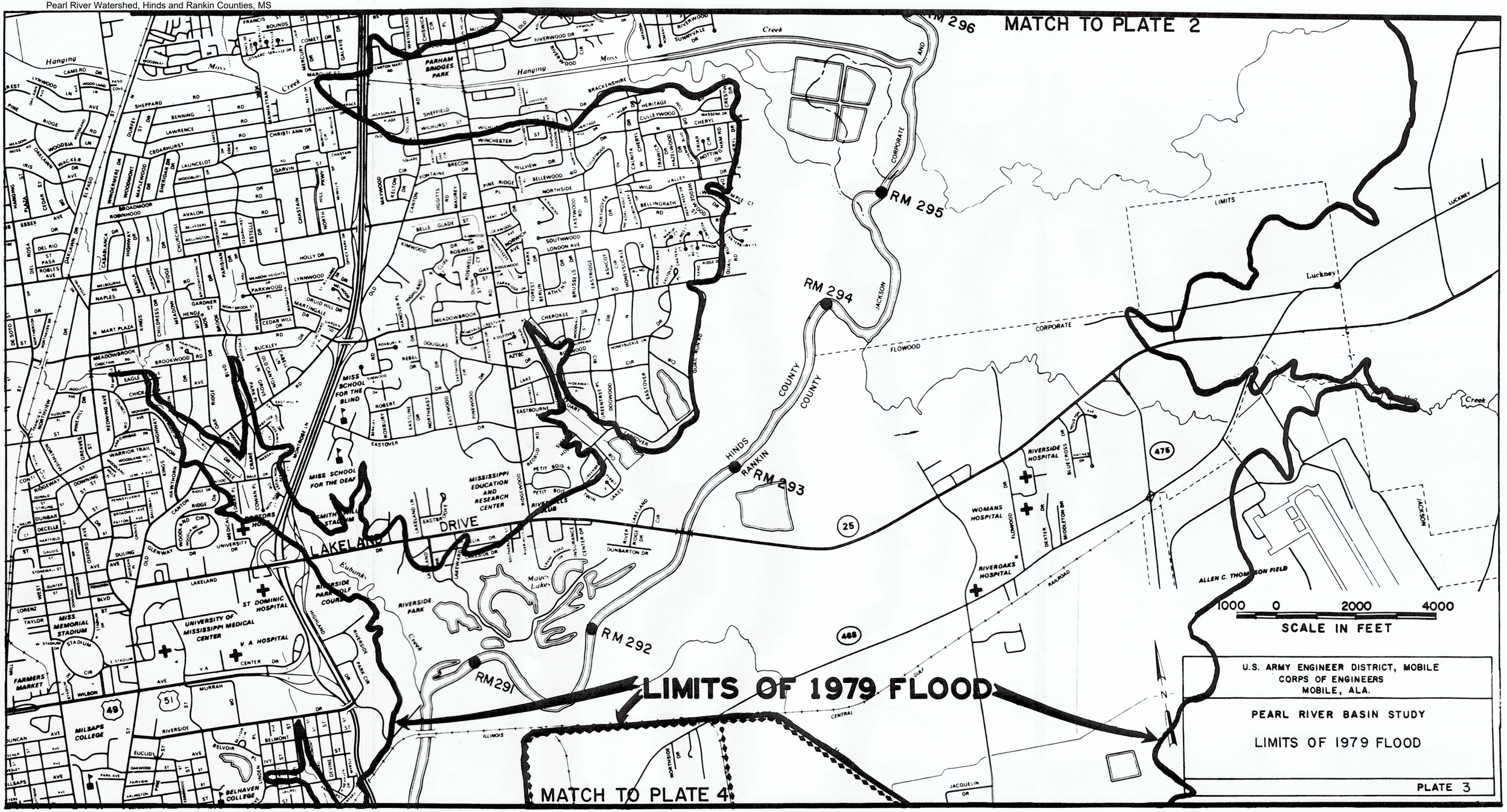
MATCH TO PLATE 3

TOUGALOO COLLEGE

COLONIAL COUNTRY CLUB

COUNTRY CLUB OF JACKSON

RIDGELAND CORPORATE


MATCH TO PLATE 2
RM 296
RM 295
RM 294
RM 293
RM 292
RM 291
LIMITS OF 1979 FLOOD
MATCH TO PLATE 4
Hanging Moss Creek
Parham Bridges Park
Miss School for the Deaf
Miss School for the Blind
Mississippi Education and Research Center
Lakeland Drive
University of Mississippi Medical Center
V A Hospital
St Dominic Hospital
Miss Memorial Stadium
Farmers Market
Milsaps College
Belhaven College
Riverside Park
Riverside Park Golf Course
Mayes Lakes
Riverside Hospital
Womans Hospital
Riveroaks Hospital
Allen C. Thompson Field
Flowood
Luckney
Jackson
Hinds County
Rankin County
Corporate Limits
1000 0 2000 4000
SCALE IN FEET
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
LIMITS OF 1979 FLOOD
PLATE 3

MATCH TO PLATE 3

LIMITS OF 1979 FLOOD

MATCH TO PLATE 5

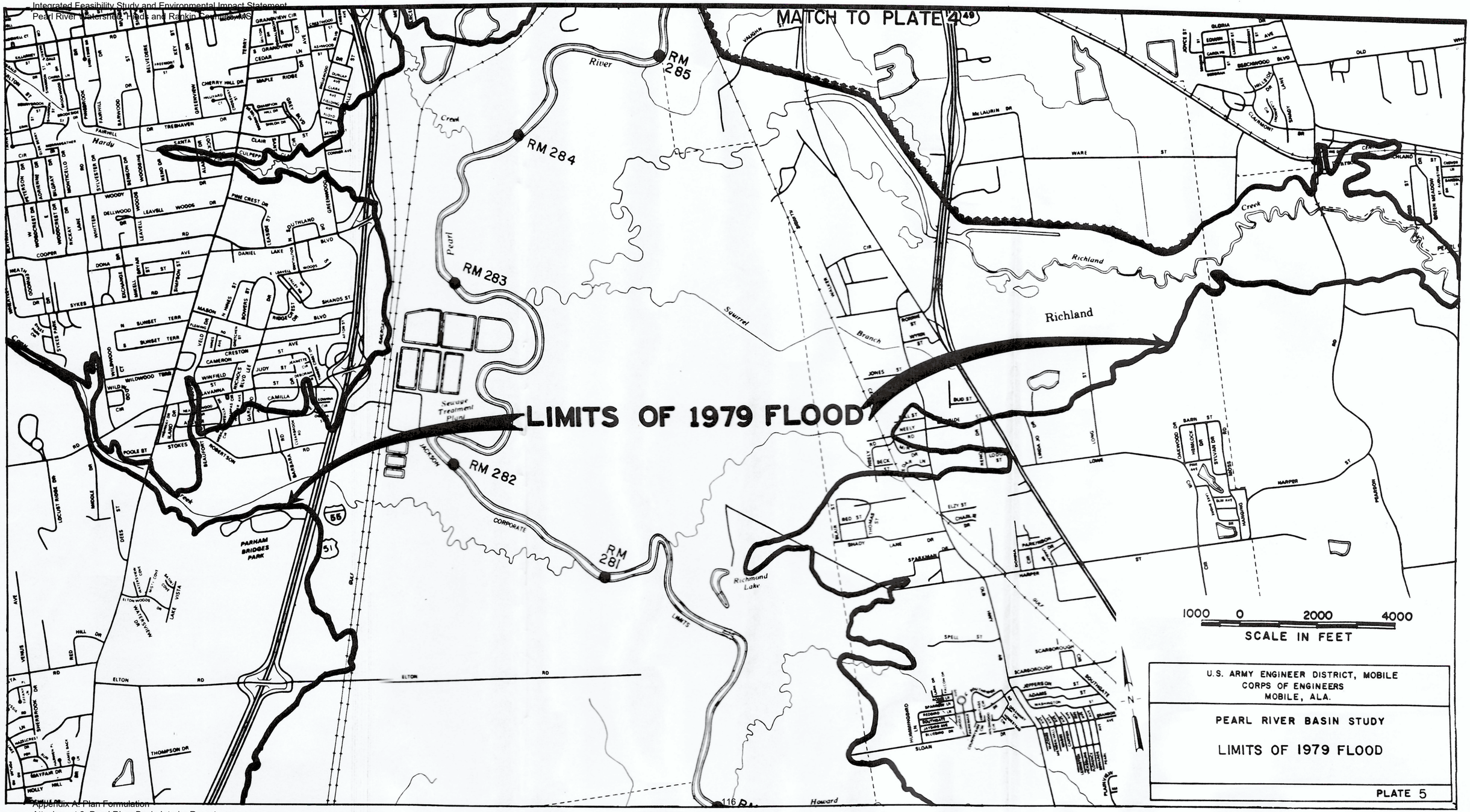
1000 0 2000 4000
SCALE IN FEET

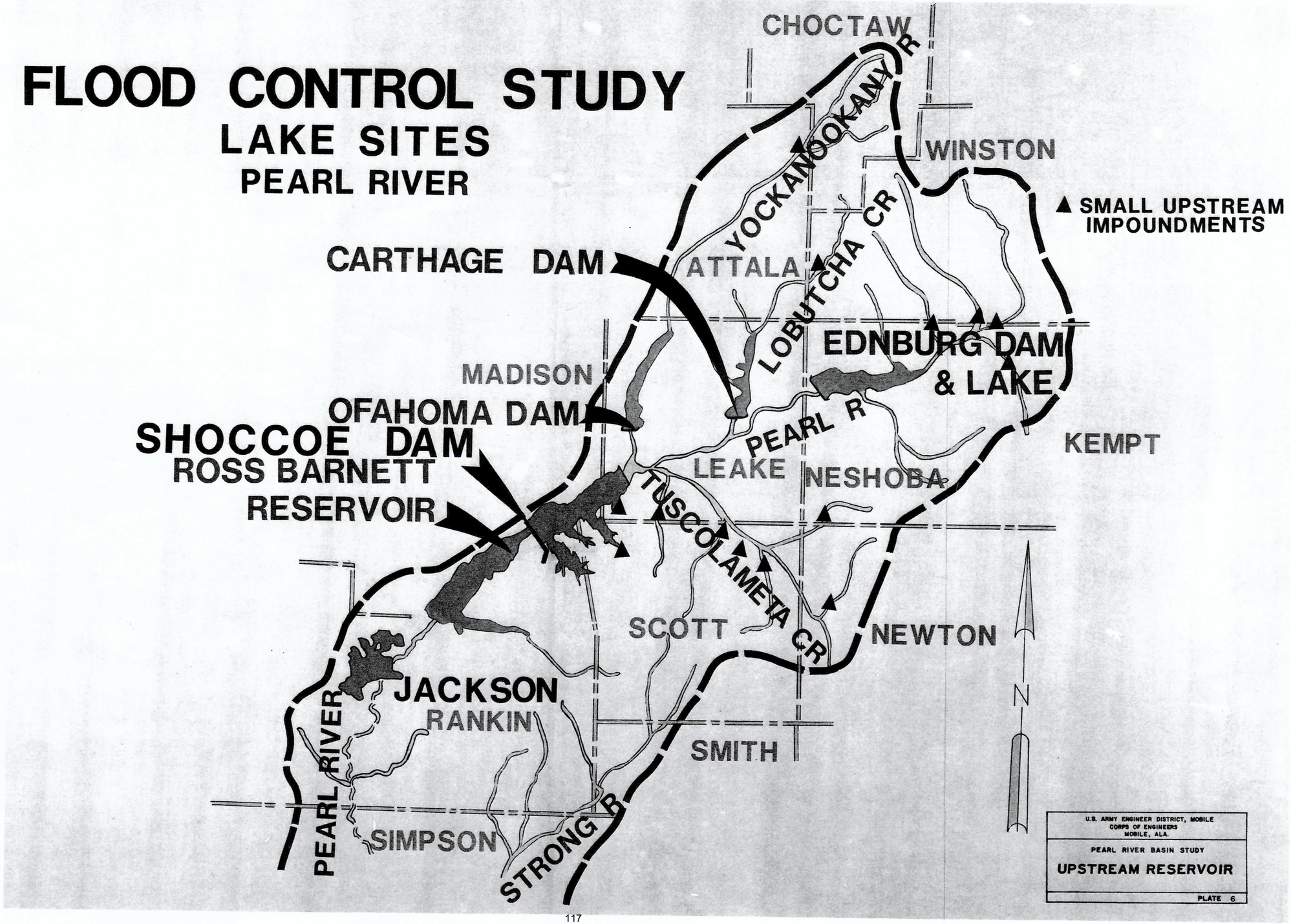
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

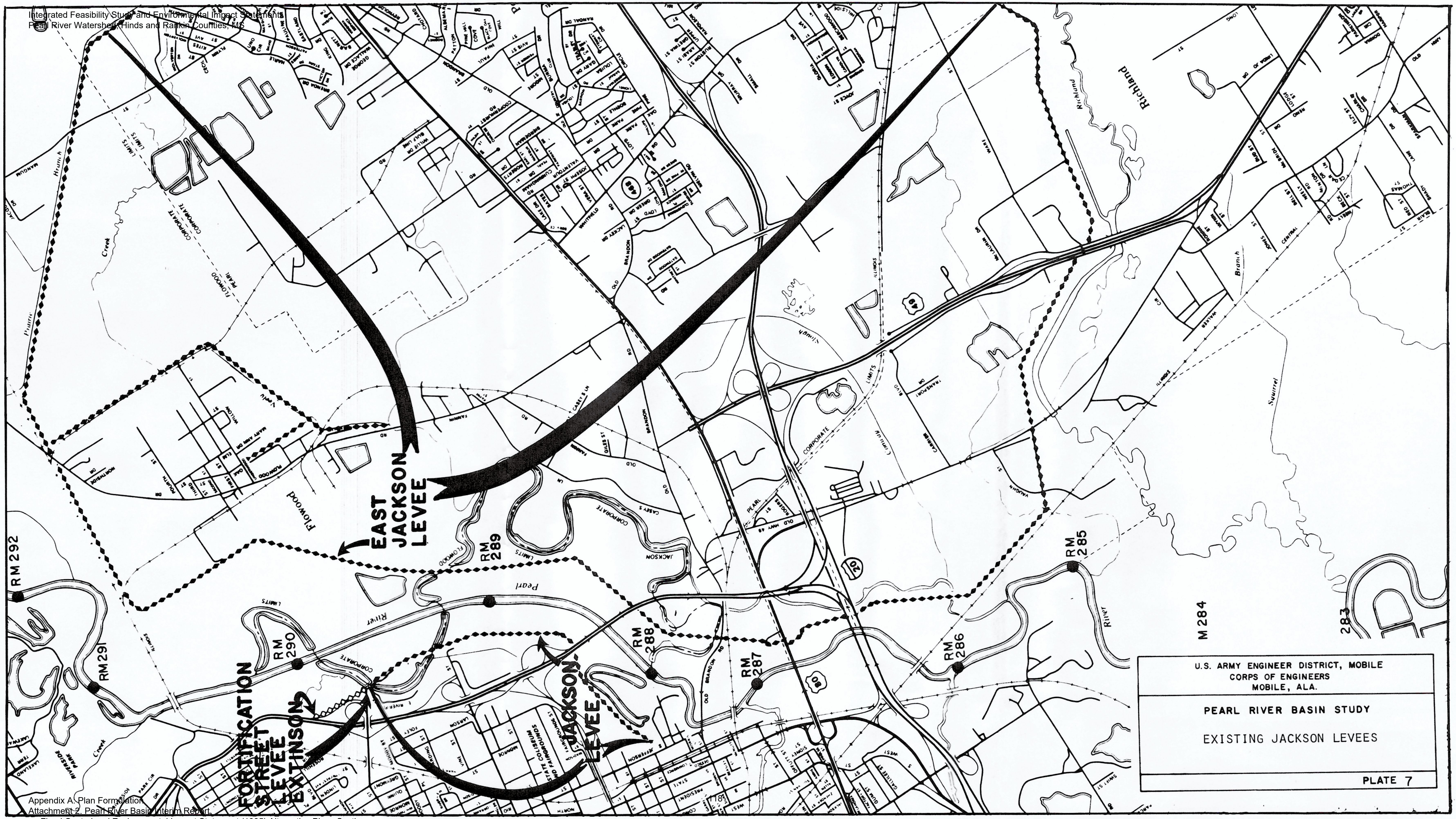
PEARL RIVER BASIN STUDY

LIMITS OF 1979 FLOOD

PLATE 4


MATCH TO PLATE 4
LIMITS OF 1979 FLOOD
Pearl River
RM 285
RM 284
RM 283
RM 282
RM 281
Creek
Squirrel Branch
Richland Creek
Richland
Richmond Lake
Sewage Treatment Plant
PARHAM BRIDGES PARK
CORPORATE LIMITS
Howard
1000 0 2000 4000
SCALE IN FEET
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
LIMITS OF 1979 FLOOD
PLATE 5


FLOOD CONTROL STUDY
LAKE SITES
PEARL RIVER
CHOCTAW
YOCKANOOKANY R
WINSTON
▲ SMALL UPSTREAM IMPOUNDMENTS
CARTHAGE DAM
ATTALA
LOBUTCHA CR
EDNBURG DAM & LAKE
MADISON
OFAHOMA DAM
SHOCCOE DAM
ROSS BARNETT RESERVOIR
PEARL R
KEMPT
LEAKE
NESHOBA
TUSCOLAMETA CR
SCOTT
NEWTON
JACKSON
RANKIN
PEARL RIVER
SMITH
SIMPSON
STRONG R
N
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
UPSTREAM RESERVOIR
PLATE 6


EAST JACKSON LEVEE
JACKSON LEVEE
FORTIFICATION STREET LEVEE EXTINSON
RM 292
RM 291
RM 290
RM 289
RM 288
RM 287
RM 286
RM 285
M 284
283
Flowood
Richland
Pearl
River
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
EXISTING JACKSON LEVEES
PLATE 7

FOUR POINT PLAN
PEARL RIVER

Carthage

SHOCCOE DAM

NATCHEZ TRACE PARKWAY

ROSS BARNETT RESERVOIR

WAVE BARRIER

ICG RR

Pearl

FORTIFICATION ST LEVEE CONSTRUCTION

BEND CUTOFF

MODIFICATION AT HWY. 25 BRIDGE

Jackson

ICG RR

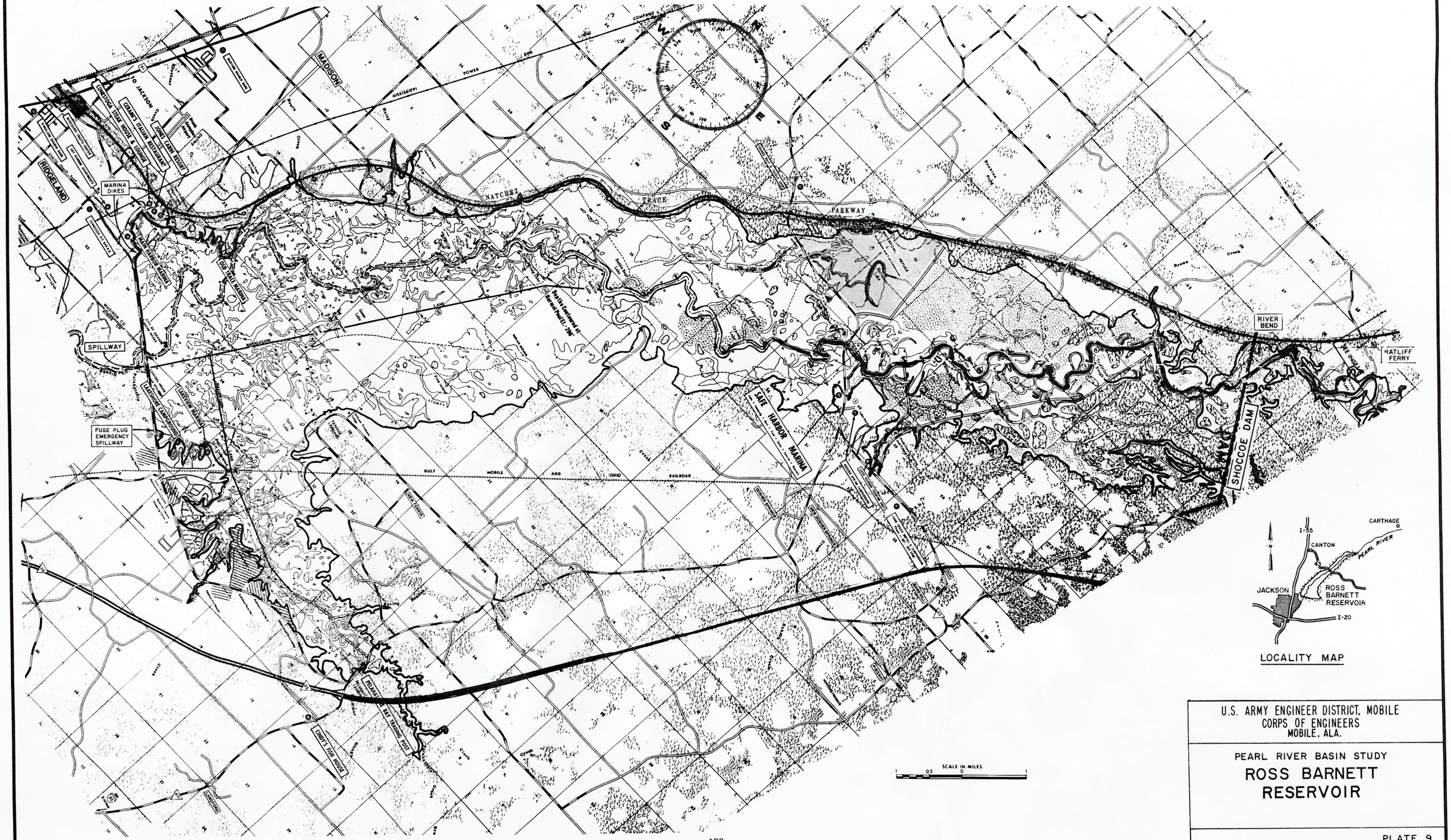
CLEARING THE FLOODWAY

NOT TO SCALE

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

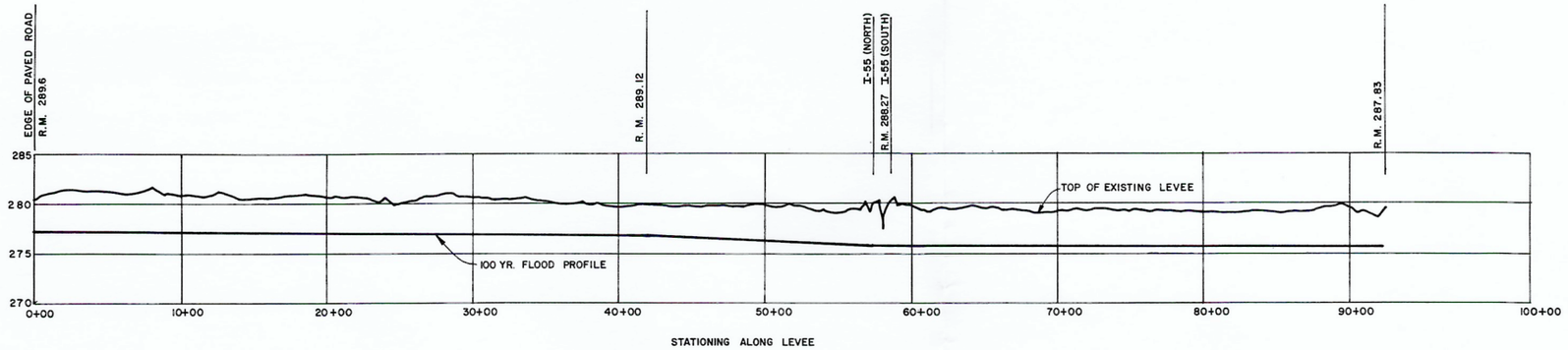
PEARL RIVER BASIN STUDY
INTERIN PLAN
[FOUR POINT PLAN]

PLATE 8

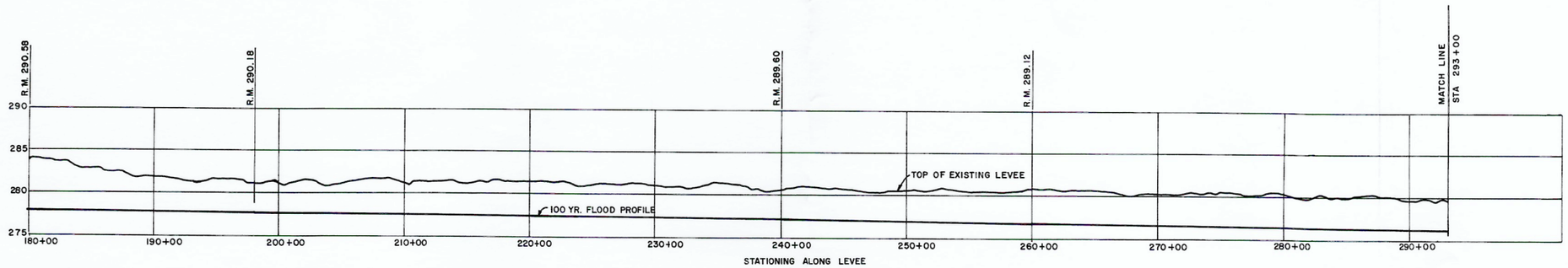

MADISON
RIDGELAND
MARINA DIKES
CONSTANZA STEAK HOUSE & LOUNGE
CRAMER'S ITALIAN RESTAURANT
JONES LANDING RESORT
NATCHEZ TRACE PARKWAY
SPILLWAY
FUSE PLUG EMERGENCY SPILLWAY
MAIN HARBOR MARINA
OLD TRACE MARINA
LAKEVIEW MARINA
LAKEHOUSE CAMPGROUND
GULF MOBILE AND OHIO RAILROAD
PELAHATCHIE BAY TRAINING POST
OMOY'S FISH HOUSE
RIVER BEND
RATLIFF FERRY
SAFE HARBOR MARINA
SHOCCOE DAM
SCALE IN MILES
CARTHAGE
I-55
CANTON
PEARL RIVER
JACKSON
ROSS BARNETT RESERVOIR
I-20
LOCALITY MAP
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
ROSS BARNETT RESERVOIR
PLATE 9

U.S. ARMY CORPS OF ENGINEERS

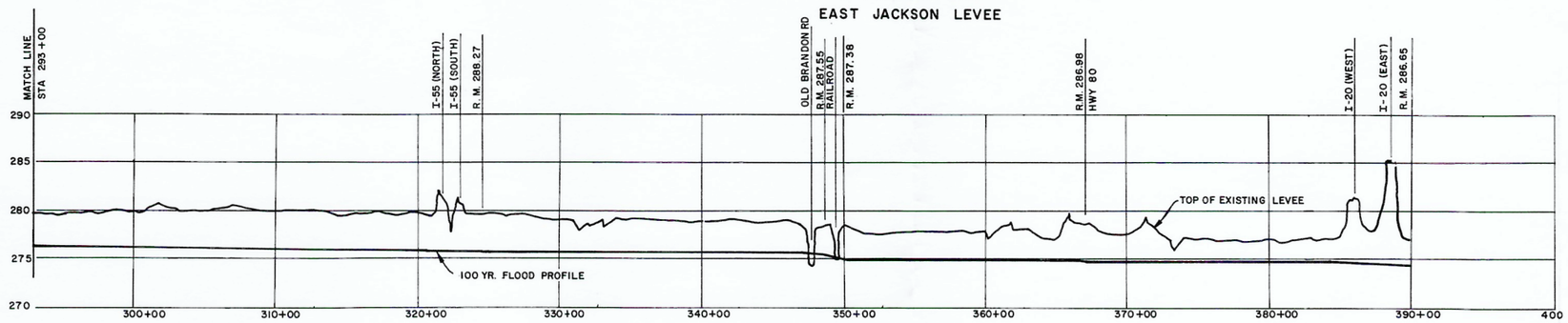
REVISIONS				
SYM.	ZONE	DESCRIPTION	DATE	APPROVED



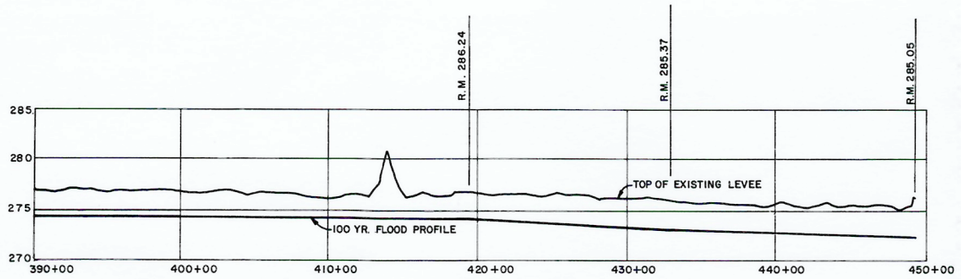
FAIRGROUND LEVEE



EAST JACKSON LEVEE



EAST JACKSON LEVEE



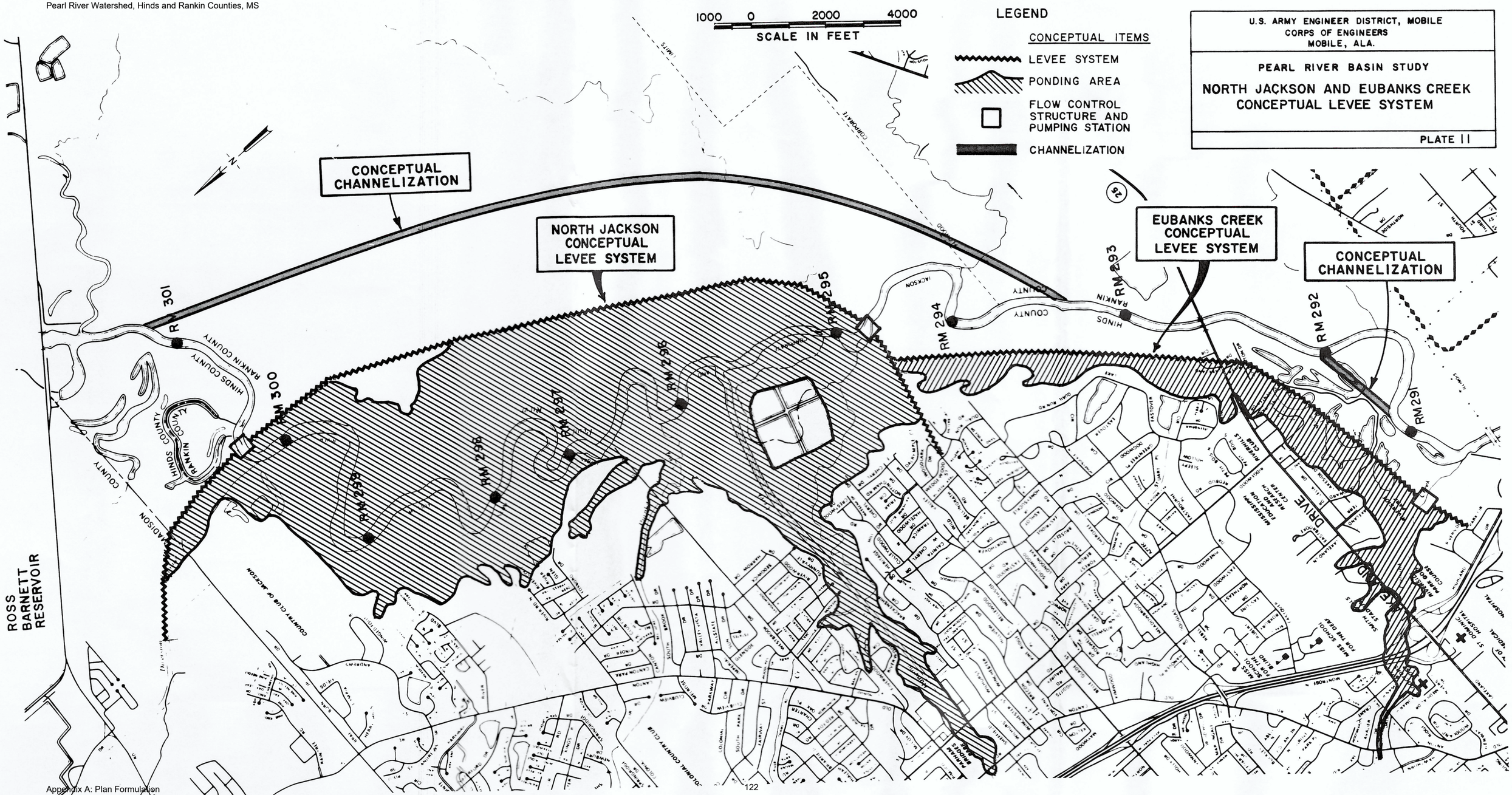
EAST JACKSON LEVEE

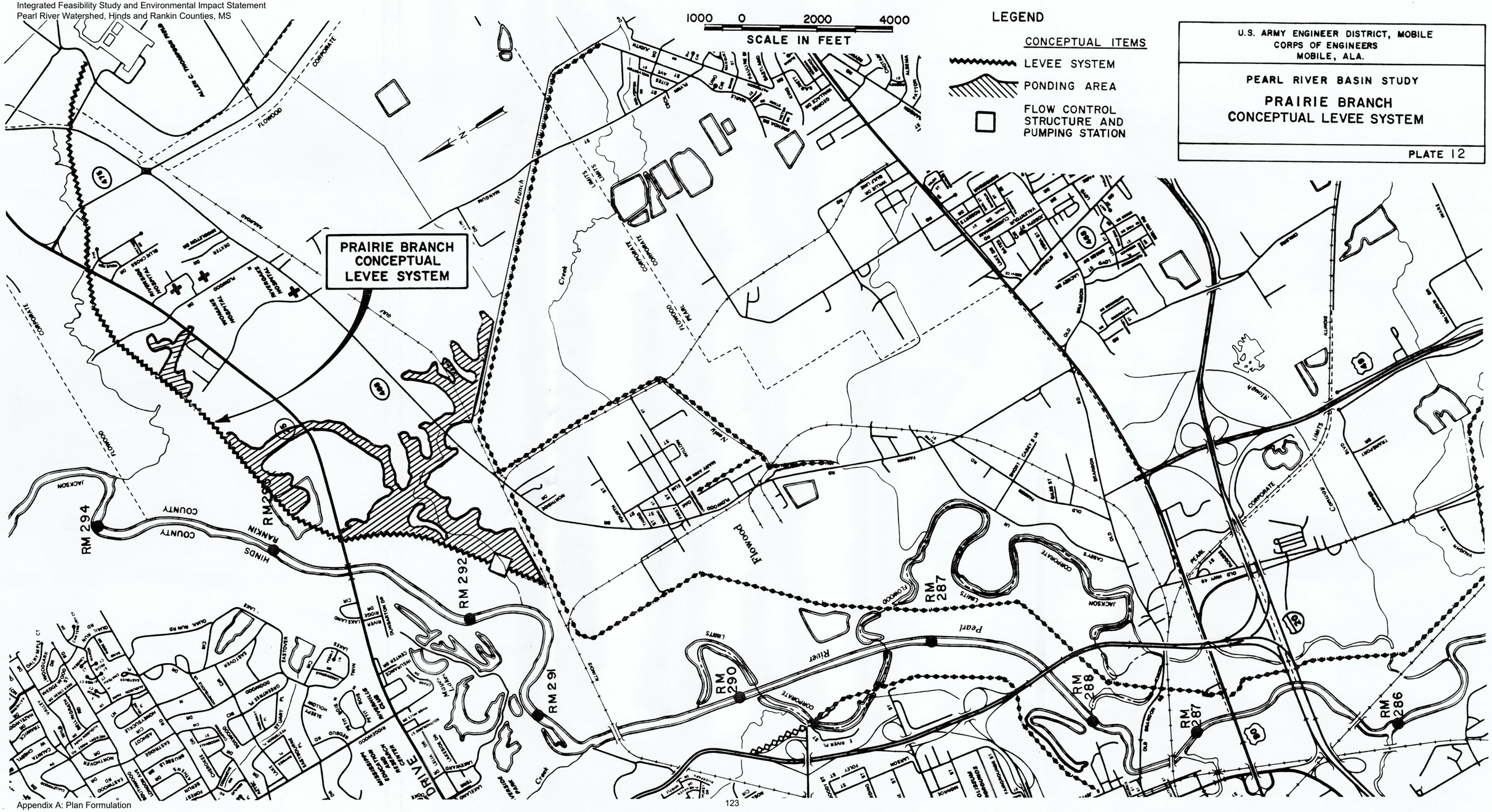
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

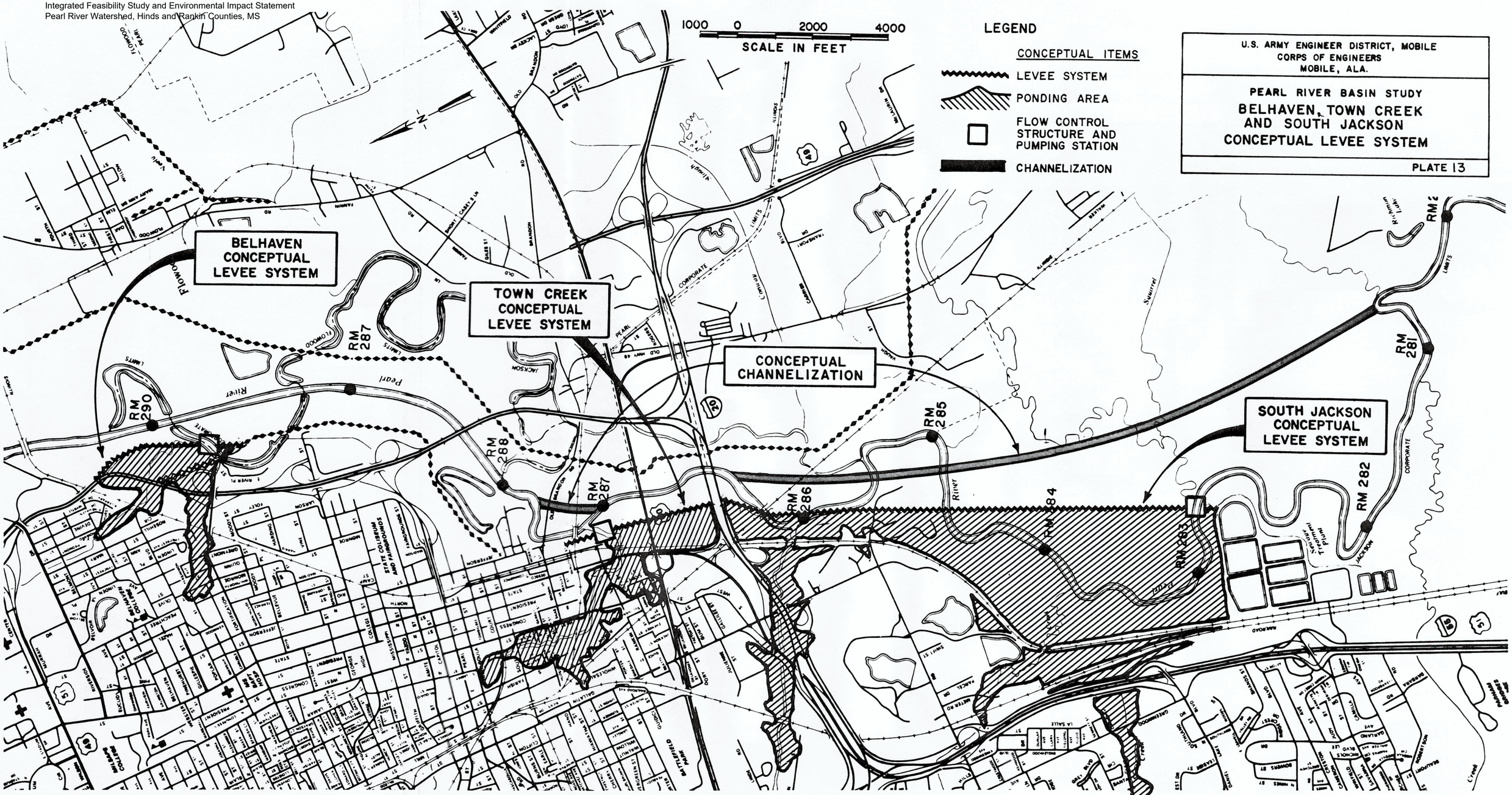
PEARL RIVER BASIN STUDY

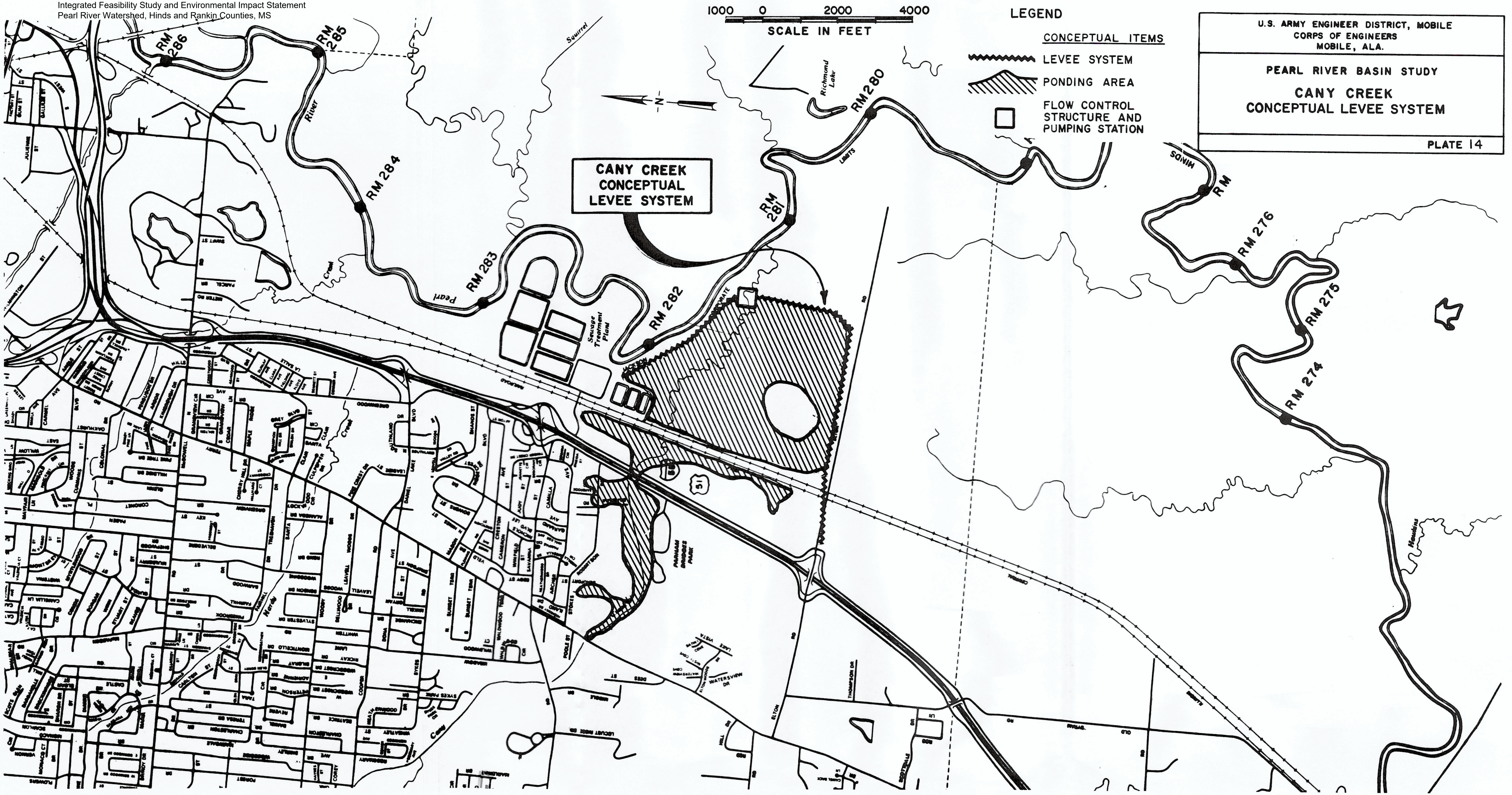
PROFILES OF
JACKSON LEVEES

PLATE 10


1000 0 2000 4000
SCALE IN FEET
LEGEND
CONCEPTUAL ITEMS
LEVEE SYSTEM
PONDING AREA
FLOW CONTROL STRUCTURE AND PUMPING STATION
CHANNELIZATION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
NORTH JACKSON AND EUBANKS CREEK CONCEPTUAL LEVEE SYSTEM
PLATE II
CONCEPTUAL CHANNELIZATION
NORTH JACKSON CONCEPTUAL LEVEE SYSTEM
EUBANKS CREEK CONCEPTUAL LEVEE SYSTEM
CONCEPTUAL CHANNELIZATION
ROSS BARNETT RESERVOIR
RM 301
RM 300
RM 299
RM 298
RM 297
RM 296
RM 295
RM 294
RM 293
RM 292
RM 291
HINDS COUNTY
RANKIN COUNTY
COUNTY CLUB OF JACKSON
COLONIAL COUNTRY CLUB


1000 0 2000 4000
SCALE IN FEET
LEGEND
CONCEPTUAL ITEMS
LEVEE SYSTEM
PONDING AREA
FLOW CONTROL STRUCTURE AND PUMPING STATION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
PRAIRIE BRANCH
CONCEPTUAL LEVEE SYSTEM
PLATE 12
PRAIRIE BRANCH CONCEPTUAL LEVEE SYSTEM
RM 294
RM 292
RM 291
RM 290
RM 288
RM 287
RM 286
RANKIN COUNTY
HINDS COUNTY
JACKSON COUNTY
Pearl River
Flowood
Creek
CORPORATE LIMITS
LEVEE


1000 0 2000 4000
SCALE IN FEET
LEGEND
CONCEPTUAL ITEMS
LEVEE SYSTEM
PONDING AREA
FLOW CONTROL STRUCTURE AND PUMPING STATION
CHANNELIZATION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
BELHAVEN, TOWN CREEK AND SOUTH JACKSON CONCEPTUAL LEVEE SYSTEM
PLATE 13
BELHAVEN CONCEPTUAL LEVEE SYSTEM
TOWN CREEK CONCEPTUAL LEVEE SYSTEM
CONCEPTUAL CHANNELIZATION
SOUTH JACKSON CONCEPTUAL LEVEE SYSTEM
RM 290
RM 287
RM 288
RM 285
RM 286
RM 284
RM 283
RM 282
RM 281
Pearl River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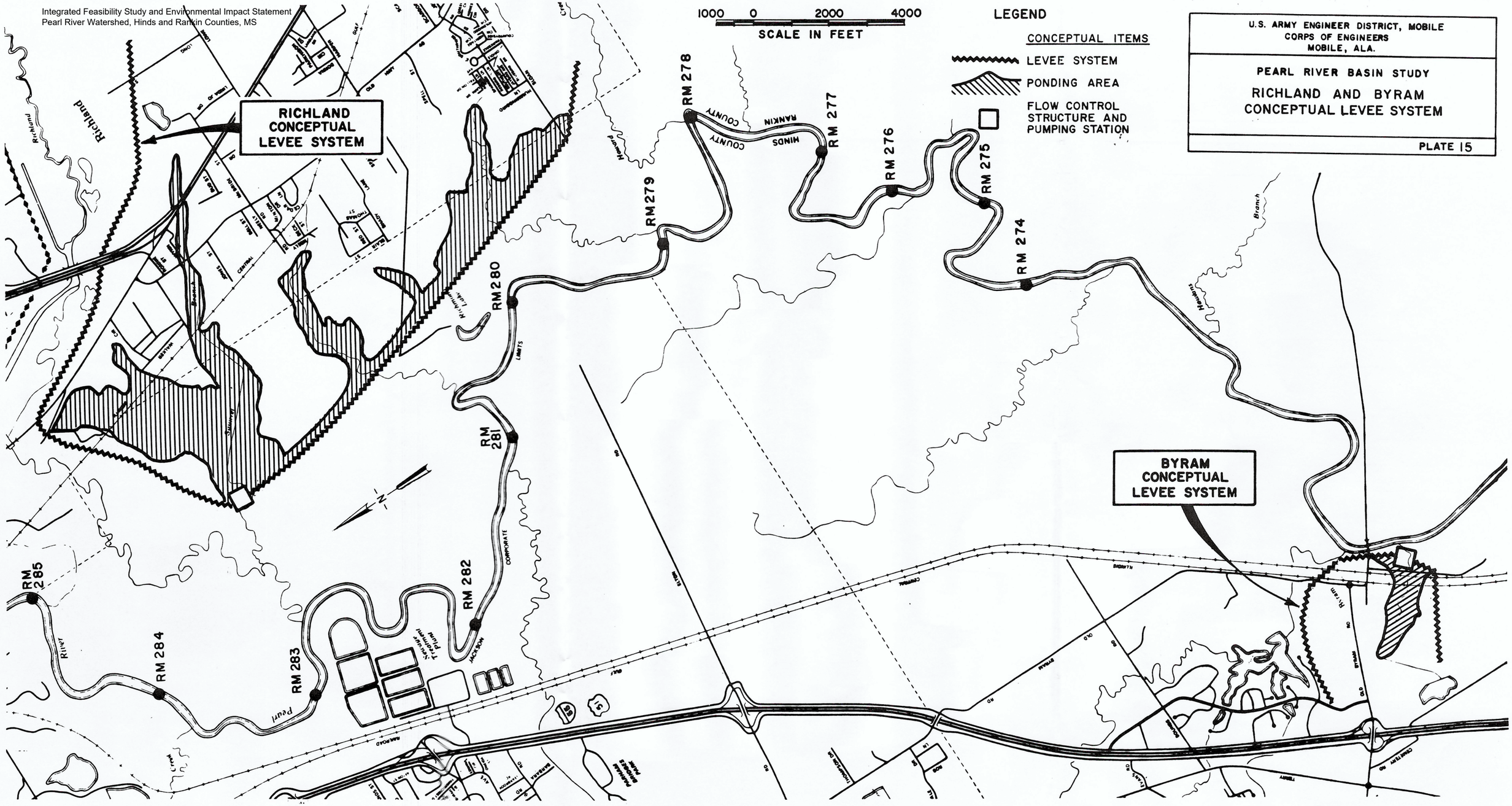
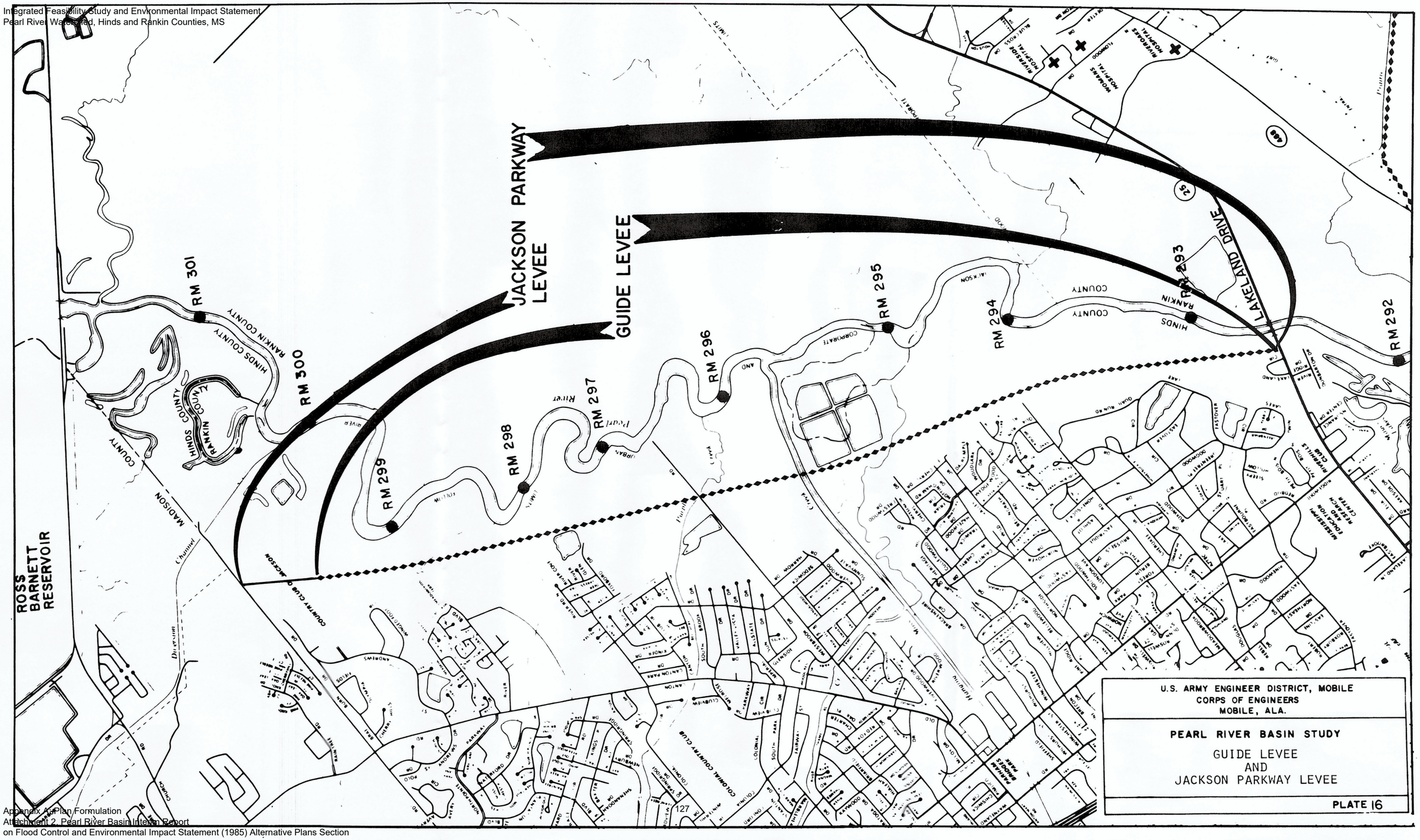
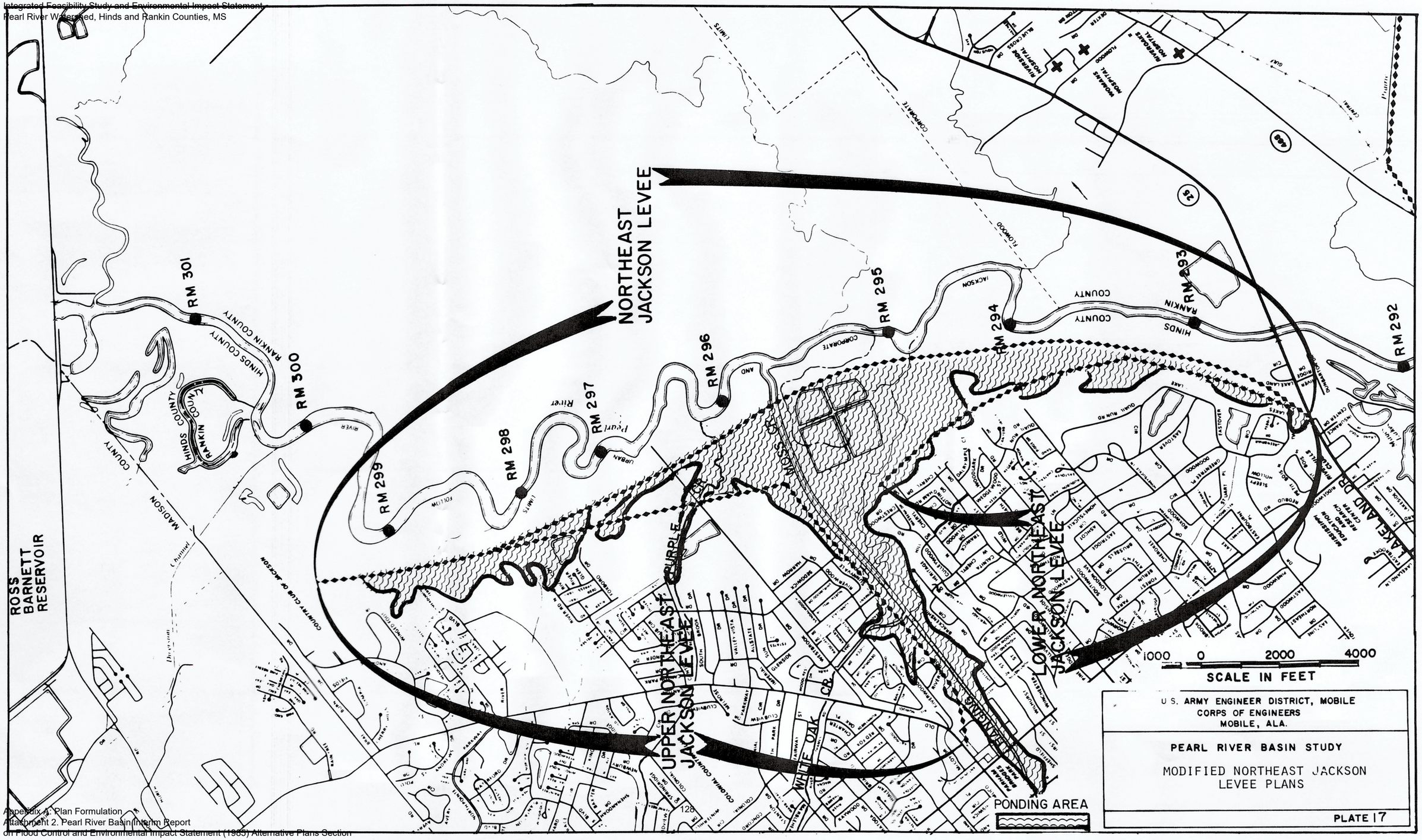
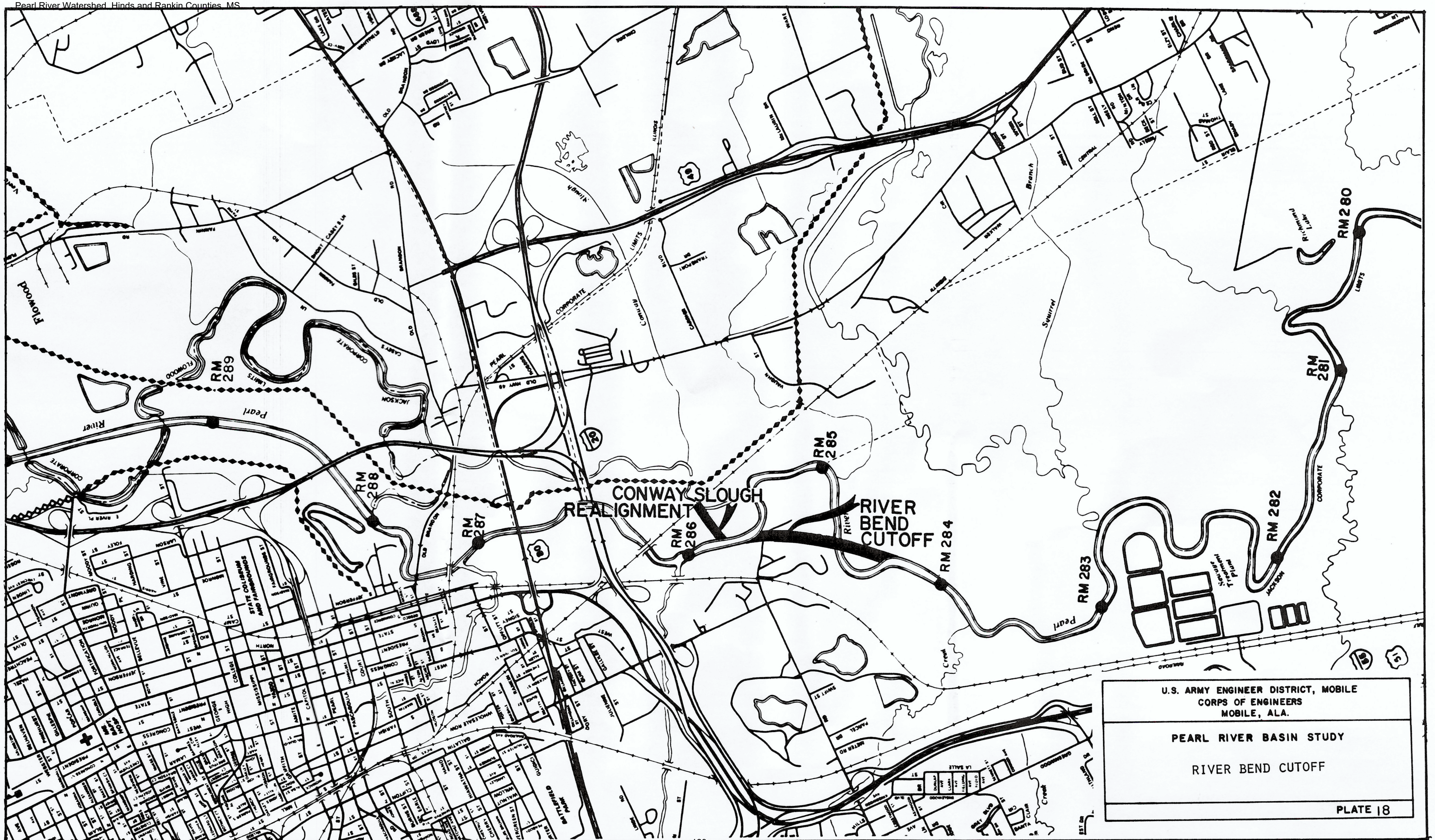
SCALE IN FEET
LEGEND
CONCEPTUAL ITEMS
LEVEE SYSTEM
PONDING AREA
FLOW CONTROL STRUCTURE AND PUMPING STATION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
CANY CREEK
CONCEPTUAL LEVEE SYSTEM
PLATE 14
CANY CREEK
CONCEPTUAL
LEVEE SYSTEM
N
RM 286
RM 285
RM 284
RM 283
RM 282
RM 281
RM 280
RM 276
RM 275
RM 274
Pearl River
Squirrel
Richmond Lake
Sewage Treatment Plant
Parham Bridges Park
51


1000 0 2000 4000
SCALE IN FEET
LEGEND
CONCEPTUAL ITEMS
LEVEE SYSTEM
PONDING AREA
FLOW CONTROL STRUCTURE AND PUMPING STATION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
RICHLAND AND BYRAM
CONCEPTUAL LEVEE SYSTEM
PLATE 15
RICHLAND CONCEPTUAL LEVEE SYSTEM
BYRAM CONCEPTUAL LEVEE SYSTEM
RM 278
RM 277
RM 276
RM 275
RM 274
RM 279
RM 280
RM 281
RM 282
RM 283
RM 284
RM 285
HINDS COUNTY
RANKIN COUNTY
Pearl River
Richland
Byram
Jackson
Corporate Limits
Sewage Treatment Plant


JACKSON PARKWAY
LEVEE
GUIDE LEVEE
ROSS
BARNETT
RESERVOIR
RM 301
RM 300
RM 299
RM 298
RM 297
RM 296
RM 295
RM 294
RM 293
RM 292
HINDS COUNTY
RANKIN COUNTY
LAKELAND DRIVE
COUNTRY CLUB OF JACKSON
COLONIAL COUNTRY CLUB
MADISON
Channel
Diversion
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
GUIDE LEVEE
AND
JACKSON PARKWAY LEVEE
PLATE 16


NORTHEAST JACKSON LEVEE
UPPER NORTHEAST JACKSON LEVEE
LOWER NORTHEAST JACKSON LEVEE
RM 301
RM 300
RM 299
RM 298
RM 297
RM 296
RM 295
RM 294
RM 293
RM 292
ROSS BARNETT RESERVOIR
HINDS COUNTY
RANKIN COUNTY
MADISON COUNTY
COUNTY CLUB OF JACKSON
COLUMBIA COUNTRY CLUB
WHITE OAK CR
LAKELAND DR
PONDING AREA
1000 0 2000 4000
SCALE IN FEET
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
MODIFIED NORTHEAST JACKSON LEVEE PLANS
PLATE 17

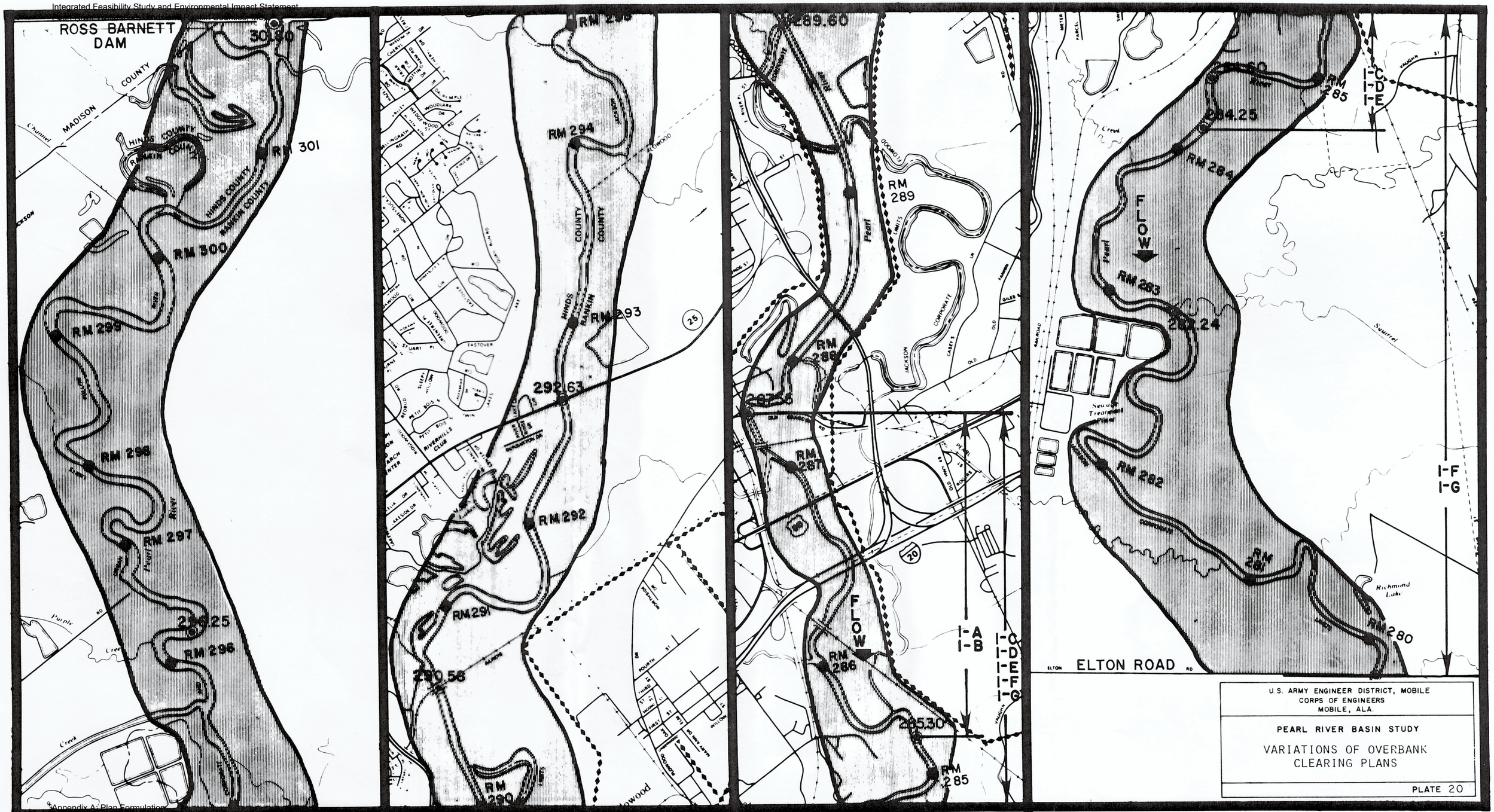

CONWAY SLOUGH
REALIGNMENT
RIVER
BEND
CUTOFF
RM 280
RM 281
RM 282
RM 283
RM 284
RM 285
RM 286
RM 287
RM 288
RM 289
Pearl
River
Flowood
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
RIVER BEND CUTOFF
PLATE 18

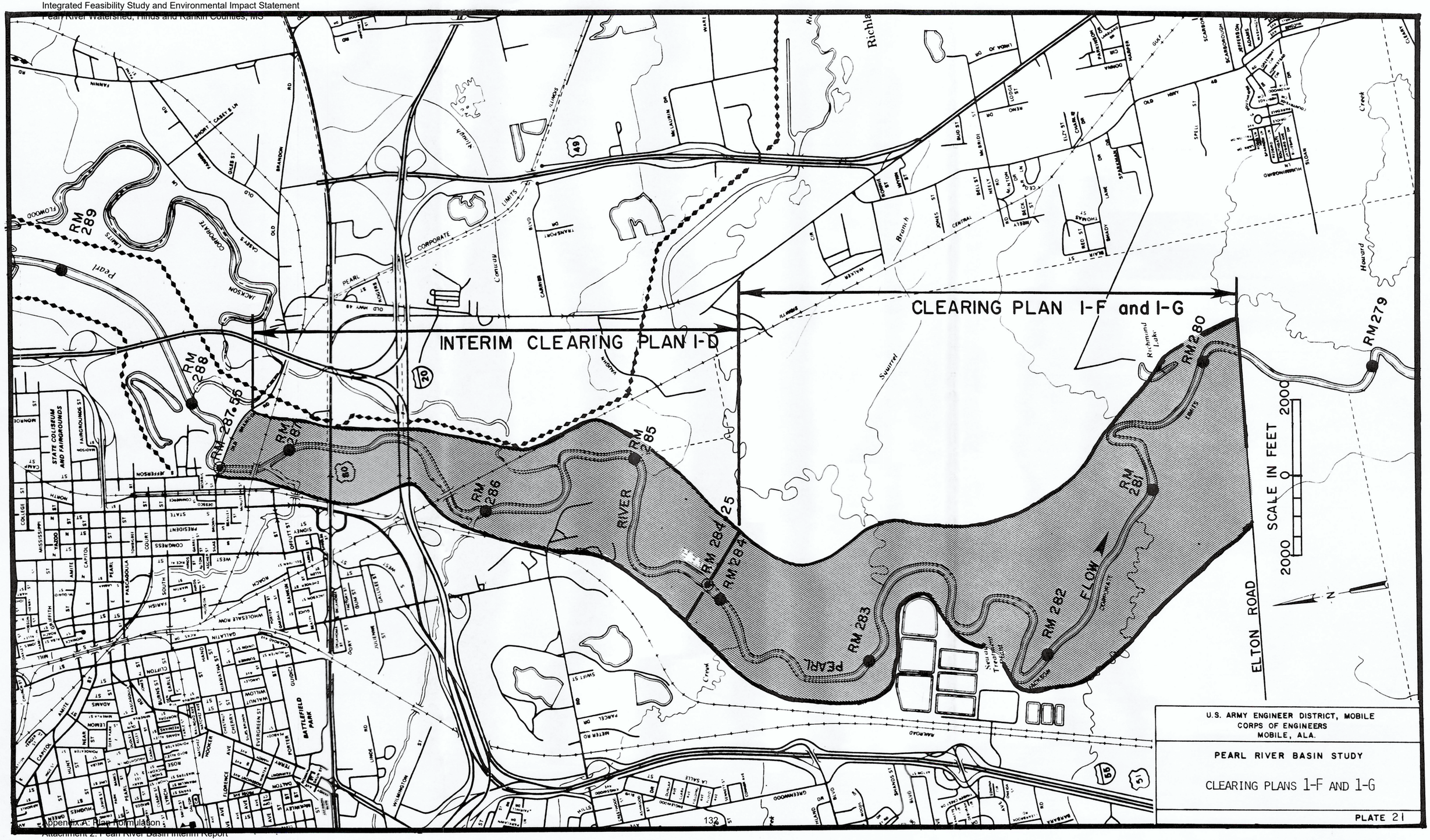
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

PEARL RIVER BASIN STUDY

OVERBANK CLEARING PLAN

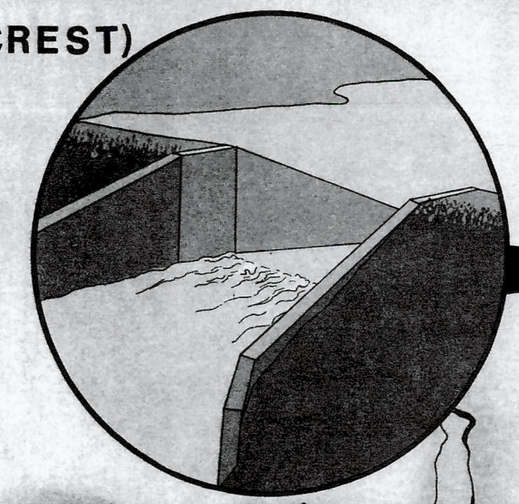
PLATE 19


ROSS BARNETT DAM
RM 301
RM 300
RM 299
RM 298
RM 297
RM 296
RM 294
RM 293
RM 292
RM 291
RM 290
RM 289
RM 288
RM 287
RM 286
RM 285
RM 284
RM 283
RM 282
RM 281
RM 280
MADISON COUNTY
HINDS COUNTY
RANKIN COUNTY
Pearl River
Channel
Creek
Stennis
Richmond Lake
ELTON ROAD
FLOW
I-A
I-B
I-C
I-D
I-E
I-F
I-G
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
VARIATIONS OF OVERBANK CLEARING PLANS
PLATE 20


INTERIM CLEARING PLAN I-D
CLEARING PLAN I-F and I-G
RM 289
RM 288
RM 287.55
RM 287
RM 286
RM 285
RM 284.25
RM 284
RM 283
RM 282
RM 281
RM 280
RM 279
PEARL RIVER
FLOW
ELTON ROAD
SCALE IN FEET
2000
0
2000
N
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
PEARL RIVER BASIN STUDY
CLEARING PLANS 1-F AND 1-G
PLATE 21

SHOCCOE DAM
PEARL RIVER

ALTERNATE
SERVICE SPILLWAY
(FIXED CREST)



WIDTH OF SERVICE
SPILLWAY 120'

PEARL RIVER

MAIN DAM
EARTH FILL

HEIGHT - 43'
LENGTH - 14,600'
TOP ELEV - 343'
BASE WIDTH - 307'
CROWN WIDTH - 10'

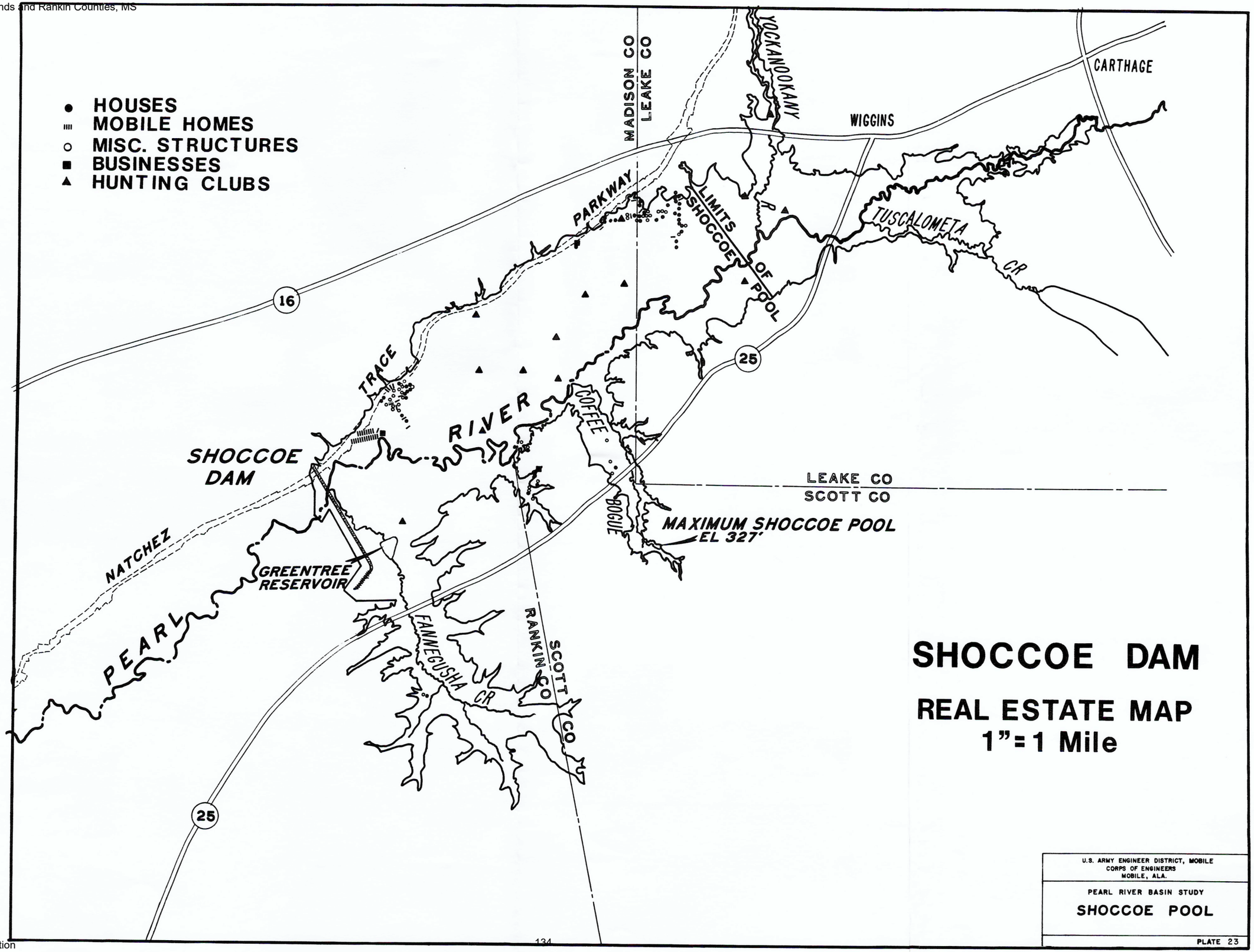
N

EMERGENCY SPILLWAY
3000' LONG
CREST ELEV 327'
(79 FLOOD LEVEL)

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

PEARL RIVER BASIN STUDY
SHOCCOE DAM
ARTIST'S CONCEPT

PLATE 22



SHOCCOE DAM

REAL ESTATE MAP
1"= 1 Mile

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

PEARL RIVER BASIN STUDY

SHOCCOE POOL

PLATE 23

Attachment 3. *Flood Control, Pearl River Basin, Mississippi, Jackson Metropolitan Area, Mississippi, Draft Feasiblity* (sic) *Report and Draft Environmental Impact Statement* (1996) Preliminary Screening Section

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96-82

US Army Corps of Engineers
Vicksburg District

FLOOD CONTROL, PEARL RIVER BASIN, MISSISSIPPI

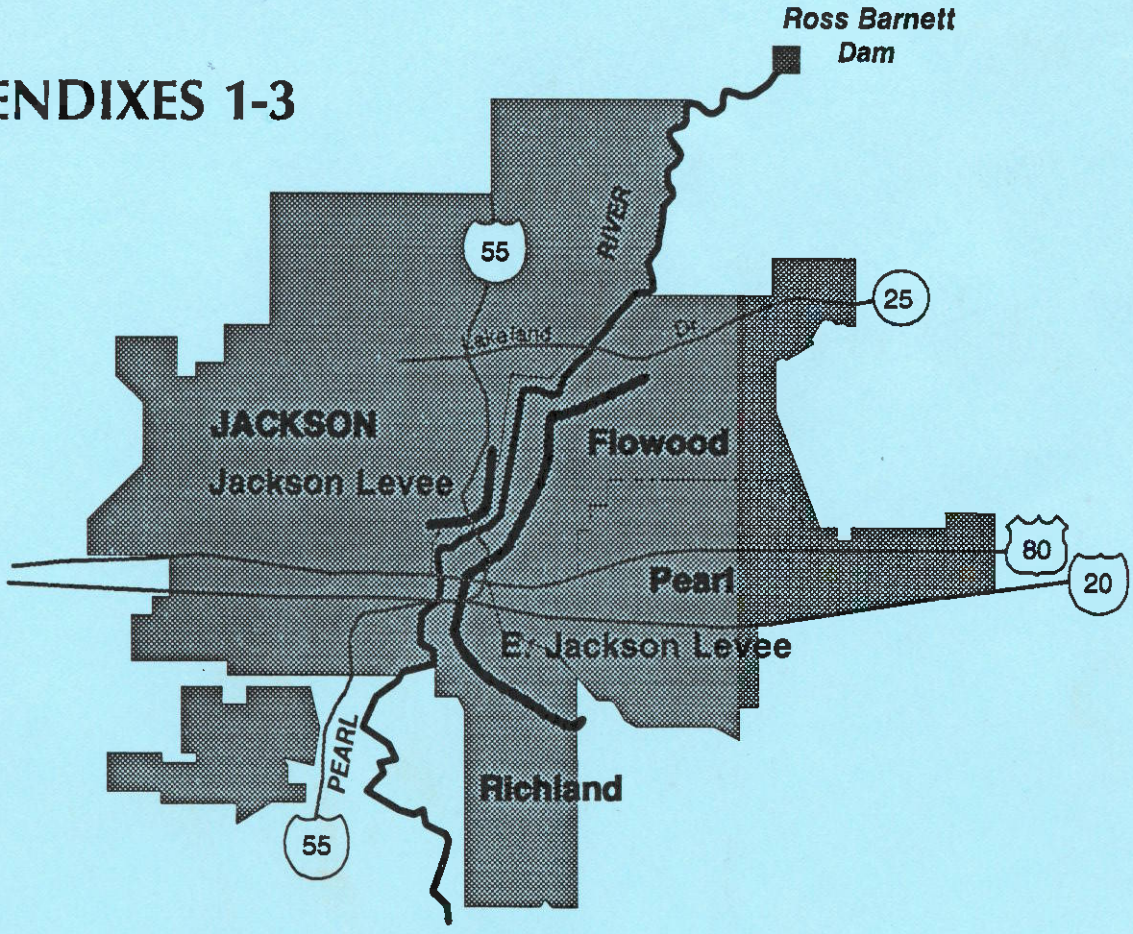
JACKSON METROPOLITAN AREA, MISSISSIPPI

FEASIBLITY REPORT
VOLUME I

MAIN REPORT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

APPENDIXES 1-3



DRAFT

JANUARY 1996

79. Displacement of people by the floods and/or the project should be minimized to the extent practicable.

PRELIMINARY SCREENING

80. A broad range of flood damage reduction measures was considered in the screening process during the reconnaissance studies and previous feasibility studies by the Mobile District in their Pearl River Basin Interim Report on Flood Control, July 1985.

81. The affected public provided assistance in identifying other alternatives to be evaluated. A scoping meeting was held in Jackson to outline the study procedures and receive public input concerning the study process and problems in the area.

82. During the early stages of the feasibility study, a review was made of existing Corps data and prior studies of the known flooding problems throughout the Pearl River Basin. Other flood problems identified included areas in Columbia, Mendenhall, and Carthage, Mississippi. Coordination with the project sponsor and SCS resulting in no further consideration of these areas by the Corps at the present time since recent Corps investigations in these areas were negative. SCS is pursuing investigation in each of these areas.

83. Alternatives identified in the reconnaissance study to provide flood protection to the Jackson Metropolitan area include no-action, nonstructural, and structural measures. These alternatives are discussed in the following paragraphs.

No-Action Alternative

84. A no-action alternative was considered, but it would not eliminate any of the damages the metropolitan area has historically experienced. This would result in continued flood damage, trauma, and serious disruptions to human endeavors in the capital area and associated impacts to the entire State of Mississippi.

Nonstructural Alternatives

85. All practicable nonstructural measures to reduce flood damages were considered in the early screening of alternatives. While some were eliminated during early formulation of alternatives, others were evaluated in detail to determine if a combination of structural and nonstructural measures would comprise the best solution for the overall project.

86. Basically, two types of nonstructural measures for flood protection exist--those which reduce existing damages and those which reimburse for existing damages and reduce future damage potential. Those nonstructural measures which reduce damages and were investigated to varying degrees in this study include the following:

a. Floodproofing by waterproofing of walls and openings in structures.

b. Raising structures in place.

c. Constructing walls or levees around structures.

d. Permanent flood plain evacuation.

(1) Relocate structures and contents to flood-free area.

(2) Relocate contents and demolish structures. Provide replacement housing.

e. Flood forecasting and warning systems with temporary evacuation.

87. Nonstructural measures which compensate or reimburse for existing damages and/or reduce future damages include:

a. Acquisition of flood-prone property.

b. Flood plain regulation by zoning ordinances, regulations, and building codes.

c. Flood insurance.

88. Residential, commercial, and public structures in the flood plain are primarily slab-on-grade construction. Raising such structures through normal jacking procedures is impractical; therefore, raising structures in place and relocating structures outside the flood plain are not viable. Constructing walls or levees around structures would be impractical due to depth of flooding and the closeness of structures in our urban area.

89. Floodproofing would provide only limited protection and is not economically justified.

90. One nonstructural alternative was evaluated during previous studies by the Mobile District. This plan consisted of relocation of occupants and/or structures from the 10-year flood plain. This plan was not economically justified. This plan alone would directly benefit only a few families and businesses and does relatively little to solve the flood problem at Jackson. The city of Jackson applied for Federal funds to purchase six properties in the flood plain in northeast Jackson under Section 1362 of Public Law 90-448. All the owners subsequently decided not to sell.

91. An enhanced flood warning (forecasting) system is operated by the Jackson-Hinds Emergency Operations Center. Flood warnings are issued by the National Weather Service. Local governments are responsible for evacuation. In Jackson, the Police Department is the lead agency in evacuation efforts.

In the other municipalities, emergency procedures are handled by the mayors' offices. Flood plain management ordinances in all the communities in the Jackson area meet Federal standards.

Structural Flood Control Alternatives

92. Levee Plans.

a. During screening of plans for the feasibility study, costs were developed for six levee plans. These plans consisted of levees in Northeast Jackson, Lakeland Drive and Eubanks Creek, Belhaven Creek, Town and Lynch Creeks, South Jackson, Byram, Laurelwood and Flowood, and Richland and raising the existing Fairgrounds and East Jackson levees. The location of these levee segments is shown on Plate 3. These plans were designated as Plans A-1, A-2, B-1, B-2, C-1, and C-2. Levee Plans A-1, B-1, and C-1 consisted of opposite borrow (borrow alongside the levee). Plans A-2, B-2, and C-2 consisted of satellite borrow areas. All levee plans included adequate interior drainage facilities where the levees would block existing drainage.

b. Plans A-1 and A-2 each provided 100-year protection. Plans B-1 and B-2 each provided protection equivalent to the 1979 flood frequency. Plans C-1 and C-2 each provided 500-year protection. Benefits were not affected by the type of borrow.

c. Levee alignments were established to provide protection to all existing development practicable while minimizing the amount of flood plain protected by the levee. This eliminated the opportunity to evaluate a wide array of alignments. The levees were located as close as possible to the existing development while maintaining adequate storage volume within the leveed area for interior runoff. During sizing of the interior drainage facilities, some minor alignment changes were necessary. Minor alignment changes were also made during the evaluation of plans to avoid significant archeological sites and environmentally sensitive areas. However, the proximity of the existing development to the flood plain simply did not provide for an analysis of varied levee alignments.

d. Each plan consists of a segment of floodwall between the Eubanks Creek levee segment and the Northeast Jackson levee segment. This area is adjacent to the LeFleur's Bluff State Park. A levee segment along the river was considered and coordinated with MDWFP. This levee segment would have to be located across the middle of the park camping area and was unacceptable to MDWFP. A floodwall adjacent to the existing development along Lakeland Drive was the only other alternative.

e. A levee segment at Byram was considered during the reconnaissance study and during the early stages of the feasibility study. Damages in this area were not enough to incrementally justify a levee at this location. An analysis of downstream impacts of the proposed levee indicated that the project would not significantly increase stages in the Byram area. As a result, the Byram segment was eliminated from further consideration.

f. Each of the six plans consisted of bendway and overbank clearing between RM 290.7 and 301.7. This clearing was determined to be necessary to minimize the increase in flood stages between the levees above Lakeland Drive. The spillway of Ross Barnett Reservoir utilizes tainter gates to regulate releases. These gates are sensitive to tailwater effects. In order to not affect the release capability of the reservoir, it was necessary to incorporate this minimal amount of clearing. Channel excavation was not considered as an option due to the potential impact it would have on sandbars, which are critical habitat for the ringed sawback turtle. Approximately 168 acres of woodlands will be cleared and maintained to provide more efficient overbank flow in this area. Approximately 74 acres, which were previously cleared at certain bendways by the city, will be maintained.

g. Gravity drainage floodgates are required at numerous locations through the levee. These consisted of 9 box structures and 9 pipe structures. These structures provided adequate outlet capacity to prevent blocked drainage as a result of constructing the levees. Pumping facilities were considered as additional flood reduction measures and are addressed separately.

h. Both levee berms and slurry trenches were considered as measures for preventing underseepage along the proposed levees. Slurry trenches were selected as the preferred measure based on high land prices and environmental considerations.

i. Mitigation requirements were developed based on analysis of impacts to terrestrial wildlife. Fisheries and waterfowl impacts were determined to be insignificant with the proposed measures. Compensation requirements were developed based on acquisition of bottom-land hardwoods, acquisition and restoration of frequently flooded cleared lands by natural succession, and acquisition and reforestation of frequently flooded cleared lands with plantings of bottom-land hardwoods. Based on compensation requirements and costs, reforestation was the preferred method of compensation. A detail presentation of the compensation analysis is presented in Appendix 2.

j. A summary of the physical features of the six levee plans is presented in Table 1. Costs of the six levee plans are presented in Table 2. Based on the cost analysis, total satellite or offsite borrow was eliminated from further consideration. The costs of the remaining three basic levee plans were used to develop a cost curve for an array of levee heights that were evaluated using the new risk analysis procedures.

TABLE 1
PHYSICAL FEATURES OF LEVEE ALTERNATIVES

Plan	Levee Embankment (cubic yards)	Borrow Area (acres)	Slurry Trench (feet)	Total Right-of-Way (acres)	Mitigation (acres)
A-1	4,319,000	477	29,100	1,289	1,001
A-2	4,319,000	350	29,100	1,016	694
B-1	6,768,000	717	51,600	1,615	1,212
B-2	6,768,000	561	51,600	1,236	901
C-1	7,529,000	783	51,600	1,700	1,283
C-2	7,529,000	641	51,600	1,378	977

TABLE 2
FIRST COST OF ALTERNATIVE PLANS
($000)

Plan	Real Estate	Construction	Mitigation	Total First Cost
A-1	21,861	44,600	1,633	68,094
A-2	20,734	49,707	1,177	71,618
B-1	22,981	53,367	1,962	78,310
B-2	21,437	60,845	1,563	83,845
C-1	23,916	56,810	2,049	82,775
C-2	22,476	65,081	1,654	89,211
D-1	1,524	4,395	2,068	7,987
D-2	799	3,195	969	4,963
E-1	2,850	8,687	3,584	15,121
E-2	1,895	6,786	1,665	10,346

93. Clearing Plans. Four clearing plans were also evaluated as separate alternatives (Figures 1-4). These plans consisted of varying degrees of clearing between RM 278.8 and 292.6. These plans were identified as Plans D-1, D-2, E-1, and E-2. Plan D-1 included total clearing of the flood plain between RM 278.8 and 285.3 while D-2 consisted of selected clearing of this same area. Plan E-1 consisted of total clearing of the flood plain between RM 287.6 and 292.6, plus the area of Plan D-1. Plan E-2 consisted of selected clearing between RM 287.6 and 292.6, plus the area of selective clearing in Plan D-2. These plans are extensions of the existing clearing that was accomplished by the Corps in 1984. Costs for the four clearing plans are presented in Table 2. Physical features of the plans are depicted in Table 3.

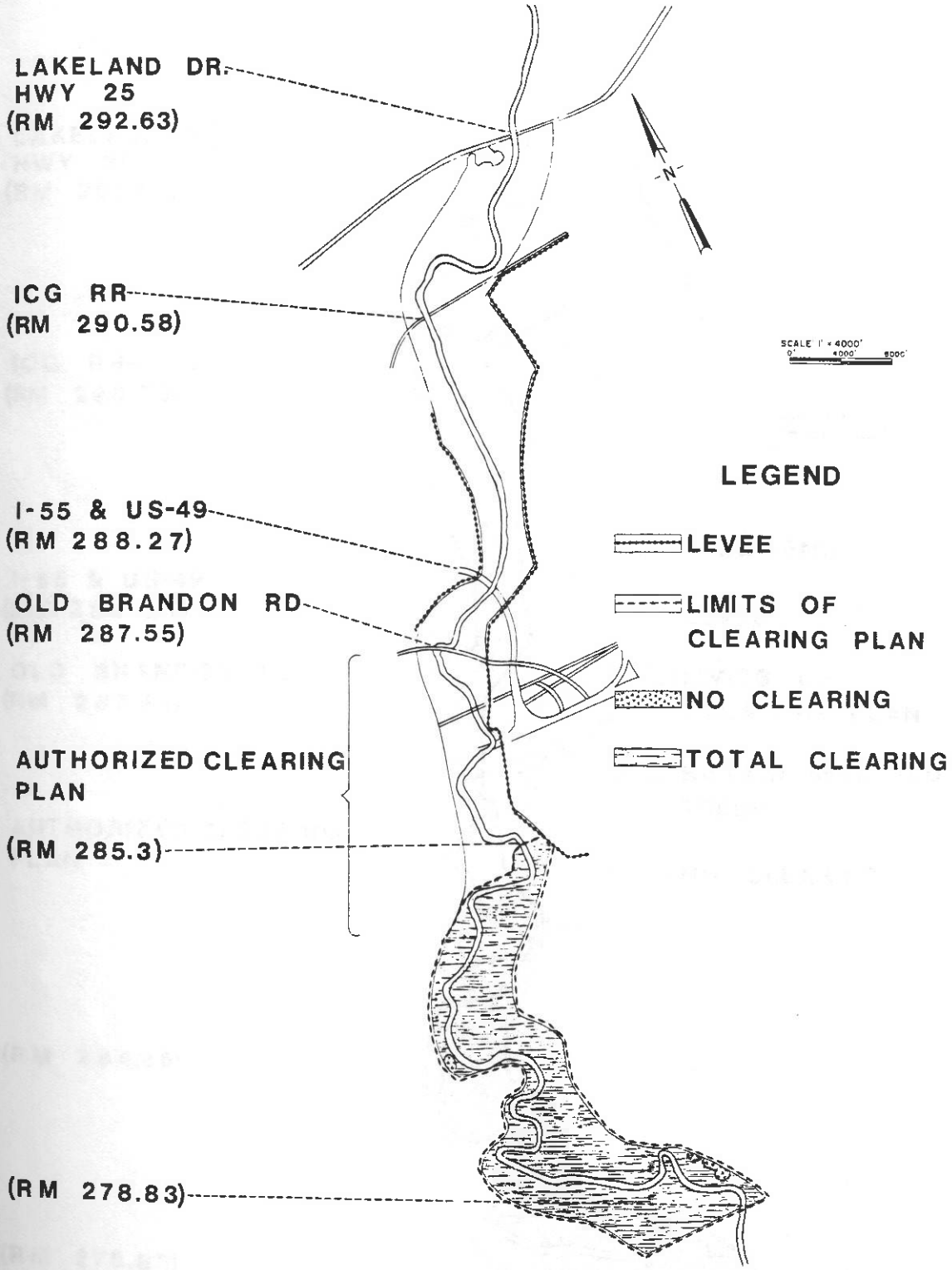


FIGURE 1
PLAN D-1

Vicinity of JACKSON, MS

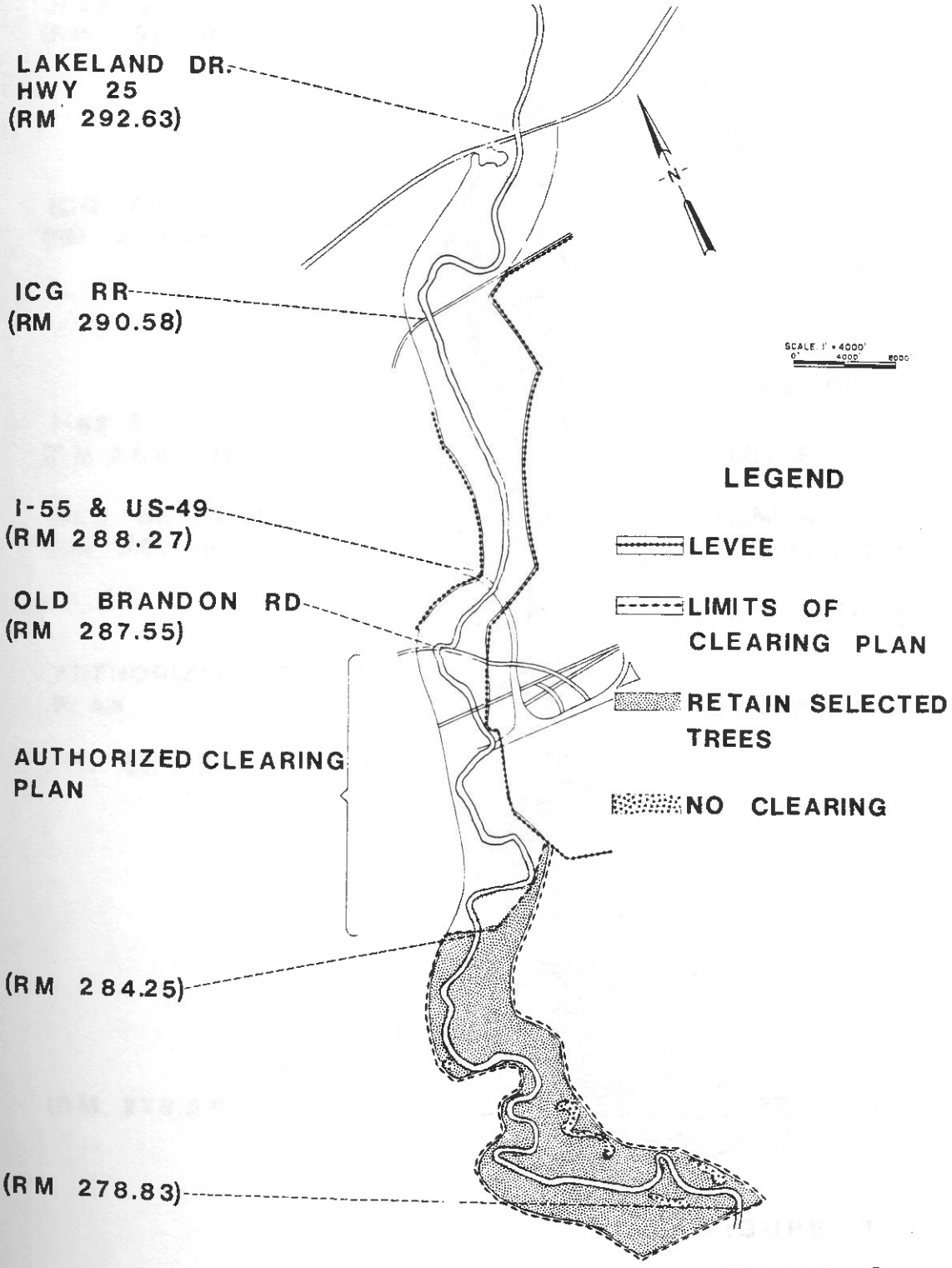


FIGURE 2

PLAN D-2

Vicinity of JACKSON, MS

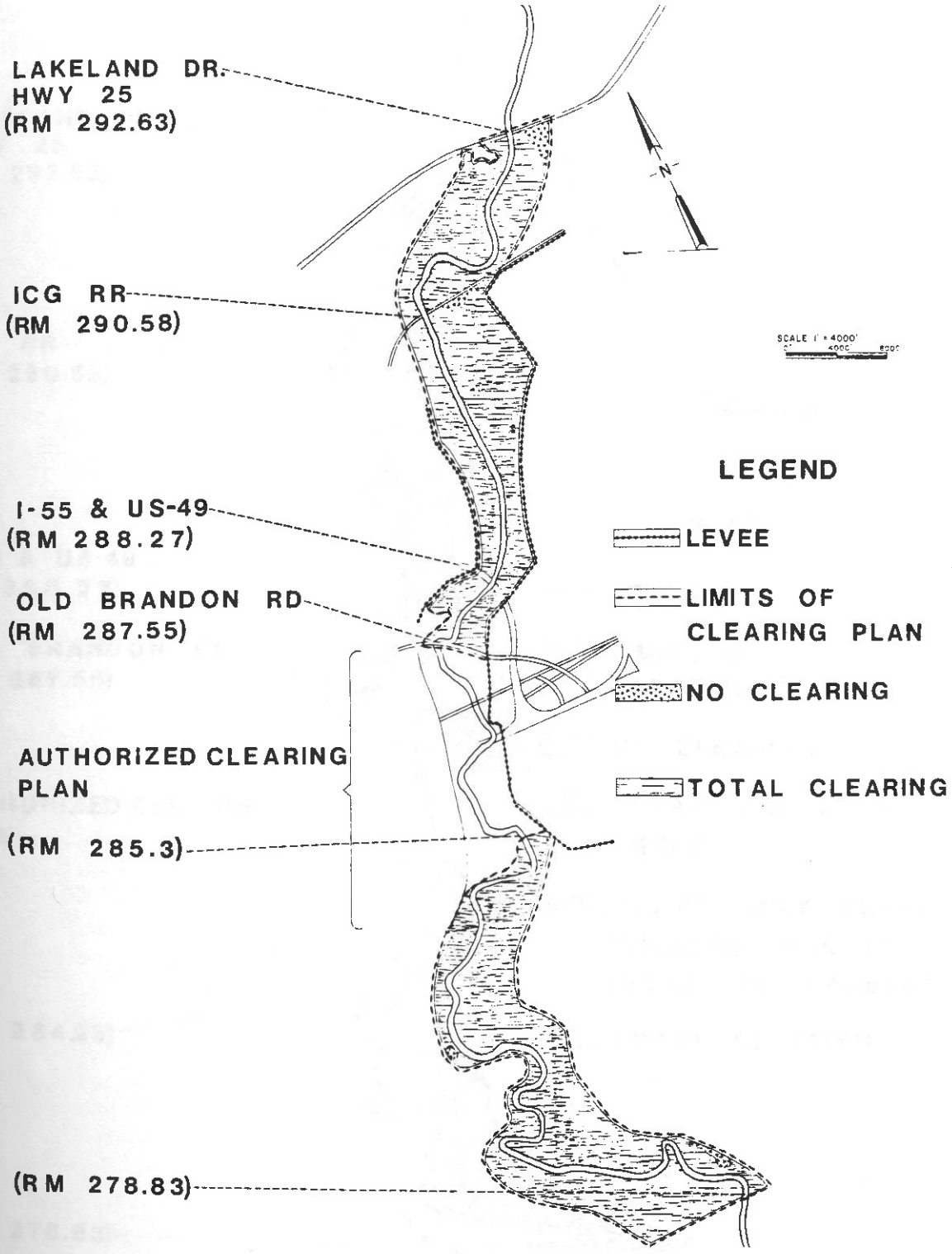


FIGURE 3

PLAN E-1

Vicinity of JACKSON, MS

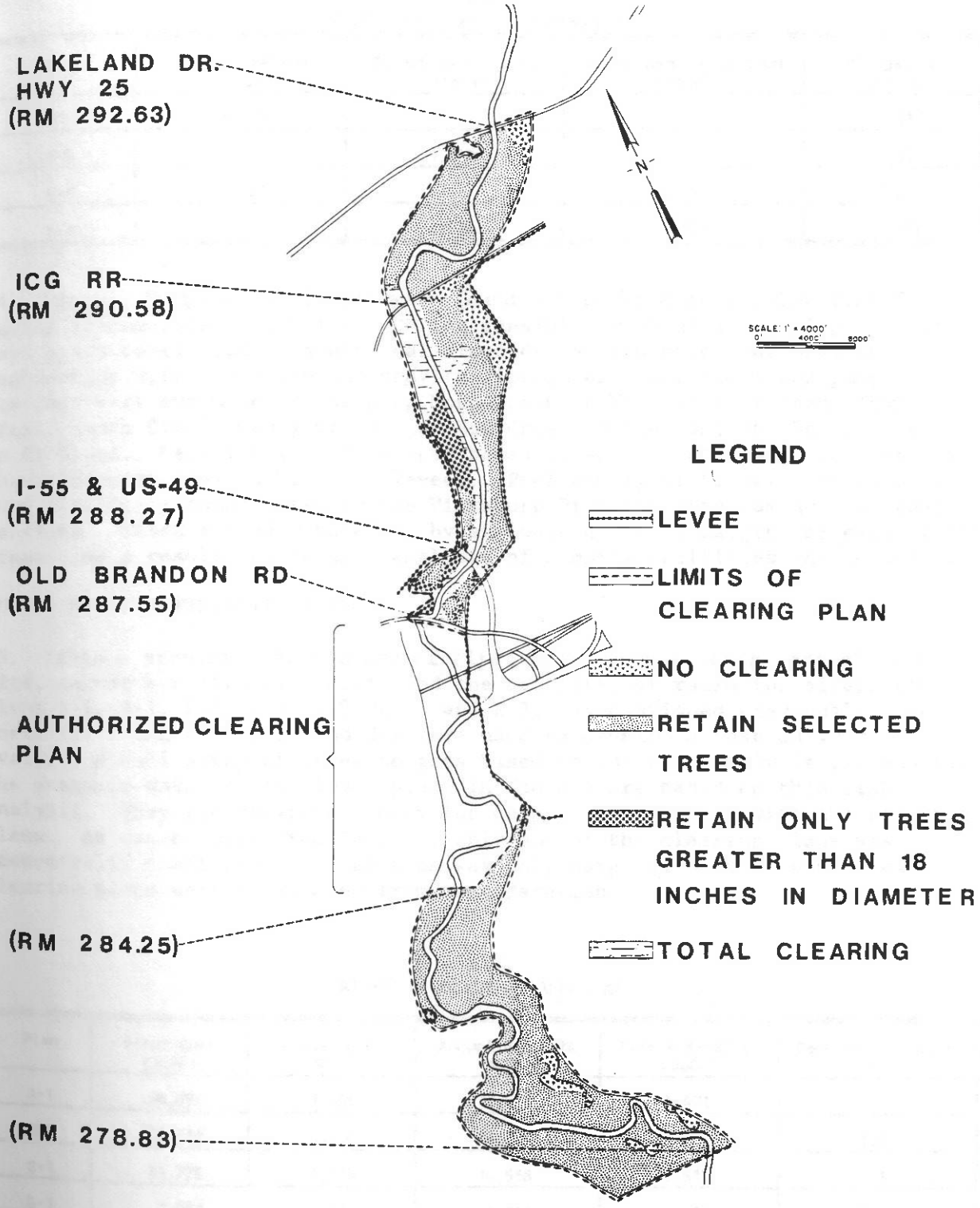


FIGURE 4

PLAN E-2

Vicinity of JACKSON, MS

TABLE 3
PHYSICAL FEATURES OF CLEARING PLANS

Plan	Total Clearing (acres)	Selective Clearing (acres)	Stone Bank Protection (tons)	Mitigation (acres)
D-1	1,402	--	--	1,317
D-2	--	1,247	--	511
E-1	2,562	--	11,000	2,408
E-2	--	2,225	11,000	987

94. Pumps. Pumping facilities were found not to be economically justified during reconnaissance studies. During feasibility studies, pumping facilities were again considered as additional flood damage reduction measures in combination with the levee and gravity floodgates. Locations for pump stations were evaluated at Hanging Moss Creek in Northeast Jackson; Town Creek, Lynch Creek, Caney Creek, and Hog Creek in Flowood; and Squirrel Branch in Richland. Benefits were developed based on additional damage reduction in these interior areas behind the levees. Preliminary costs based on comparable pump facilities constructed by the Vicksburg District were compared to these benefits. Costs exceeded benefits by at least a 8 to 1 margin for each of the areas. As a result, no further analysis of pumping facilities was conducted.

SCREENING OF ALTERNATIVE PLANS

95. Table 4 presents the summary of first cost, annual costs, annual benefits, excess benefits over cost, and the benefit-cost ratio for alternative Plans A-1, B-1, C-1, D-1, D-2, E-1, and E-3. As mentioned previously, the costs for Plans A-1, B-1, and C-1 were used to develop a cost curve to evaluate a full array of levee heights based on the risk analysis procedures. The economic data for the levee plans in Table 4 are based on this risk analysis. They are shown here only for comparison purposes with the clearing plans. As can be seen from Table 4, only one of the clearing plans was economically justified and that plan was only marginal. As a result, all clearing plans were eliminated from consideration.

TABLE 4
SUMMARY OF ECONOMIC ANALYSIS a/

Plan	First Cost ($000)	Annual Cost ($000)	Annual Benefits ($000)	Excess Benefits ($000)	Benefit-Cost Ratio (%)
A-1	68,094	7,505	12,976	5,471	1.7
B-1	78,310	8,604	14,124	5,520	1.6
C-1	82,775	9,053	14,568	5,515	1.6
D-1	7,987	1,136	1,218	82	1.1
D-2	4,963	785	445	(340)	0.6
E-1	15,111	2,053	1,684	(369)	0.8
E-2	10,346	1,549	829	(720)	0.5

NOTE: Numbers in parenthesis represent negative benefits.
a/ Based on May 1993 price levels, 7-3/4 percent discount rate.

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Attachment 4. *Flood Control, Pearl River Basin, Mississippi, Pearl River Watershed, Mississippi, Feasibility Study Draft and Environmental Impact Statement - Preliminary* (2007) Preliminary Screening Section

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US Army Corps of Engineers®
Vicksburg District

Flood Control, Pearl River Basin, Mississippi
PEARL RIVER WATERSHED, MISSISSIPPI

Feasibility Study

MAIN REPORT

Draft & Environmental Impact Statement

Volume I

PRELIMINARY

Not for Public Release

DRAFT

February 2007

89. Displacement of people by the floods and/or the project should be minimized to the extent practicable.

PRELIMINARY SCREENING

90. The Pearl River Basin Interim Report on Flood Control, July 1985, completed by the Mobile District, recommended Shoccoe Dam to protect the Jackson Metropolitan Area. The draft Jackson Metropolitan Area, Mississippi, completed by the Vicksburg District in January 1996, recommended a comprehensive levee plan. Both studies considered a broad range of flood damage reduction measures in the screening process.

91. The affected public provided assistance in identifying other issues to be evaluated. A NEPA scoping meeting with approximately 400 in attendance was held in Jackson on 23 February 2004 to outline the study procedures and receive public input concerning the study process and problems in the area. An information meeting was held on 11 March 2004 in Biloxi, Mississippi, with approximately 50 in attendance. The transcripts of these meetings are included in Appendix 1.

92. Alternatives considered in this feasibility study to provide flood protection to the Pearl River Watershed include no-action, the comprehensive levee plan, and the LL plan. These alternatives are discussed in the following paragraphs.

NO-ACTION ALTERNATIVE

93. A no-action alternative was considered, but it would not eliminate any of the damages the metropolitan area has historically experienced. This would result in continued flood damage, trauma, and serious disruptions to human endeavors in the capital area and associated impacts to the entire State of Mississippi.

COMPREHENSIVE LEVEE PLAN

GENERAL

94. The comprehensive levee plan consists of constructing approximately 21.9 miles of new levee, 3,720 feet of floodwall, enlarging 10.5 miles of the existing Jackson and East Jackson levees, building 9 box culverts and 9 concrete pipe water control structures, and constructing landside connecting ditches. The comprehensive levee plan is shown on Plate 3. Limited overbank clearing would be required to reduce stages at Lakeland Drive and minimize adverse impacts to the tailwater on the Ross Barnett spillway. This overbank clearing consists of a 100-foot strip on each side of the channel top bank from RM 290.5 to 301.5 and a 400-foot strip across six bendways. Plates 4-V-1 through 4-V-17 in Volume II show the proposed alignment of the levee and the location of major drainage structures and landside connecting ditches.

95. The levees would be fully compacted, have 1 vertical on 3 horizontal side slopes, a 10-foot-wide crown, and a 5-foot-thick impervious riverside face. Because of the 1 vertical on 3 horizontal landside slope, no roadway addition was considered. Any roadway crown addition would have added substantial construction and real estate requirements. For new levee closures required at highways, railroads, etc., an earthen and sandbag closure would be required. The Fairgrounds and East Jackson levee enlargements would be constructed on the landside of the existing levee to minimize the necessity of impervious clay materials. Additional borrow borings would be taken during the preparation of plans and specifications to confirm this.

Levee Segments

96. Each levee segment is described in the following paragraphs:

a. Northeast Jackson levee (Station 0+00 to 301+54). The Northeast Jackson levee (shown on Plates 4-V-1, 4-V-2, and 4-V-3) begins in the Jackson Country Club area near County Line Road and extends southward along the west bank of the Pearl River to Lakeland Drive (Highway 25). This proposed levee segment is approximately 5 miles long and has an average height of 22 feet. From Highway 25, a floodwall would extend south and westward to high

ground just east of Eubanks Creek. This floodwall is required because of the highly developed area south of Lakeland Drive and the close proximity to LeFleur Bluff State Park (Mayes Lakes area).

b. Eubanks Creek (Station 0+00 to 16+96). This segment, shown on Plate 4-V-3, begins at high ground just south of Lakeland Drive and extends southerly to Eubanks Creek, then continues in a westward direction to high ground. The levee would be 0.3 mile long and have an average height of 24.5 feet.

c. Belhaven Creek (Station 0+00 to 17+06). The Belhaven Creek Reach, shown on Plate 4-V-4, is an extension of the existing Fairgrounds levee necessitated by an increase in the level of protection for that area. The levee begins at high ground along the shoulder of the northbound lane of Interstate 55. The average height of the levee is 25 feet and is approximately 0.3 mile long.

d. Fairgrounds levee (Station 0+00 to 92+41). The entire Jackson levee, shown on Plate 4-V-4, will be enlarged to raise it 3 to 5 feet to provide the same level of protection as the new levees. In addition, the extension along the Fortification Street ramp will be raised to the proposed levee design grade and be connected to the Belhaven Creek levee. This segment would be approximately 1,600 feet long.

e. Town and Lynch Creeks levee (Station 0+00 to 71+95). This reach of levee, shown on Plate 4-V-5, begins on high ground near the Old Brandon Road crossing on the Pearl River (Woodrow Wilson Bridge) and proceeds southerly along the west bank of the river. The levee crosses Highway 80 and Interstate 20 before tying into high ground just south of Lynch Creek. The levee is approximately 1.4 miles long and has an average height of 17 feet.

f. South Jackson levee (Station 0+00 to 198+63). The South Jackson levee, shown on Plates 4-V-6 and 4-V-7, begins at high ground approximately 1 mile above the Jackson Sewage Treatment Plant and extends south along the west bank of the river until it reaches the disposal pond levees. A riverside enlargement of the perimeter levee around the plant would be required. The levee would then extend south from that point and ultimately tie back into high ground just north of Elton Road interchange on Interstate 55 south. Approximately 3.8 miles of levee would be required for this portion of the comprehensive levee system and the average height of the levee would be 10 feet.

g. Flowood levee (Station 0+00 to 279+24). This levee, shown on Plates 4-V-8 and 4-V-9, originates on high ground at a point approximately 0.25 mile west of Fannin Road and 1.25 miles north of Highway 25 (Lakeland Drive) and extends southwesterly around a newly developed residential area. From this point, the levee would continue approximately parallel to

Lakeland Drive before turning southwesterly to follow along the east bank of the Pearl River. After crossing Lakeland Drive, the levee would continue to follow the east bank of the river until intersecting the existing East Jackson levee just west of Highway 468. This segment of levee would be approximately 5.3 miles long and have an average height of 13 feet.

h. East Jackson levee (Station 140+00 to 626+25). Approximately 8.7 miles of the existing East Jackson levee, shown on Plates 4-V-10 to 4-V-14, would be raised approximately 2 to 6 feet to provide design flood protection. Also, a 0.5-mile extension would be required at the downstream end tying into the ICGR embankment just north of Childre Road. The upper limits of the levee enlargement would end near Highway 468.

i. Richland levee (Station 0+00 to 264+34). The Richland levee, shown on Plates 4-V-15 to 4-V-17, would be "U-shaped" around the city of Richland. It would begin at high ground east of Highway 49 and extend northwesterly across Highway 49 to a point near the ICGR embankment. From this point, the levee turns westerly until it crosses the ICGR embankment. Then the levee would extend southerly to high ground 0.25 mile southeast of the intersection of Old Highway 49 and the ICGR. Approximately 5 miles of levee would be required for this portion of the levee system with an average height of 13 feet.

Gravity Floodgates

97. Structures recommended to be built through the project levee are listed below.

a. Northeast Jackson.

Station 25+30 - Two 60-inch-diameter concrete pipes

Station 110+93 - Two 12- by 12-foot box culverts

Station 147+18 - One 12- by 12-foot box culvert

Station 235+51 - Two 48-inch-diameter concrete pipes

b. Floodwall extension.

Station 291+11 - One 36-inch-diameter concrete pipe

c. Eubanks Creek.

Station 10+94 - Two 8- by 7-foot box culvert

d. Fairgrounds extension.

Station 9+64 - One 12- by 10-foot box culvert

e. Town and Lynch Creeks.

Station 16+65 - Three 12- by 12-foot box culverts

Station 65+90 - Three 12- by 12-foot box culverts

f. South Jackson.

Station 37+79 - Two 48-inch-diameter concrete pipes

Station 165+34 - Two 9- by 9-foot box culverts

g. Flowood.

Station 41+57 - Two 48-inch-diameter concrete pipes

Station 92+27 - One 48-inch-diameter concrete pipe

Station 175+05 - Two 6- by 5-foot box culverts

Station 197+24 - Two 36-inch-diameter concrete pipes

Station 257+94 - Two 8- by 6-foot box culverts

h. Richland.

Station 31+50 - One 36-inch-diameter concrete pipe

Station 152+74 - Two 48-inch-diameter concrete pipes

Property Relocations

98. Due to the increase in stages between the proposed levees in the vicinity of Lakeland Drive, existing development on each side of Lakeland Drive on the west bank of the Pearl River would be adversely affected. Stages could increase by as much as 1 foot in this area with the larger floods. Early investigations revealed that a levee or floodwall could not be constructed around this development without acquiring many of the 28 buildings at this location. As a result, the recommended plan includes total acquisition of this area. Two other commercial buildings adjacent to the Richland levee will likely require acquisition due to their proximity to Richland Creek.

Mitigation Measures

99. Following the detail design of the comprehensive levee plan, compensation requirements were recomputed. The recommended compensation measure of acquisition and reforestation of frequently flooded cleared lands was evaluated. Based on the analysis in Appendix 2, approximately 1,680 acres would be required to offset adverse terrestrial impacts of the comprehensive levee plan. Due to the fact that mitigation would be accomplished during construction of the project and all lands would be acquired from willing sellers, the specific location of the mitigation land cannot be determined until immediately prior to the time of acquisition. Table 1 depicts the criteria used in the selection of the lands at the time of acquisition. Development measures proposed for the mitigation lands include planting of appropriate open areas in bottom-land hardwood species, establishing necessary access roads, surveying and establishing boundaries, and establishing a management headquarters.

TABLE 1
MITIGATION SITE SELECTION CRITERIA

DRAINAGE BASIN LOCATION CRITERIA
1. Lower Pearl River Basin (south of Jackson and west of Interstate 59)
2. Upper Pearl River Basin (north of Jackson)
3. Bogue Chitto River Basin
4. Bayou Pierre River Basin
5. Mississippi Delta-Yazoo River Basin, Sunflower River Basin, etc.
6. Lower Big Black River Basin (west of Interstate 55)
7. Leaf River Basin
EXISTING LAND USE TYPE CRITERIA
1. Degraded wetlands in riverine flood plains; e.g., abandoned surface mines, actively farmed lands, pasture lands
2. Degraded upland forests in riverine flood plains
3. Cutover forested wetlands
4. Mature bottom-land forests
LAND REHABILITATION METHODS CRITERIA
1. Wetland restoration including replacement of hydrology and woody vegetation
2. Wetland reforestation where hydrology is in place
3. Reforestation of uplands associated with riverine habitats
4. Preservation of a unique habitat or a habitat important to a Federally listed threatened or endangered species
SPECIFIC LAND LOCATION CRITERIA
1. Sites adjacent to state management areas, national wildlife refuges, U.S. Forest Service lands, etc., that are managed for fish and wildlife
2. Sites adjacent to existing forested areas
3. Sites adjacent to farmed areas that would provide corridors between wooded areas
4. Sites adjacent to developed residential areas
5. Sites adjacent to developed commercial areas

SUMMARY OF COMPREHENSIVE LEVEE PLAN

100. Table 2 shows a breakdown of the costs for the comprehensive levee plan. An economic summary is shown in Table 3.

TABLE 2
SUMMARY OF FIRST COST a/
COMPREHENSIVE LEVEE PLAN

Account	Item	Amount ($)
01	Lands and Damages b/	67,282,446
02	Relocations	17,266,188
06	Fish and Wildlife Facilities	695,797
11	Levees and Floodwalls	64,256,458
15	Floodway Control and Diversion Structures	25,122,665
30	Planning, Engineering, and Design	21,802,250
31	Construction Management	9,339,300
	TOTAL	205,765,104

a/ October 2006 price levels.
b/ Includes mitigation lands.

TABLE 3
ECONOMIC SUMMARY
COMPREHENSIVE LEVEE PLAN

Item	Amount
First Cost ($)	205,765,000
Interest During Construction ($)	12,175,000
Total Investment ($)	217,940,000
Interest ($)	10,625,000
Sinking Fund ($)	1,084,000
Annual Operation and Maintenance ($)	123,000
Total Annual Cost ($)	11,832,000
Expected Annual Benefits ($)	13,981,000
Excess Benefits ($)	2,149,000
Benefit-Cost Ratio	1.20
Project Effectiveness (%)	79

DESCRIPTION OF LL PLAN

GENERAL

101. This alternative consists of upper and lower lakes along the Pearl River south of the Ross Barnett Reservoir. The lakes would extend from the Ross Barnett Reservoir outlet downstream along the Pearl River to approximately 3 miles southwest of Interstate 20. The combined lakes would cover approximately 4,727 acres (4,149 acres of the upper lake and 578 acres of the lower lake) at normal operating level. Weirs at both upper and lower lakes would regulate flows. The original LL plan proposed by local interests included two fixed crest weirs. The plan was modified from this original configuration for the purposes of constructability and flood damage reduction. Studies indicated that to significantly reduce flood damages, the upper weir would need to be a gated structure. The lakes would function as "flow thru" reservoirs with

minimal floodwater storage capacity. Flood protection would be provided by the project's lowering stages thru the Jackson Metropolitan Area. The LeFleur Lakes alternative is shown in Plate 4. Major components of the plan are discussed in the paragraphs below.

COMPONENTS OF LL PLAN

Weirs

102. The upper lake would be controlled by a hinge gate crest weir control structure approximately 800 feet long to be located immediately downstream of the Interstate 55 bridge crossing. The lower lake would be controlled by a fixed crest weir located approximately 3 miles downstream of Interstate 20. The upper lake would have a permanent pool elevation of 270.0 feet, NGVD, and the lower lake a permanent pool elevation of 260.0 feet, NGVD.

Channel Improvements

103. The plan includes major channel improvement on the Pearl River from the outlet of the Ross Barnett Reservoir to approximately 3 miles south of Interstate 20, a distance of approximately 16 river miles. Channel improvement includes excavating a 2,000-foot bottom width channel from River Mile (RM) 301.69 (outlet of Ross Barnett) to RM 292.63 (upstream of Lakeland Drive), a 1,500-foot bottom width channel from RM 292.4 (downstream of Lakeland Drive) to RM 288.5 (upstream of Interstate 55), and an approximate 1,000-foot bottom-width

channel from RM 288.2 (downstream of Interstate 55) to RM 284.0. At the request of the Mississippi Department of Transportation and Development, channel excavation will not be performed through any of the existing bridges or the proposed Airport Parkway bridge crossings. The total amount of channel material to be excavated is estimated at approximately 62,050,000 cubic yards.

LL Island and Disposal Areas

104. An island located at approximate RM 290.0 to RM 292.4 would be constructed from excavated material. The island would tie into high ground between the Lakeland Drive Pearl River relief opening bridge and the Pearl River Lakeland Drive bridge. This Island will be approximately 661 acres in size and will be encapsulated by a sheet pile retaining wall up to elevation 285.0 feet, NGVD. Access to the LeFleur Lakes Island will be from Lakeland Drive between the Pearl River bridge and the Pearl River relief opening bridge. Other disposal sites will be located along the Pearl River excavation reaches with the majority of the disposal being located in the overbank area from RM 293.5 to RM 296.0. These disposal sites will be filled to elevation 285.0 feet, NGVD. The island and disposal areas are shown on Plate 4. All disposal sites would be compacted to provide for commercial and other development opportunities.

Gallatin Street Landfill Removal

105. The Gallatin Street Landfill will be removed and excavated through and will be relocated to another landfill. The total amount of material to be removed is estimated at approximately 1.9 million cubic yards.

Utility Relocations

106. The extensive channel excavation and other plan components plan would require the relocation of numerous public utilities. Utilities requiring relocation include 4 natural gas lines, 11 communication lines, 9 electrical distribution lines, 2 drinking water lines, and 2 sanitary sewer lines.

Property Acquisition/Relocation

107. All lands lying in the lake footprint would be acquired in fee title. In addition, a 3-foot flowage easement would be acquired around the perimeter of the permanent pools (flowage easements from elevation 270.0 to 273.0 feet, NGVD, upper pool and 260.0 to 263.0 feet, NGVD, lower pool). Such flowage easements are typically included in Corps impoundments.

The portion of the LeFleur Bluff State Park lying in the Pearl River flood plain will be inundated with the minimum 270.0 feet, NGVD, upper lake pool elevation and require relocation.

Existing Jackson Levee (Fairground Levee)

108. The Jackson Levee will not require modification. However, the gravity outlets will be blocked by the 270.0-foot, NGVD, upper pool elevation which is between the existing 1- and 2-year frequency flowline on the Pearl River at this location. The existing 45-cfs capacity pump station will also not require modification; however, it will be operated to pump all inflows and will pump approximately twice as long from current conditions due to the gravity outlets being blocked. A riverside seepage berm will be required for the entire length of the existing levee along with a layer of riprap for toe protection.

Existing East Jackson Levee

109. The East Jackson Levee also will not need to be raised. The existing gravity outlet structure will be relocated downstream of the lower lake weir with a landside connecting channel to levee station 450+00. No pump modification will be required for the East Jackson Levee Pump Station. A riverside seepage berm will be required for the entire length of the existing

levee along with a layer of riprap for toe protection. A short section of this levee located near RM 291.0 will be relocated to the east to allow for construction of the LeFleur Lakes Island and associated channel improvements.

New Levees

110. Three new levee segments will also be needed to provide a comprehensive flood control plan for the Jackson Metropolitan Area. These include the Town and Lynch Creek Levee, South Jackson Levee, and the Richland Levee included in the comprehensive levee plan alternative. The Town Creek and Lynch Creek Levee will require pump stations on each creek since the lower lake pool elevation of 260.0 feet, NGVD, will be too high to provide gravity outlet flow. These levee segments are discussed below.

a. Town and Lynch Creeks Levee. This segment includes 7,195 feet of new levee. A pump station will be required on each creek with no gravity outlet structure. All inflows will be required to be removed by pumping similar to the existing Jackson levee discussed above. The lower lake pool elevation of 260.0 feet, NGVD, is too high to provide gravity outlet flow. Pump stations providing 2,500 cfs each will be required at stations 16+65 and 65+90. The drainage area of each creek is approximately 15 square miles. Approximately 2,400 feet of slurry trench will be required along the alignment. A riverside seepage berm will be required for the entire length of the new levee along with a layer of riprap for toe protection.

b. South Jackson Levee. This segment includes 19,863 feet of levee. An approximately 1,600-foot connecting ditch would be required along the landside toe upstream of Hardy Creek. A double 48-inch pipe would be required at station 37+79 and a double 9- by 9-foot box at station 165+34. Approximately 7,600 feet of slurry trench will be required.

c. Richland Levee. This segment includes about 26,434 feet of new levee. Approximately 3,200 feet of landside connecting ditch is included at the lower end of the levee. A floodgate will be required to include a single 36-inch pipe at station 31+50. A double 48-inch pipe floodgate will also be required at station 152+74. Local interests have requested the inclusion of a pumping station to remove interior ponding.

Mitigation Measures

111. The recommended compensation measure includes acquisition and reforestation of approximately 8,080 acres of frequently flooded cleared lands to offset adverse terrestrial impacts of the LL plan. The mitigation criteria for selection of land at the time of acquisition shown in the aforementioned Table 1 for the comprehensive levee plan would similarly apply to the LL plan.

SUMMARY OF LL PLAN

112. Table 4 shows a breakdown of the costs for the LL plan. An economic summary is shown in Table 5.

TABLE 4
SUMMARY OF FIRST COSTS a/
LL PLAN

Account	Item	Amount ($)
01	Lands and Damages b/ c/	176,263,497
02	Relocations	38,370,744
06	Fish and Wildlife Facilities	
09	Channels and Canals	776,615,685
11	Levees and Floodwalls	12,177,741
13	Pumping Plants	89,482,322
15	Floodway Control and Diversion Structures	60,287,514
30	Planning, Engineering, and Design	204,132,875
31	Construction Management	71,446,375
	TOTAL	1,428,776,753

a/ October 2006 price levels.
b/ Includes mitigation estimated at approximately $12,401,463.
c/ Excludes costs for relocating LeFleur Bluff State Park.

TABLE 5
ECONOMIC SUMMARY
LL PLAN

Item	Amount
First Cost ($)	1,428,777,000
Interest During Construction ($)	93,409,000
Total Investment ($)	1,522,186,000
Interest ($)	74,207,000
Sinking Fund ($)	7,569,000
Annual Operation and Maintenance ($)	3,175,000
Total Annual Cost ($)	84,951,000
Expected Annual Benefits ($)	16,052,000
Excess Benefits ($)	-68,899,000
Benefit-Cost Ratio	0.2
Project Effectiveness (%)	91

DESIGN AND CONSTRUCTION CONSIDERATIONS

113. Construction of the comprehensive levee plan would require approximately 4 years to complete. The LL plan is estimated to require approximately 8 years to complete. Project design will be based on current technical guidelines and additional engineering data or surveys that may be necessary. Remaining design requirements consist of preparation of plans and specifications for the weirs, pumping stations, island, various levee segments and drainage structures, and preparation of soil reports for various project components.

SUMMARY OF ECONOMIC, ENVIRONMENTAL, AND OTHER SOCIAL EFFECTS

114. Table 6 illustrates the environmental impacts for the comprehensive levee plan and the LL plan.

TABLE 6
SUMMARY OF ENVIRONMENTAL IMPACTS OF THE
COMPREHENSIVE LEVEE PLAN AND LL PLAN

Resource	Impacts
Comprehensive Levee Plan	
Terrestrial Habitat	Net loss of 2,503 AAHUs, 891 acres of bottom-land hardwoods, 60 acres of mixed-pine hardwoods, 34 acres of pine, and 39 acres of cypress-tupelo. Requires 1,680 acres of reforestation/management.
Aquatic Habitat and Fisheries	Temporary degradation of aquatic habitat with corresponding adverse impact to associated fisheries during construction. Borrow areas would create 778 acres of aquatic habitat.
Waterfowl Habitat	Reduction in forested flood plain would have minor adverse impacts to resident, and to a lesser extent, migratory waterfowl.
Water Quality	Increased turbidity and lowered DO levels during construction; no long-term significant impacts.
Ground Water	No impact expected
Endangered Species	No impact expected
Air Quality	Short-term releases of CO, NO, and particulates would be emitted during construction phase; no long-term adverse impacts.
Wetlands	Wetland conversion would total approximately 931 acres. Compensated by terrestrial mitigation.
Cultural Resources	No impact expected
LL Plan	
Terrestrial Habitat	Net loss of 2,183 AAHUs, 4,414 acres of bottom-land hardwoods, 934 acres of mixed-pine hardwoods, 272 acres of pine, and 1,150 acres of cypress-tupelo. Requires 8,080 acres of reforestation/management.
Aquatic Habitat and Fisheries	Temporary degradation of aquatic habitat with corresponding adverse impact to associated fisheries during construction. Borrow areas would create 4,730 acres of aquatic habitat.
Waterfowl Habitat	Reduction in forested flood plain would have minor adverse impacts to resident, and to a lesser extent, migratory waterfowl.
Water Quality	Increased turbidity and lowered DO levels during construction; no long-term significant impacts.
Ground Water	No impact expected
Endangered Species	Impacts to ringed sawback turtle and Gulf sturgeon due to loss of breeding habitat.

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