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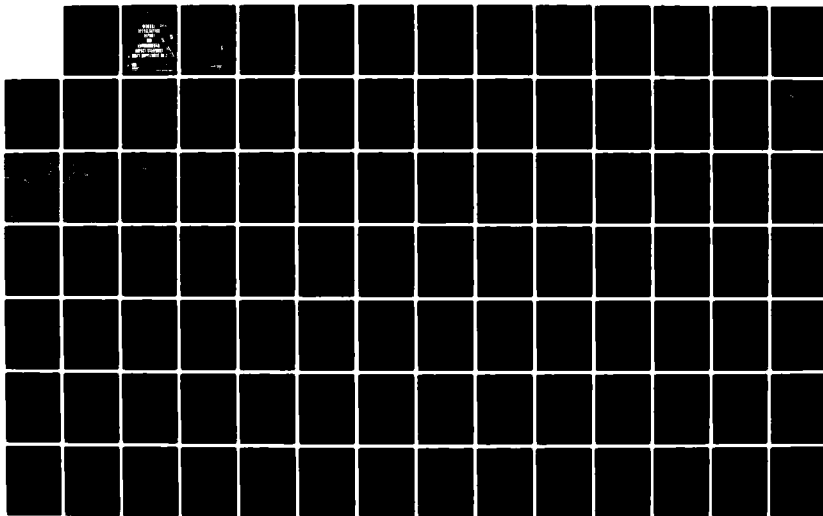
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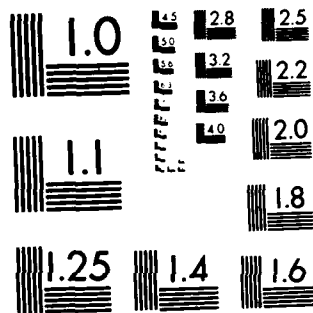
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RED RIVER WATERWAY
LA., TEX., ARK., AND OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

**GENERAL DRAFT
REEVALUATION
REPORT
AND
ENVIRONMENTAL
IMPACT STATEMENT
DRAFT SUPPLEMENT NO.2**

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SELECTED
APR 6 1983
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US Army Corps
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New Orleans District

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

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APR 6 1983
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DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND ENVIRONMENTAL IMPACT
STATEMENT DRAFT SUPPLEMENT NO. 2

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT

SECTION I - GENERAL

1. Authorization.

a. Public Law. Public Law 90-483, 90th Congress, approved 13 August 1968, authorized the construction of the "Red River Waterway, Louisiana, Texas, Arkansas, and Oklahoma" project in accordance with the recommendations of the Chief of Engineers as contained in House Document No. 304, 90th Congress, 2d Session. The appropriations act of 1971, approved 7 October 1970 as Public Law 91-439, provided the authority to initiate preconstruction planning on the Mississippi River to Shreveport, Louisiana, reach of the project.

b. House Document. House Document No. 304, 90th Congress, 2d Session, presents a project that will provide, in part, a navigation route from the Mississippi River at its junction with Old River via Old and Red Rivers to Shreveport. The improvement includes development of a channel approximately 236 miles long (realigned), 9 feet deep, and 200 feet wide. The development of the channel will consist of construction of a system of 5 locks and dams, realignment as necessary to develop an efficient channel, and bank stabilization and training works as necessary to hold the newly developed channel in position. Facilities to provide opportunities for recreation and for fish and wildlife development are an integral part of the project.

c. Design Memorandum No. 2 - Phase I - General Design Memorandum - Plan Formulation - Site Selection. In October 1976, the subject document was approved and recommended a navigation plan referred to as the B-3 modified (B-3M) plan. The B-3M plan met the project purpose requirements set forth in the house document; however, different lock and dam locations and pool elevations were used in some cases to achieve these purposes.

d. Pool 2 Design Change. Investigations subsequent to the submission and October 1976 approval of the Phase I - GDM revealed that certain changes in the lock and dam locations and pool elevations as recommended therein could improve navigation and reduce real estate requirements, project induced damages to fish and wildlife, and ground-water impacts to urban and agricultural lands along the river. One of these changes consisted of raising the Pool 2 elevation from 58 to 64. An environmental assessment was made to evaluate the impacts of the higher pool elevation. It was determined that the impacts of the 64 foot pool elevation were

not significant and a Finding of No Significant Impact (FONSI) was prepared and signed on 21 April 1982. The FONSI established 64 feet as the elevation of Pool 2, and that elevation will be used throughout this report. (App N)

2. Purpose and Scope of this Report. The purpose of this report is to present the results of the investigations conducted subsequent to the submission and October 1976 approval of the Phase I - GDM. The results of the investigations are presented in a comparative analysis of the B-3 modified (B-3M) plan as developed and recommended in the above referenced GDM and the B-1 plan which includes alternate locations for Locks and Dams 3, 4, and 5, and altered pool elevations of pools 3, 4, and 5. The major physical differences of the B-3M and the B-1 plans are shown on Table 1.

TABLE 1
Physical Comparison of Alternative
Project Plans

Lock & Dam	B-1		B-3M	
	Location (1)	Pool Elevation (2)	Location (1)	Pool Elevation (2)
1	43	40	43	40
2	87	64	87	64
3	141	95	137	87
4	206	120	185	115
5	250	145 (3)	243	145 (3)

(1) 1967 river mile.

(2) Elevations in feet above the National Geodetic Vertical Datum (NGVD) are used throughout this report.

(3) Appendix A includes the details of a comparative pool elevation study for Lock and Dam No. 5.

3. Investigations Subsequent to Phase I GDM submission and approval. Investigations made subsequent to the Phase I GDM - Plan Formulation, Site Selection approved October 1976 and used in the preparation of this report include:

a. Topographic maps for pools 2, 3, 4, and 5 were developed to determine the extent of flooding, required flowage easements, and impingement of pools on existing levees for alternate project plans including B-3M and B-1 plans. These maps are based on aerial surveys made in April 1978, March 1979, and September 1981.

b. A comprehensive groundwater study which estimates the impacts of post project pool elevations on adjacent agricultural and urban lands for the B-1 and B-3M plans.

c. An updated environmental assessment which incorporates the latest available data in considering the effects of the B-1 and B-3M plans.

d. Public meetings held in Shreveport, Louisiana on 19 May 1980 and Alexandria, Louisiana on 20 May 1980 to allow interested parties to present their views regarding the B-3M and B-1 plans (See Appendix C for the written statements submitted at or subsequent to the public meetings).

e. Coordination with Federal, state and other local agencies to provide assistance and expertise in areas such as fish and wildlife impacts, hydropower potential, port and recreational development and groundwater impact assessment.

f. Revision of DM No. 3, Hydrology, for presentation of comparative hydrologic data for the B-1 plan to be used in the planning and design of various projects features.

g. Real estate studies to define and appraise changes in land requirements and values for B-3M and B-1 plans.

h. Cost estimates based on the latest design impact data available.

i. A modeling study to estimate the effects of the project on the water quality in the river.

j. Wildlife mitigation studies and a submission of an interim report (December 1978) which included recommendations for the acquisition and management of 12,000 acres of bottomland hardwoods. PL 96-285 (June 28, 1980), establishes the Tensas National Wildlife Refuge. The refuge will mitigate all wildlife losses below mile 104 on the Red River.

k. Updated preliminary hydropower feasibility studies by FERC, and approval of minimum provisions for future hydropower at Lock and Dam No. 2.

l. A survey to determine the ordinary high water line (OHWL). Hinge pool investigations have been completed using this survey and have been used in EIS and flowage easement investigations. The OHWL survey will also be used in an indorsement to DM No. 3 - Revised Hydrology.

m. Tributary studies which estimate the impacts of post project pool elevations on tributary flows and adjacent lands.

n. Studies which estimate the impact of post project pool elevations on drainage and sewer outfalls.

4. Planned Future Investigations. A detailed hydropower feasibility study is underway. Utilizing information presently available, a wildlife mitigation report will be prepared and coordinated with appropriate state and Federal agencies. The mitigation report will be prepared concurrently with the final EIS and the recommended mitigation plan will be presented in the final EIS.

SECTION II - PLAN SELECTION PROCESS

5. Comparison of the B-3M and B-1 plans.

a. General. The common denominator of both plans is the provision of navigation, bank stabilization and recreation for the Mississippi River to Shreveport reach of the Red River Waterway project. The physical differences of the plans relative to lock and dam locations and pool elevations are shown in Table 1 and plates 1 and 2. The following paragraphs discuss the major differences in the two plans which support the selection of one plan for detailed design and construction.

b. Major differences leading to plan selection. Both plans may be assumed to provide equivalent navigation, bank stabilization and recreation benefits. Thus the final plan selection is based on the comparison of the costs (economic and environmental) of implementing the plans. Those areas where considerable effort was made to determine costs are discussed below.

(1) Groundwater effects.

(a) General. A groundwater impact study was performed to predict changes in groundwater levels associated with project construction and to assess the impacts of changes to the existing groundwater regime on the urban and rural areas. The analyses methods utilized in the impact study are based on state-of-the-art methodologies developed for the New Orleans District, Corps of Engineers, specifically for the Red River Waterway Project. They include groundwater modeling by the U. S. Geological Survey; agricultural area impact assessment methodology by the Soil Conservation Service; and urban area impact assessment methodology by D'Appolonia Consulting Engineers, Inc. In urban areas, the impact analysis is of major facilities, such as gas, sewerage and water supply networks; major structures; and large commercial and industrial developments; and residential areas. The analyses addressing the rural areas focused on crop response to raised groundwater levels and the associated impacts on a study area basis. The groundwater reports are available for review at the New Orleans District Office of the Corps of Engineers. Detailed tabular groundwater data is presented in Appendix M.

(b) Agricultural impacts. Table 2 presents the economic impacts of post project groundwater levels, dredged material placement, and pool flooding to agricultural lands along the river for the B-1 and B-3M plans. As a whole, the B-1 plan would have less impact on agricultural lands in the project area. Neither plan will significantly impact agricultural net return.

(c) Urban impacts. Eleven urban areas in the project area were designated for groundwater impact evaluation. Those areas are Alexandria, England Air Force Base, Boyce, Colfax,

Natchitoches, Clarence, Campti, Coushatta, Shreveport, Bossier City, and Barksdale Air Force Base. The most common impact to the municipal facilities was due to increased infiltration to the existing sewerage system. Impacts to urban vegetation were usually the second most common impact in the urban areas. Table 3 provides a summary of these sewerage and vegetation impacts for the B-1 and B-3M plans. A brief review of Table 3 indicates that increased infiltration into the sewerage systems for the entire project area may result in increased present day treatment costs of about \$19,925 and \$19,750 per year for plans B-3M and B-1, respectively. The vegetation impacts for the project area, in general, are mild to moderate in degree of impact. The maximum acreage of urban vegetation predicted to be affected due to any one plan is less than 1,000 acres.

TABLE 2

SUMMARY OF AVERAGE ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS - BASED ON
PRESENT LAND USE^{1/} - RED RIVER WATERWAY PROJECT AREA
AGRICULTURAL LANDS

<u>POOL</u>	<u>B-3M</u>			<u>B-1</u>		
	<u>PRE</u> <u>PROJECT</u>	<u>POST</u> <u>PROJECT</u>	<u>DECREASE</u>	<u>PRE</u> <u>PROJECT</u>	<u>POST</u> <u>PROJECT</u>	<u>DECREASE</u>
1	\$ 6,665,300	\$ 6,500,000	\$-165,300	\$ 6,665,300	\$6,500,000	\$-165,300
2	8,103,800	7,865,500	-238,300	8,103,800	7,865,500	-238,300
3	9,706,600	9,591,800	-114,800	9,706,600	9,565,400	-141,200
4	7,255,100	6,940,200	-314,900	7,255,100	7,062,400	-192,700
5	8,149,400	7,917,700	-231,700	8,149,000	7,984,000	-165,400
TOTAL	\$39,880,200	\$38,815,200	\$-1,065,000	\$39,880,200	\$38,977,300	\$-902,900

^{1/} The estimates are based on future (year 2005) conditions and the additional conditions that authorized drainage projects in the area will not be constructed and that the existing land use will continue through the life of the navigation project. The estimates include the impacts to agricultural land due to raised groundwater levels, pool flooding, and dredged material placement. The estimates are based on topographic maps with a scale of 1" = 1 mile and contour intervals of 5 to 20 feet. Such maps cannot be used to determine precise acreages of small plots of ground, but can be used to estimate overall pool acreages with reasonable accuracy. Between the river levees, topographic maps with a scale of 1" = 600 feet and contour intervals of 2 feet were used, however this represents only a small portion of the groundwater study area.

TABLE 3
SUMMARY OF URBAN IMPACT ASSESSMENTS
DESIGNATED URBAN STUDY AREAS
RED RIVER WATERWAY PROJECT (1,2,3)

L/D No.	URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
		PLAN B-3M	PLAN B-1
2	Sewerage Systems	Increased infiltration and associated treatment costs of 62,000 gallons per day and \$18,000 per year, respectively.	Increased infiltration and associated treatment costs of 62,000 gallons per day and \$18,000 per year, respectively.
2	Vegetation	Mild impact of 220 acres.	Mild impact to 220 acres.
4	Sewerage Systems	Increased infiltration and associated treatment costs of 27,320 gallons per day and \$1,925 per year, respectively.	Increased infiltration and associated treatment costs of 24,800 gallons per day and \$1,750 per year, respectively.
4	Vegetation	Mild impact to 99 acres; moderate impacts to 36 acres.	Mild impact to 35 acres.
5(4)	Vegetation (Pool 145)	Mild impact to 477 acres; moderate impact to 155 acres, severe impact to 50 acres. ⁽⁵⁾	Mild impact to 477 acres; moderate impact to 155 acres, severe impact to 50 acres. ⁽⁵⁾

NOTES:

- (1) There were no urban study areas for Lock and Dam No. 1.
- (2) The study assessed the following additional urban characteristics and the estimated impacts were minimal: soils, water supply systems, storm drainage, roads and streets, airport runways, sanitary landfills, cemeteries, gas distribution systems, deep foundations, shallow foundations, underground structures, excavation dewatering, sand and gravel sources, and groundwater quality.
- (3) Minimal impacts in Pool 3 for both plans.
- (4) Only vegetation impacts in Pool 5 are quantifiable.
- (5) Severe impacts involve 50 acres of intermediate urban trees.

(2) Real estate requirements. Project required lands for the purpose of this report will be classified as either project construction lands or flowage easements lands. Construction lands include lands required for construction of locks and dams and associated features, bank stabilization and channel realignment works, and dredged material placement. For this report it was assumed that the navigational servitude extends to the OHWL. Easements will not be taken over lands below the OHWL. While there may be exceptions to this criteria, those exceptions will be determined on an individual basis as the need requires. Hinge pool operation will be used on Red River Waterway, when necessary, to minimize real estate acquisition and promote sediment transport. A hinge pool operation involves opening the gates of the dam when river discharges are rising to cause stages in the lower portion of the pool to fall below the normal pool elevation. The amount that the pool can be lowered will be limited by the criterion that adequate depths for navigation must be maintained. A flow of 50,000 cfs is needed to insure adequate depths for navigation. Flowage easements will be required in all cases where postproject flowlines are raised above the higher of the (OHWL) or the corresponding preproject flowline. It is proposed that flowage easements will be taken below a line that is 3 feet above the pool elevation from the location of each lock and dam upstream to the intersection of this line with the OHWL. A freeboard of 3 feet above the pool was selected to allow for (a) wave setup and runup, (b) saturation of the shoreline, (c) inaccuracies of operation and mapping, and (d) minimizing the need for the hinge pool operation.

Hinge pool investigations have been completed using the OHWL survey. Based on these investigations, it has been determined that for the B-1 plan, a hinge pool operation in Pool 3 would reduce the flowage easement requirements by approximately 7,000 acres. For the B-3M plan, hinge pool operations would reduce flowage easement requirements in Pools 3, 4, and 5 (145') by approximately 770 acres. Hinge pool operations in the remaining pools would not reduce the required flowage easements. Hinge pool operations have been assumed in the preparation of the flowage easement estimates shown in Appendix L. Plates showing the OHWL, preproject and postproject flowline, and the taking line are available for review in the New Orleans District office. In general, the real estate requirements for the B-1 plan are less than the B-3M plan. A detailed comparison of the real estate costs is shown in Appendix L.

(3) Construction cost comparison. A comparison of estimated Plan B-1 and Plan B-3M construction costs for each pool is provided in Appendix L. The total construction costs for Plan B-1 and Plan B-3M are \$1,591,323,000 and \$1,613,549,000, respectively.

(4) Maintenance dredging. Annual maintenance dredging requirements for the B-1 and B-3M plans are 323,000 and 414,000 cubic yards, respectively.

(5) Hydropower potential.

(a) The potential for hydropower development and production for the B-1 and B-3M plans is a function of the available head and discharge at the lock and dam sites. Table 4 below shows the maximum head difference at each lock and dam for both plans. The total maximum lift is the same for both plans. Preliminary FERC estimates of the benefits and costs of hydropower development are presented in Appendix J. Annual excess benefits for hydropower development are \$7,747,000 and \$8,003,000 for the B-1 and B-3M plans, respectively. Total project annual excess benefits increase to \$28,176,000 and \$26,720,000 for the B-1 and B-3M plans, respectively, when hydropower excess benefits are included.

(b) Feasibility studies are being made by both the Corps of Engineers and non-Federal entities which have been granted FERC preliminary permits. Minimum provisions for hydropower at Lock and Dam No. 2 have been approved. Authority to include minimum provisions for future hydropower at Locks and Dams 3, 4, and 5 will be requested at such time that design studies have progressed sufficiently to define plans and cost estimates for these locks and dams.

TABLE 4
MAXIMUM HEAD DIFFERENTIAL
(feet)

<u>Lock and Dam</u>	<u>B-1</u>	<u>B-3M</u>
1	36	36
2	24	24
3	31	23
4	25	28
5	25	30
TOTAL	141	141

(6) Recreation potential. The recreation potential of the B-1 and B-3M plans may be considered the same for plan selection purposes. With either plan, the recreation demand would be the same and the recreation facilities would be designed to satisfy this demand.

(7) Tributaries. An interior drainage study was performed to determine the impact the proposed project would have on tributary flows into the Red River. The computations performed for the tributary streams show that while higher stages may result at certain discharges, the flow will generally be contained within the banks of the tributary or will be below the taking line. Based on current data, the Red River post-project flowlines will not cause a significant amount of additional flooding along the tributaries regardless of which project plan is selected. The interior drainage study indicates that more detailed studies are required for Bayou Pierre, Saline Bayou, and Bayou Nantache. These studies are underway and the results will be presented in

(8) Environmental.

(a) Site specific differences. The B-3M alternatives would impact an environmentally significant area in the Lock and Dam No. 3 area which would not be adversely impacted by the B-1 plan. This particular area is dominated by pine hardwoods mixed with areas of cypress-tupelo swamp. Both these habitat types have very high habitat values. In addition, many of the pines in this area are at or approaching maturity and are potential habitat for the red-cockaded woodpecker, an endangered species which is strongly suspected to occur in the project area. The B-1 alternative would cause more flooding in Pool 3 than would the B-3M alternative because of a higher pool elevation. However, overall there would be over 1,800 more acres of terrestrial habitat flooded by the B-3M plan than would be flooded by the B-1 plan because the B-3M sites for Locks and Dams 4 and 5 are further downstream.

(b) Wildlife mitigation. Bottomland hardwood acquisition required to mitigate total project area losses according to HES analysis range from 16,055 to 18,592 acres for the B-1, 145' and B-3M, 145' alternatives, respectively. Acquisition requirements according to U.S. Fish and Wildlife Service HEP analysis range from 20,100 to 20,900 acres for the two respective alternatives. Requirements according to user-day analysis range from 5,441 to 5,946 acres. Establishment of the Tensas National Wildlife Refuge as authorized in Public Law 96-285 June 1980, will mitigate project losses below river mile 104. An analysis of project impacts above mile 104 indicates a need to acquire 14,081 acres of bottomland hardwoods according to HES analysis to mitigate losses for the B-1 (145') Plan. A user-day analysis indicates a need for 5,896 acres of bottomland acquisition to mitigate for losses. Bottomland hardwood acquisition above mile 104 for the B-1 plan would be approximately 16,200 acres according to HEP analysis. A more detailed analysis of mitigation and other mitigation possibilities are discussed in Appendix E of this report.

(c) Fishery resources. The net impacts to commercial and sport fishery resources are very similar for the B-1 and B-3M plans. Annual commercial harvest is expected to increase approximately 45 percent for either alternative over without project conditions. The annual man-days of sportfishing is projected to increase from 115,852 (without project condition) to 380,022 and 406,405 for the B-1 and B-3M plans, respectively.

(9) Public views. Public meetings were held on 19 and 20 May 1980 in Shreveport and Alexandria, respectively, to allow the general public to express their views concerning the B-1 and B-3M plans. A summary of views presented in written statements is indicated on page 10.

a. Preferred the B-1 Plan	29
b. Preferred the B-3M Plan	2
c. Was anti-project	1
d. Was pro-project, regardless of plans	1

Additional statements were concerned with the pool elevation at Lock and Dam 5. Appendix C includes all written statements submitted at or subsequent to the public meeting.

c. Coordination with other agencies. The following agencies were involved to varying degrees in the provision of input during the plan reformulation process.

1. U.S. Fish and Wildlife Service
2. The Federal Energy Regulatory Commission
3. Louisiana Department of Wildlife and Fisheries
4. Red River Waterway Commission
5. Soil Conservation Service
6. U.S. Geological Survey
7. Louisiana Department of Transportation and Development,
Office of Public Works

6. Conclusions of the comparative analysis. In view of the quantifiable and non-quantifiable areas examined in the preceding comparative analysis, the B-1 plan is more favorable than the B-3M plan. An economics analysis is presented in Appendix G to support this conclusion. In the original Phase I GDM, it was anticipated that groundwater impacts for the B-1 plan would be much greater than those accruing to the B-3M plan. This anticipated adverse impact was a major factor leading to the recommendation of the B-3M plan at that time. Subsequent to that recommendation, a detailed groundwater impact study was performed and revealed very minor differences in groundwater impacts between the two plans. Also subsequent to the original Phase I GDM, it was discovered that significant surface flooding would occur if the B-3M plan was implemented. The B-1 plan would significantly reduce this flooding. Considering these two major areas of public concern coupled with the other factors discussed in the preceding comparative analysis, the B-1 plan is proposed for detailed design and construction.

SECTION III - PROPOSED PROJECT PLAN

7. Description of proposed plan.

a. Navigation. The navigation improvement includes development of a channel 236 miles long from the Mississippi River up the Red River to Shreveport. The channel will be 9 feet deep and 200 feet wide. Five locks and dams will provide the lift of approximately 141 feet. The locks will have useable dimensions of 84 feet by 685 feet.

b. Bank stabilization. The purpose of the bank stabilization feature of the plan for the Mississippi River to

Shreveport reach of the project is to fix the channel along a navigable alignment and to prevent erosion and the loss of the valuable adjacent lands and improvements. Realignment of the channel will be attained through dredging, cutoffs, and training works. Bank stabilization will be accomplished by use of a variety of tested works, such as trench fill revetment, stone dikes, and other methods in combination with the improved channel alignment.

c. Recreation.

(1) General. Public access and recreation facilities will be developed at each lock and dam site, at selected points along the navigation channel, and at selected bendways formed by channel realignment.

(2) Master plan. A recreation master plan for the Mississippi River to Shreveport reach has been prepared. In this plan, approximately 13,000 acres of land are proposed for recreation development. Of this acreage approximately 3,000 acres will have been used for dredge material disposal. Intensive use recreation is planned on approximately 4,000 acres. This high use recreation basically consists of developed campsites, fishing piers, swimming beaches, game courts, amphitheaters, picnic units, picnic shelters, equestrian facilities, launch ramps, volleyball and children's playgrounds. Approximately 2,000 acres are planned as low density use. This low density use consists of primitive campsites, horseback trails, bicycling trails, hiking trails, and nature trails. Approximately 7,000 acres are proposed as fish and wildlife management areas or natural or scenic areas.

The master plan identifies 26 sites for recreation development, 10 of these sites are located on oxbow cutoff lands with a combined water surface area of 3,400 acres. Six alternative recreation sites were chosen in the event there are physical changes which make the recommended sites less desirable or there are problems in acquiring some of the proposed sites. The master plan has been submitted to the local sponsor and we are awaiting their comments on the plan and cost-sharing provisions.

d. Relocations.

(1) General. Facility relocations are required to accommodate the plan of improvement; the accountability for the relocations is governed by the requirements of the authorizing document. The costs reflect 1 October 1981 price levels.

(2) Roads and bridges. Eleven highway bridges cross The Red River between the general vicinity of Shreveport, Louisiana, and the point of confluence with the Old River and the Atchafalaya River; one highway bridge spans the Old River lock on the navigation channel between the Old River and the Mississippi River. Three of the highway bridges; US Highway 165 (Business) at Alexandria, LA Highway 8 at Boyce and US Highway 84 at Coushatta,

are to be replaced by the Louisiana Department of Transportation and Development, Office of Highways, under that agency's bridge replacement program (partially funded by the Federal Highway Administration). The district has prepared relocation documents for minor modifications to the following two highway bridges: LA Highway 107/115 at Moncla and LA Highway 3026/28 at Alexandria. The remaining highway bridges are considered to be satisfactory.

(3) Railroads and bridges. Four railroad bridges cross the Red River between the general vicinity of Shreveport, Louisiana, and the point of confluence with the Old River and the Atchafalaya River. The district is currently preparing relocation documents for major modifications to the Louisiana and Arkansas Railway Company bridge and the Missouri-Pacific Railroad Company bridge at Alexandria. The St. Louis Southwestern Railway Company bridge and the Illinois Central Gulf Railroad Company bridge at Shreveport will not be relocated at this time as discussed in Appendix A.

(4) Utilities. The project will require the relocation of 31 crossings consisting of 21 submerged pipelines, 2 aerial powerlines, and 3 submarine communication cables.

(5) Outfalls. Surveys and analyses were made to determine if drainage and sewer outfalls would be adversely impacted by the various pool levels of the waterway project. The data on the drainage outfalls were analyzed and it was determined that the effects of the waterway project on the landside water surface elevations would be negligible. The data on the sewer outfalls were analyzed or the owners of these outfalls were contacted and questioned relative to the hydraulic adequacy of their outfalls to accommodate the proposed pool elevations. It was determined that these sewer outfalls would function adequately for either plan. Table 5 presents a breakdown of the outfalls located in each of the navigation pools.

TABLE 5
OUTFALLS VERSUS POOL
PLAN B-1

<u>POOL</u>	<u>DRAINAGE</u>	<u>OUTFALLS</u> ^{1/}	
			<u>SEWER</u>
1	0		0
2	9		8
3	28 ^{2/}		1
4	13		1
5	15		7
TOTAL		65	17

^{1/} Discharge directly into Red River, unless otherwise noted.
^{2/} Eleven of these drainage outfalls discharge into tributaries to the Red River.

e. Aids to navigation. Requirements and costs for navigation aids have been estimated by the U.S. Coast Guard. The aids will consist of shore lights, unlighted buoys, and daymarks on appropriate towers. A land based installation is a requirement of the project. The real estate estimates in this report do not include the cost of the land based installation because the requirements for this installation have not been defined at this point.

f. Real estate requirements. Approximately 20,344 acres of land will be required for construction and maintenance of the B-1 plan navigation channel from the Mississippi River to Shreveport, Louisiana. Of this, 3,000 acres will be used for recreation development. An additional 10,000 acres and 7,319 acres will be required for recreation and flowage easements, respectively. Wildlife mitigation might require additional land acquisition which would be recommended for Congressional consideration in a separate authorization report. Final mitigation requirements have not been determined.

8. Estimate of first costs. Based on October 1981 price levels, the total cost for the proposed project plan (B-1 plan) for the Mississippi River to Shreveport, Louisiana reach of the Red River Waterway (excluding mitigation) is \$1,591,322,000. Appendix L presents a summary of first costs for the total project and a total of first costs tabulated by navigation pools.

9. Comparison with current PB-3 estimate.

a. General. The cost for the tentatively selected plan (Plan B-1) is \$1,591,322,000. This estimate is compared to the October 1981 PB-3 estimate (\$1,474,432,000) in Table 6. Both estimates are based on October 1981 price levels. The PB-3 estimate is based on the B-3M plan with a Pool 2 elevation of 58 feet.

b. Lands and Damages. The Plan B-1 cost of \$23,928,000 represents an increase of \$3,038,000 over the PB-3 estimate. This increase is due to the completion of detailed topographic maps which have resulted in a more accurate determination of lands required for the project.

c. Relocations.

(1) Roads. The Plan B-1 cost of \$464,000 represents a decrease of \$316,000 in the PB-3 estimate. This cost reduction was presented in RDM No. 5 (Moncla Bridge) and RDM No. 16-B (Fulton Street Bridge). These design memorandums were approved on 15 January 1981 and 29 January 1981, respectively.

(2) Railroads. The PB-3 cost of \$42,270,000 has been reduced to \$18,750,000 for Plan B-1. This cost reduction is due to the elimination of two railroad bridge relocations in Pool 5.

(3) Utilities. The PB-3 cost of \$12,170,000 has been

reduced to \$5,456,000 for Plan B-1. The PB-3 estimate was prepared based on information available at the time of the Phase I - GDM submission. Since that time, more detailed studies have been performed resulting in a significant reduction in the number of required utility relocations.

d. Navigation Dams. The Plan B-1 cost represents a \$69,716,000 increase over the PB-3 estimate. This is due in part to different lock and dam locations and pool elevations for each plan. However, the primary reason is that more reliable estimates have been prepared for this feature based on cost and design experiences gained from construction of Lock and Dam No. 1 and from completed plans and specifications on John H. Overton Lock and Dam. This information has been utilized in developing new cost estimates for Locks and Dams 3, 4, and 5. In addition, after the Phase I - GDM was completed, model studies were performed which resulted in design changes that were not included in the original estimates. These changes impacted the estimates that were originally prepared for the PB-3.

e. Navigation Locks. Increases in cost of navigation locks over the PB-3 estimate, \$39,056,000, are due to the same reasons as discussed above for navigation dams.

f. Access Roads. The cost for access roads in the B-1 Plan is \$320,000 less than in the current PB-3 estimate. This difference is primarily due to the Plan B-1 lock and dam sites being more accessible to the existing road system in the project area.

g. Channels and Canals. The costs for this feature are increased \$33,902,000 over the PB-3 estimate. This cost increase is due to the higher pool elevation for Pool 2, and the changed locations for Locks and Dams 3, 4, and 5. In addition, cost and design experiences gained from completed stabilization and realignment work as well as design changes resulting from model studies have resulted in increased costs for this item.

h. Levees and Floodwalls. The costs for this feature have increased \$2,228,000 over the PB-3 estimate. Completion of topographic maps after the PB-3 estimate was prepared, indicates that the navigation pool will impinge on existing levees in Pools 3 and 5 for the B-1 estimate.

i. Summary. The increased cost of the selected plan (Plan B-1) over the PB-3 estimate is primarily a result of improved estimates based on the experience gained from the construction of Lock and Dam No. 1, the construction of channel protection and realignment projects, and the preparation of plans and specifications for John H. Overton Lock and Dam. The increased cost is not due to the tentatively selected plan since Appendix L shows an even greater increase for the B-3M plan.

TABLE 6
SUMMARY OF FIRST COST POOLS 1 - 5
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs PB-3 ESTIMATE
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	PB-3
01.	Real Estate Costs ^{1/}	\$ 23,928,000	\$ 20,890,000
02.	Relocations		
.1	Roads	464,000	780,000
.4	Railroads	18,750,000	42,270,000
.7	Utilities	<u>5,456,000</u>	<u>12,170,000</u>
	Subtotal-Relocations	\$ 24,490,000	\$ 55,220,000
04.	Navigation Dams	305,440,000	235,724,000
05.	Navigation Locks	374,067,000	335,011,000
08.	Access Roads	6,167,000	6,487,000
09.	Channels & Canals	598,629,000	564,727,000
11.	Levees & Floodwalls	8,688,000	6,460,000
14.	Recreation Facilities	47,720,000	47,720,000
18.	Cultural Resources	75,000	75,000
19.	Buildings, Grounds, & Utilities	5,860,000	5,860,000
20.	Permanent Operating Equipment	<u>791,000</u>	<u>791,000</u>
	Subtotal-Items 04.-20.	\$1,347,437,000	\$1,202,855,000
	Subtotal	\$1,395,855,000	\$1,278,965,000
30.	Engineering & Design	118,810,000	118,810,000
31.	Supervision & Administration	72,525,000	72,525,000
	Navigation Aids	<u>4,132,000</u>	<u>4,132,000</u>
	TOTAL	<u>\$1,591,322,000</u>	<u>\$1,474,432,000</u>

^{1/} Detailed real estate costs shown in Appendix L.

10. Operation and maintenance, and replacement costs. The estimated average annual operation and maintenance costs are shown in the table below. Average annual replacement costs are shown in Table 8.

TABLE 7
OPERATION AND MAINTENANCE COSTS
B-1 Plan

Mississippi River to Shreveport, LA
(Average annual costs)

Item	Federal	Non-Federal	Total
Relocations	0	\$ 483,000	\$ 483,000
Lock & dam complexes	2,666,700	0	2,666,700
Access roads	109,500	0	109,500
Channels and canals	8,696,600	132,500	8,829,000
Recreation facilities	233,800	668,700	902,500
Navigation aids	510,100	0	510,100
Maintenance dredging	355,300	0	355,300
	12,572,000	1,284,100	13,856,100

TABLE 8
REPLACEMENT COSTS
B-1 Plan

Mississippi River to Shreveport, LA
(Average annual costs)

Item	Federal	Non-Federal	Total
Relocations	0	\$192,450	\$192,450
Lock and dam complexes	10,950	0	10,950
Recreation facilities	10,300	10,300	20,600
Total	\$21,250	\$202,750	\$224,000

11. Environmental Analysis. A summary of impacts of the proposed action on the various environmental elements is presented in the following paragraphs. A more detailed discussion is contained in the accompanying EIS and in various appendixes of this report.

a. Biological resources.

(1) Terrestrial ecosystems. Approximately 32,900 acres of terrestrial habitat would be affected by construction activities such as new channel cuts, lock and dam construction, revetments, dredged material disposal and flooding and freeboard areas. An additional 300 to 400 acres of lands are projected to be impacted annually as a result of maintenance dredging areas. Over 17,000 acres would be lost permanently as terrestrial habitat due to new channel cuts, revetments, and project flooding. More than 11,000 acres would be impacted by dredged materials disposal. Most of these disposal areas would be used for agriculture, although approximately 3,000 acres of disposal areas would be developed into recreational areas. The remaining lands affected by freeboard would be those lands within 3 feet elevation

above and normally adjacent to the navigation pool that would be subjected to increased soil saturation or wave wash. These areas may have an adverse impact on agricultural lands but should not have an adverse impact on most of the project woodlands. Besides the 32,900 acres previously mentioned, an estimated 6,680 acres of woodlands would be lost due to induced clearing for agriculture. An additional 9,772 acres of land would be developed as recreational areas. The majority of these recreational lands are planned for wildlife management or scenic/natural areas and would enhance the value of the lands for wildlife. An estimated 29,720 acres of primarily soybean land is projected to experience slightly decreased yields as a result of raised groundwater. An estimated 7,160 acres, primarily woodlands, are projected to experience slightly increased yields. The primary habitat type impacted by the project would be agricultural lands. Because of induced clearing and dredged material disposal, there would be a project caused increase in agricultural land. The primary woodland type impacted would be the cottonwood-willow-sycamore complex.

(a) Wildlife resources. Permanent loss of woodlands and open lands would mean a loss of wildlife habitat. Over 2,300 acres of bottomland hardwoods (BLH) and approximately 15,400 acres of cottonwood-willow-sycamore (CWS) would be lost or permanently altered. BLH and CWS of the project area have a deer carrying capacity of 1 per 30 acres and 1 per 60 acres, respectively.

(b) Endangered species. The project should not have an adverse impact on any threatened or endangered species or their critical habitats.

(2) Aquatic ecosystems. Approximately 3,700 acres of natural oxbow lakes and backwater areas are present in the project area. Approximately 840 acres of this habitat would be permanently lost because of dredged material disposal and construction features. Another 2,000 acres would change in nature because they would be incorporated into the navigation or flood pool. The remaining 860 acres would remain relatively unchanged. An estimated 7,887 acres of the present river channel would be converted to oxbow lakes and protected by upper closures from rapid filling-in with silt. However, 2,435 acres of this habitat would gradually silt up over the project life. Approximately 8,900 acres of new aquatic habitat would be created by flooding of terrestrial areas. Project area tributaries would experience stage level increases and decreased velocities as a result of raised water levels. Approximately 10 miles of river bottom would be impacted by maintenance dredging on an annual basis.

(a) Fishery resources. Because of the increase in aquatic habitat and change from a free flowing to a more stable habitat, there would be an increase in fishery productivity. Commercial fish harvest is expected to increase from 290,000 to

532,000 pounds annually. Userdays of sportfishing is expected to increase from 116,000 to 402,000 annually by the end of the project life.

(b) Other aquatic fauna. Reduction in turbidity would benefit phytoplankton and zooplankton populations. Construction work would, however, cause increases in turbidity as well as destruction of existing benthic communities. Benthic communities will be adversely impacted by annual maintenance dredging. Bank stabilization, as well as impoundment, would lend more stability to the Red River system and encourage the establishment of benthic and vegetative communities. Potential low dissolved oxygen levels during periodic low flow conditions in deep pool areas could cause setbacks to benthic as well as fish populations. Increased navigability would cause an increase in boat and barge traffic in the Atchafalaya as well as the Red River. Potential impacts of navigation traffic include sediment resuspension, bank drawdown, hull and prop damage to aquatic organisms, scouring, shoreline erosion, current reversal, noise, and pollutant spills.

b. Water quality. Present water quality in the Red River is generally good with respect to parameters considered to be key water quality indicators, although some trace contaminants have been detected in water and bottom sediments. Implementation of the Red River Waterway project would result in low dissolved oxygen levels in the deeper portions of the pools during low flows usually during summer months; these levels would occasionally be below the State of Louisiana standard of 5mg/l. However, water quality in the system should generally support a productive aquatic habitat. The lowering of fecal coliform levels in the system would provide some increase in the sanitary quality of the water for water supply and contact recreational uses. Algal blooms and excessive plant growth may cause some impact on esthetics or recreational uses of the water in the warmer months. The potential for concentration of metals, pesticides and PCBs induced by project implementation is undetermined. The likelihood of extensive density stratification, produced by extreme combinations of low flow and high temperature cannot be assessed. The most important effect would probably be temperature shock on organisms during rapid destratification.

c. Recreational resources. Project implementation necessitates development of recreational lands as an authorized project purpose. The current recreational master plan recommends acquisition of 12,768 acres of recreational lands on 26 sites. A concept of resource use was adopted that provides for urban, suburban, and rural recreational situations in the context of estimated recreational demands and cultural and environmental opportunities. Much of the recreational development is centered around providing access to and development of oxbow lakes. Fishing and other aquatic sports, as well as general recreation, would be enhanced by the project. Although wildlife management is planned for some recreational sites there could be a loss overall to hunting opportunities because of project caused woodland losses.

d. Archeological resources. At least 51 sites would be impacted by the following project related activities: revetment construction (15), channel excavation (19), placement of dredged material (11), permanent or seasonal flooding (4) and development of recreational sites (2). Channel stabilization, which would prevent river meandering, should have a beneficial impact on other cultural remains.

SECTION IV - LOCAL COOPERATION

12. Local cooperation requirements. The conditions of local cooperation as specified by the authorizing law are quoted in paragraph 3 of the Phase I design memorandum and are not repeated here.

13. Status of local cooperation. In November 1964, a constitutional amendment was approved in a state-wide (Louisiana) election which authorized the state legislature to create an agency with the necessary power and authority to fulfill the requirements of local cooperation for that portion of the project within Louisiana. The legislature then, by Louisiana Act 17, approved 13 June 1965, formed the Red River Waterway District expressly to provide the required local cooperation. The governing body of the District, the Red River Waterway Commission, in response to a request dated 15 October 1968 provided, on 26 February 1969, formal assurances of local cooperation for that portion of the project within Louisiana. These assurances were accepted on behalf of the United States on 15 April 1969. The Commission, on 23 May 1973, executed revised assurances to cover the provisions of Public Laws 91-646 and 91-611. The principal officers of the Commission currently responsible for fulfillment of local cooperation conditions are as follows:

Mr. Irwin F. Hingle, Jr., Chariman
Red River Waterway Commission
Louisiana Department of Public Works
Box 44155, Capitol Station
Baton Rouge, LA 70804

Mr. D. F. Attaway
Secretary-Treasurer
Red River Waterway
Commission
P.O. Box 1110
Shreveport, LA 71101

14. Views of local interests. The Red River Waterway Commission represents local interests in the State of Louisiana. The plan presented herein was coordinated in detail with the engineering support staff of the Commission (State of Louisiana, Office of Public Works). This report was sent to the Commission on 7 July 1982 for review and comments (see transmittal letter page 21).

15. Departures from The Phase I - GDM, approved October 1976.

a. Pool 2 was raised from 58' to 64' (refer to FONSI).

b. Lock and Dam No. 3 was moved from 1967 river mile 137 to 141 and Pool 3 was raised from 87' to 95'.

c. Lock and Dam No. 4 was moved from mile 185 to mile 206 and Pool 4 was raised from 115' to 120'.

d. Lock and Dam No. 5 was moved from mile 243 to mile 250.

e. Flowage easements in pools, 3, 4, and 5 are required on approximately 12,200 acres of land.

SECTION V - CONCLUSIONS AND RECOMMENDATIONS

16. Conclusions. The B-1 alternative compared to the previously approved B-3M alternative is a more cost effective means of achieving the primary objectives of navigation and bank stabilization. Moreover, the adverse impact of the B-1 plan is less than the B-3M plan. It is consistent with existing statutes and policies. The overall public interest will be best served by implementation of the B-1 plan.

17. Recommendation.

a. The B-1 plan, as presented herein, for the Mississippi River to Shreveport, Louisiana, reach of the Red River Waterway project, consists essentially of the following:

(1) A system of five locks and dams. The lock dimensions are 84 feet by 685 feet (usable chamber length). The pintle to pintle dimensions are 785 feet.

(2) Development of a realigned channel approximately 236 miles long, 9 feet deep, and 200 feet wide with complementary bank stabilization and river training works to hold the realigned channel in position.

(3) Recreation facilities and public access at the site of each lock and dam, at selected points along the navigation channel, and at various oxbow lakes formed by channel realignment.

b. Analysis of the overall effects of the proposed construction indicates that the total benefits to be derived outweigh the associated costs. Further, the study of all reasonable alternatives indicates that the plan presented herein is the best means of accomplishing project objectives and is therefore recommended for approval.



DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

REPLY TO
ATTENTION OF:

LMNED-P

7 July 1982

Mr. Irvin F. Hingle, Jr., Chairman
Red River Waterway Commission
Red River Waterway District
P.O. Box 44155, Capitol Station
Baton Rouge, Louisiana 70804

Dear Mr. Hingle:

Inclosed are four copies of the draft General Reevaluation Report and Environmental Impact Statement Supplement No. 2 (disclosure document) for the Red River Waterway, Mississippi River to Shreveport.

Our current schedule for the draft disclosure document is as follows:

LMVD review of draft	30 Jun - 14 Jul 82
Publish notice of availability in the Federal Register	13 Aug 82
Review by the public	13 Aug - 27 Sep 82
Resolve comments and reproduce in final form	27 Sep - 30 Nov 82
Submit final document to LMVD	1 Dec 82
LMVD review and file with EPA	1 Dec - 15 Dec 82
EPA publish notice in Federal Register	24 Dec 82
Final review	24 Dec 82 - 24 Jan 83
Record of decision signed	7 Feb 83

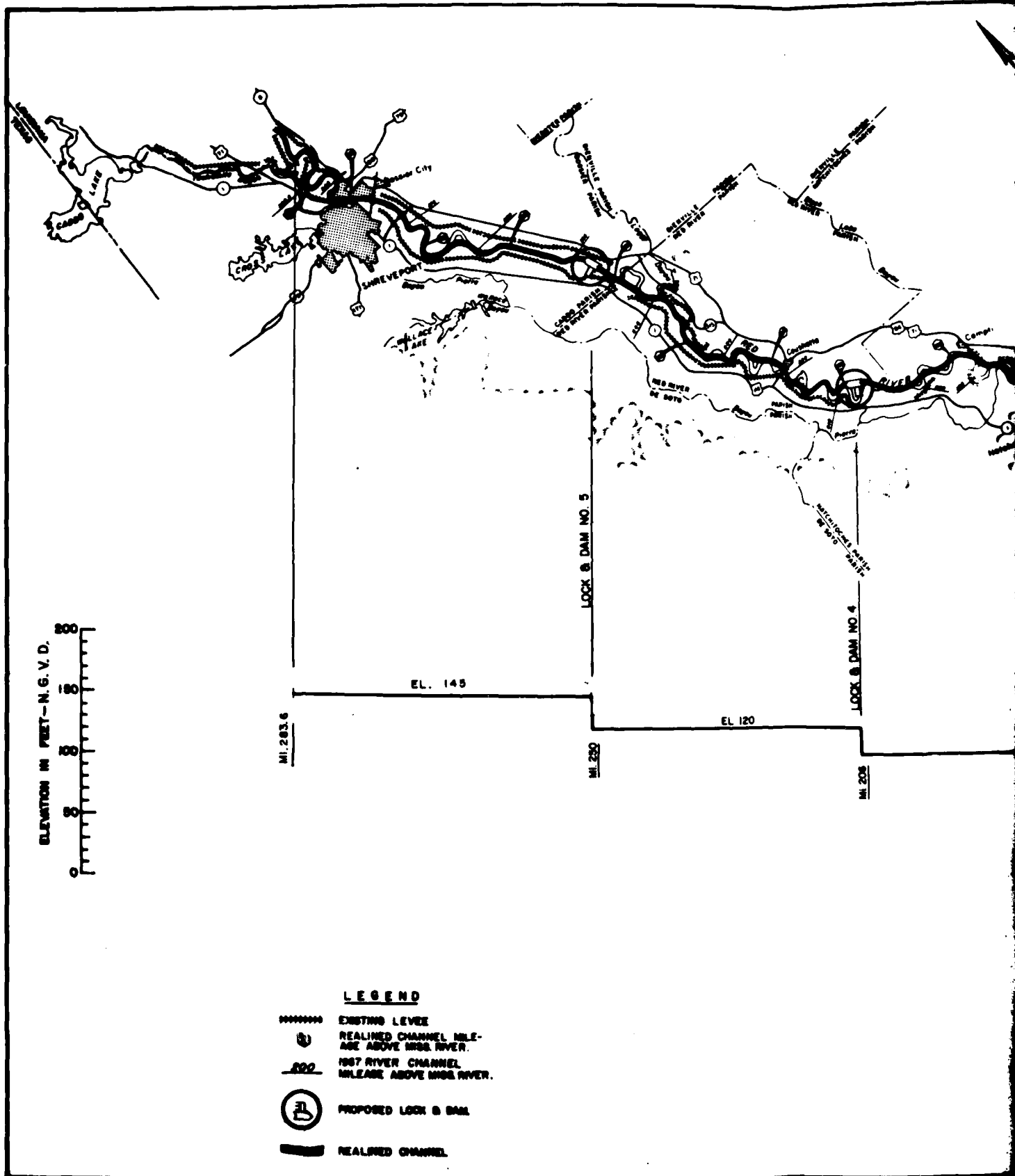
Please give us your position on the recommended plan and any comments you may have on the disclosure document by 21 Jul 82. If you desire, personnel of my staff will brief you and your staff on the contents and background studies of the document.

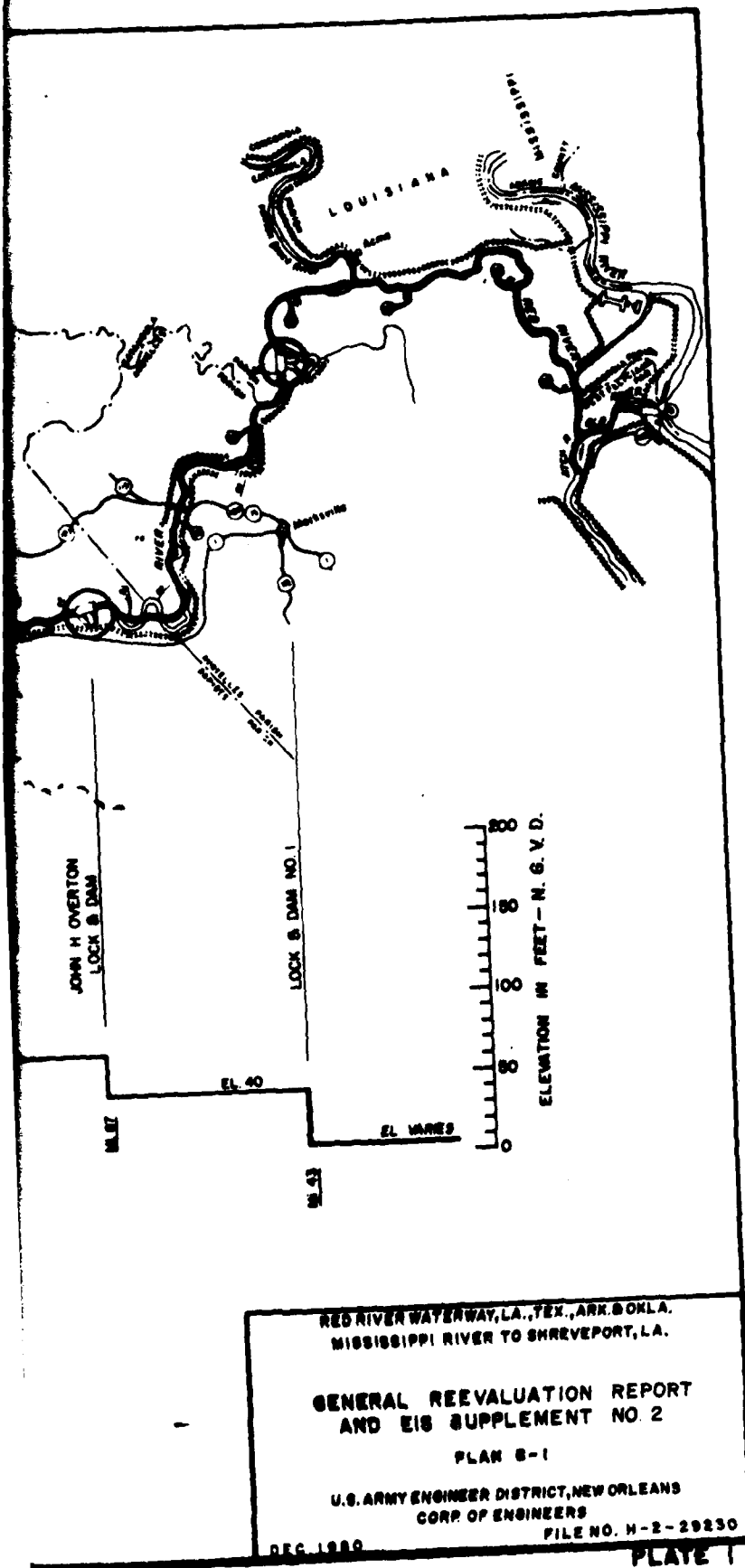
Sincerely,

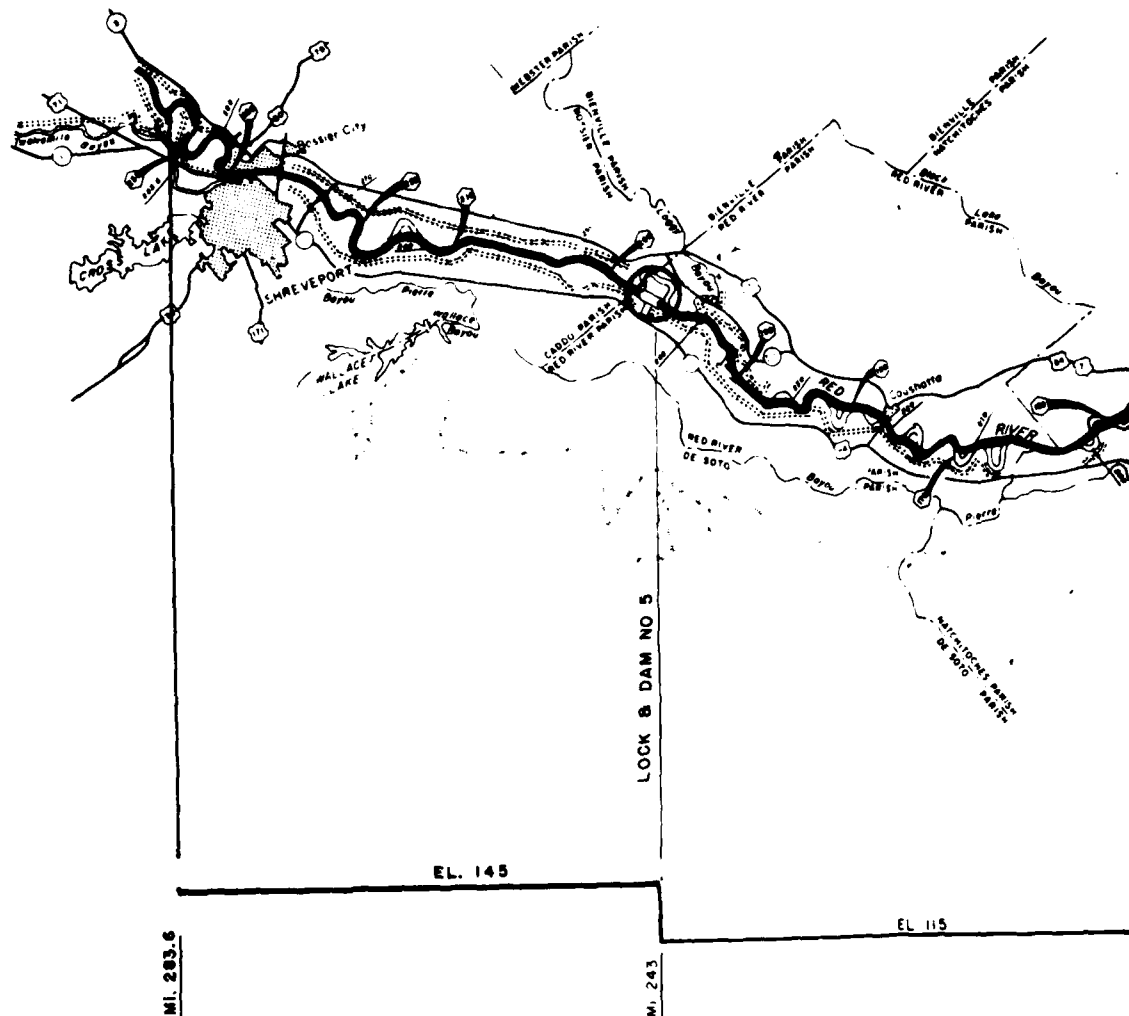
/S/

1 Inclosure
As stated

ROBERT C. LEE
Colonel, CE
District Engineer

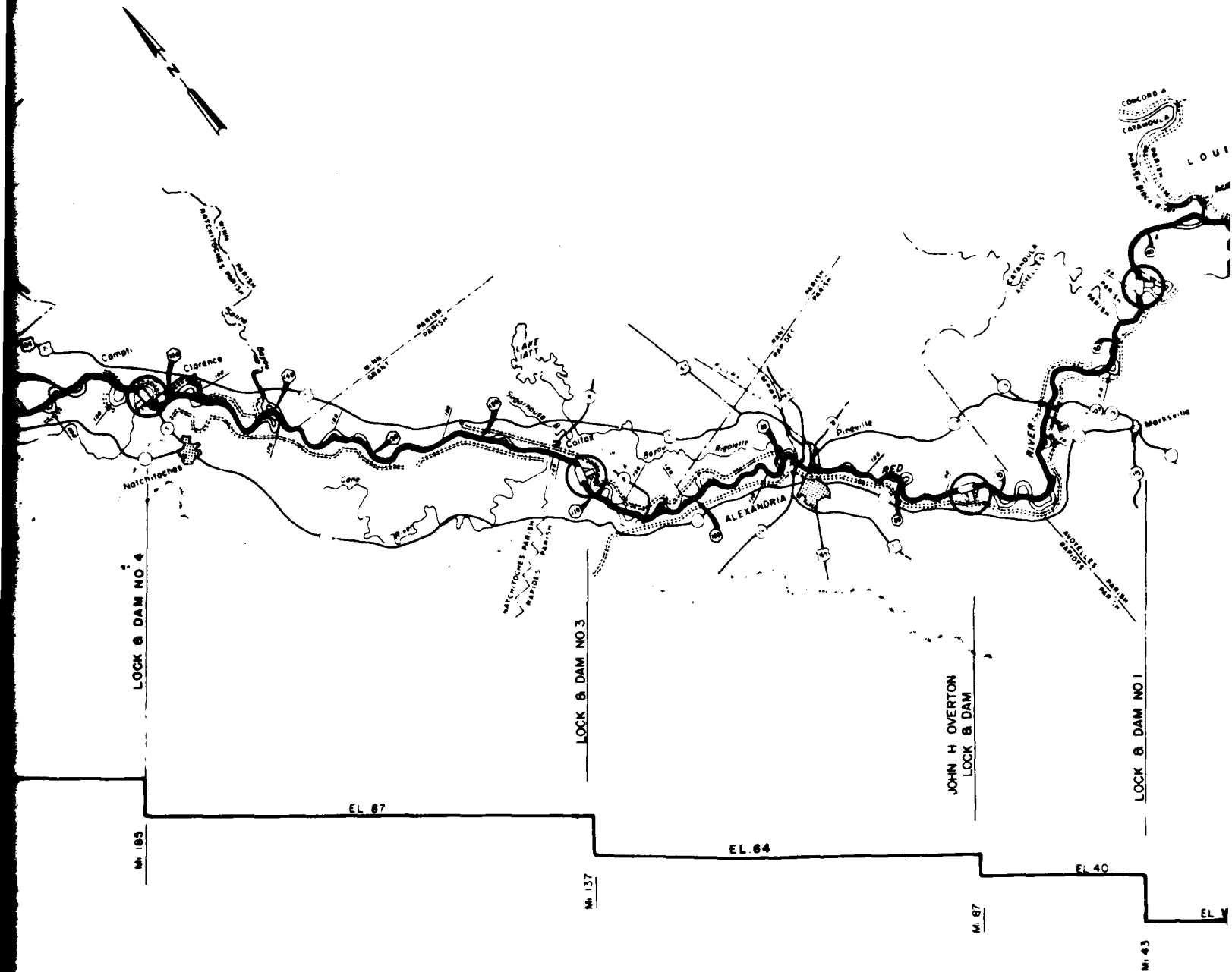






LEGEND

- EXISTING LEVEE
- ② REALIGNED CHANNEL MILE-AGE ABOVE MISS RIVER
- 200 1967 RIVER CHANNEL MILEAGE ABOVE MISS RIVER
- Ⓛ PROPOSED LOCK & DAM
- REALIGNED CHANNEL



SCALE OF MILES

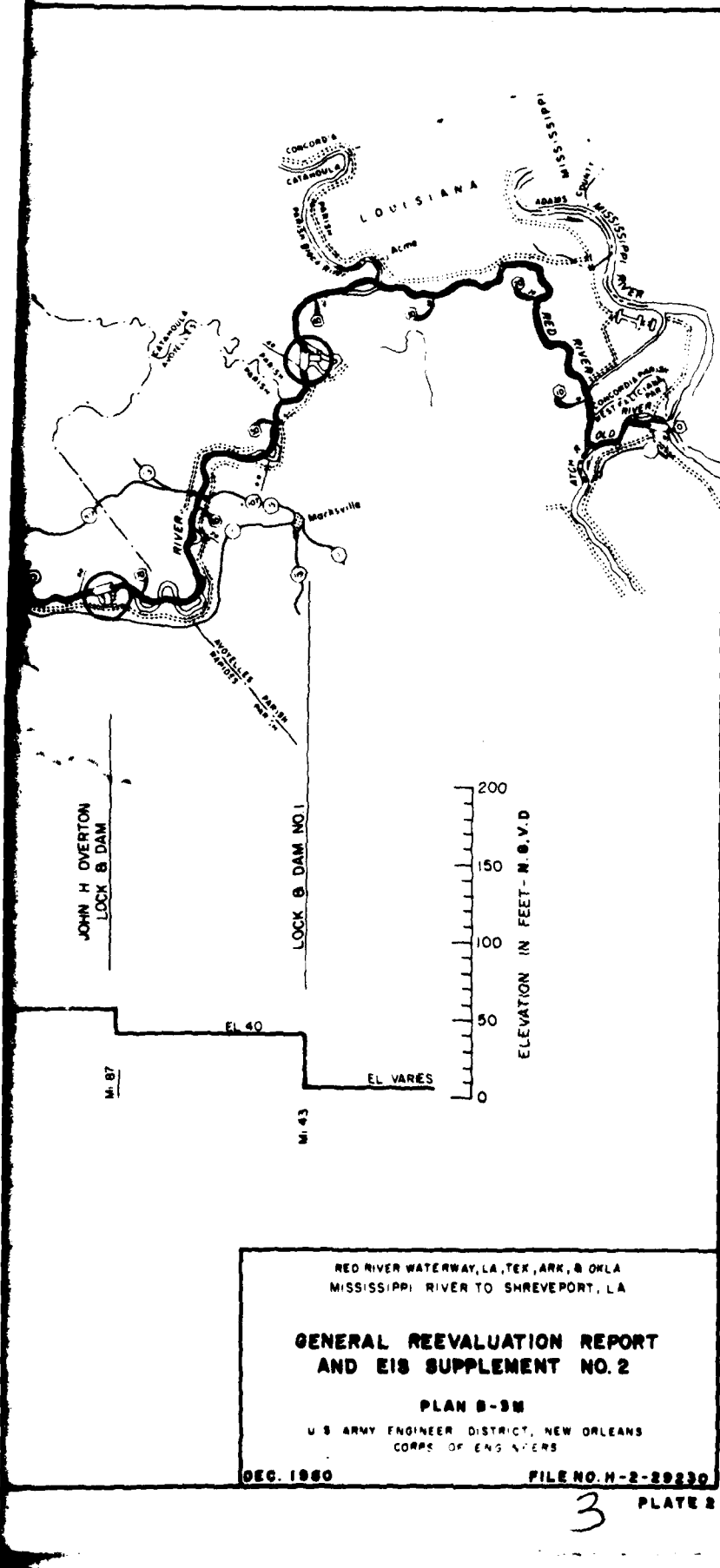
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RED RIVER
MISSISSIPPI

GENERAL
AND

U S ARMY

DEC. 1980



DRAFT
SUPPLEMENT NO. 2
TO FINAL ENVIRONMENTAL IMPACT STATEMENT

Red River Waterway, Louisiana, Texas,
Arkansas, and Oklahoma, and Related Projects
(Mississippi River to Shreveport, Louisiana, Reach)

The responsible lead agency is the US Army Engineer District, New Orleans. The responsible cooperating agency is the US Fish and Wildlife Service.

Abstract: The Red River Waterway (RRWW) project area is a region specialized in agriculture, mining, small industry, and local-serving businesses. The alluvial valley is characterized by meander belt deposits and lakes related to river migration. The dominant topographic highs are the natural and artificial levees; the lows are the backwater areas and filled-in channels. The present Red River is characterized by a meandering water course and is a threat to agricultural lands adjacent to the channel. In this supplement, impacts of providing navigation via five locks and dams, and bank stabilization from the confluence of the Red, Atchafalaya, and Mississippi Rivers at the Old River control channel to Shreveport, Louisiana, are reevaluated. Investigations since submission of Final Supplement I to the RRWW Environmental Impact Statement to the Council on Environmental Quality have revealed that impacts, in general, would be greater than originally anticipated. The B-3 Modified (B-3M) Alternative with a 145-foot pool elevation in Pool No. 5 was the selected plan that was analyzed in Supplement I. This supplement presents the results of a restudy to further evaluate project alternatives, based on a comparative analysis of the B-3M and B-1 Alternatives, using three different pool elevations in Pool No. 5 for each alternative. The B-3M Alternative provides the same benefits as the B-1 Alternative when comparing like pool elevations in Pool 5. However, more lands are impacted by construction of the B-3M Alternative than with the B-1. The B-1, 135-foot Alternative is the favored plan environmentally in that it causes the least adverse impact to the terrestrial environment. The B-1, 145 Alternative is the recommended plan. It provides greater potential for hydropower development and would lessen the costs of providing future navigation to Daingerfield, Texas, should such navigation become economically and environmentally feasible.

SEND YOUR COMMENTS TO THE DISTRICT
ENGINEER BY 17 FEBRUARY 1983.

If you would like further information on this statement, please contact: Mr. David Reece
U.S. Army Engineer District,
New Orleans, P.O. Box 60267
New Orleans, LA 70160
Commercial Telephone:
(504) 838-2522
FTS Telephone: 687-2522

NOTE: Information, displays, maps, etc., discussed in the Red River Main Report are incorporated by reference in the EIS.

1. SUMMARY

a. Major Conclusions and Findings

(1) The purpose of this study was to determine the impacts of providing navigation via five locks and dams and bank stabilization within the Red River from its juncture with the Old River control channel and Atchafalaya River to Shreveport, Louisiana. Two alternatives, the B-1 and B-3M, were assessed. Additionally, three varying pool elevations (135-foot, 137-foot, and 145-foot NGVD) in Pool No. 5 were evaluated for both the alternatives. Therefore, in actuality, six different methods or alternatives for accomplishing navigation to Shreveport were addressed.

(2) Generally, the B-1 Alternatives were considered superior from an environmental standpoint when comparing like-pool elevations for Pool No. 5. Obviously, higher pool elevations in Pool No. 5 flooded more lands and had greater adverse impact on terrestrial resources. Acres of project lands impacted by construction activities plus flooding and freeboard, but exclusive of ground water impacts, recreational development, induced clearing, and maintenance dredging, would be as follows:

	135-foot	137-foot	145-foot
B-1	28,200	29,300	32,900
B-3M	29,000	30,100	34,900

Recreational development would cause impacts, both adverse and beneficial, on an additional 9,882 acres of terrestrial habitat regardless of the selected plan. Induced clearing, common to any of the alternatives, would impact an estimated 6,670 acres. An additional 300 to 400 acres, primarily agricultural lands, would be impacted annually by maintenance dredging on lands not included in the above estimates. Agricultural lands were the areas most affected followed by cottonwood-willow-sycamore (CWS) which was the primary woodland-type impacted. The majority of farmlands directly impacted are between the river and the levee and are not considered prime or unique farmlands. Even though agricultural lands would be most affected initially, there would be an overall increase in agricultural lands over the life of the project. This would happen because of project-induced increases brought about by bank stabilization and by dredged-material disposal areas which would, after use, be placed into agricultural production. The freeboard areas are the lands no greater than 3 feet in elevation above the navigational pools which are projected to be subjected to increased soil saturation, and in places, wave action. This would be expected to cause decreased yields, changes in, or abandonment of, agricultural lands, but not have an overall adverse impact on wooded lands. Although it is difficult to quantify, much of the freeboard land could become vegetated with wetland species and become more beneficial to fish and wildlife. Ground water changes, considered separately from freeboard, are

projected to have significant impacts on agricultural lands. The majority of agricultural lands impacted by ground water are considered prime farmlands. Impacts are not significantly different between B-1 and B-3M alternatives but are greater with higher pool elevations in Pool NO. 5. For the ground water study area as a whole, acres of land with decreased yields (mostly soybean) for the B-1 135-foot, and B-1 145-foot, range from 26,440 to 29,720 acres, respectively. The comparative range for the B-3M Alternative is 25,720 to 30,660 acres. Lands with increased yields (mostly woodlands) for the B-1 Alternatives range from 6,240 to 7,160 acres and for the B-3M Alternatives range from 5,800 to 6,200 acres. The aquatic resource will gain significantly as a result of the project. Greater than 10,000 acres of aquatic habitat will be created as a result of impoundment upstream of locks and dams. The fishery and recreational potential will be enhanced as a result.

(3) Executive Order 11988, Floodplain Management, deals with minimizing or avoiding adverse impacts associated with the base floodplain unless there is no practicable alternative. The majority of impacts of this project do take place on the floodplain of the Red River. Some of the existing floodplain would be flooded permanently. It is estimated that 6,670 acres of woodland clearing would be induced. Bank stabilization and increased navigational potential might induce development in association with port facilities. Increased industrial and agricultural development of the floodplain is anticipated. Although some of the floodplain would be impounded for navigational purposes, high-water levels of annual and up to 100-year floods would actually be reduced by approximately 2 feet as a result of channel realignment. This would further encourage floodplain development. Some beneficial tradeoffs are, however, expected. In addition to an expanded and improved aquatic habitat, some lands adjacent to the floodpools might increase in value to wildlife as native and induced vegetation reacts to increased soil saturation. On these areas, development by man might be discouraged. Additionally, a wildlife mitigation plan is being formulated which would offset losses associated with project construction and induced woodland clearing. It is possible, although speculative at present, that mitigation lands could be acquired, in part, within the floodplain and prevent the development thereof. The public has had input into the plan selection process and the selected alternative is judged to be the best plan overall and acceptable from the standpoint of E.O. 11988 when viewed within the array of possible alternatives.

(4) Wildlife mitigation needs have been studied by both Corps and US Fish and Wildlife Service (USFWS) biologists. In February 1981, the USFWS provided the Corps with a Planning Aid Report (PAR) which showed the range of impacts and needed wildlife mitigation for the B-1 and B-3M alternatives. Their analysis, based on Habitat Evaluation Procedure (HEP) showed mitigation needs (bottomland hardwood acquisition) to range from 17,600 acres for the B-1, 135-foot alternative to 20,900 acres for the B-3M, 145-foot alternative. Corps analysis, based on Habitat Evaluation System (HES), showed needs to

range from 12,310 to 18,592 acres for like alternatives. Although it would be expected that different habitat-based analyses would show different results, some of the differences are accountable to different baseline data and slight discrepancies in projected land-use trends. However, both alternatives were in agreement as to the relative impacts and mitigation needs by alternative and were useful in plan selection. In June, 1980, Congress passed an act to establish the Tensas National Wildlife Refuge, PL 96-285. The lower 104 miles of this project, along with several other projects, are to be mitigated by Tensas. As a result of this Act, mitigation analysis has been performed for the tentatively selected plan (B-1, 145-foot) above mile 104. According to USFWS HEP analysis, purchase of 16,277 acres of bottomland hardwoods would mitigate project losses above mile 104. Corps HES analysis showed a need for 14,081 acres of bottomland hardwoods. In these habitat-based analyses, both agencies used identical baseline acreages and projected land-use trends. The USFWS has, also, suggested other possibilities for mitigating wildlife losses above mile 104. These range from purchase of 8,486 acres of mixed habitat in the upper project area provided with heavy plantings of hardwood species, to 21,273 acres in the same area with no planting of trees. Wildlife mitigation is discussed in detail in Appendix E and in the Coordination Act Report (CAR) (Appendix K). The Corps will continue to work with the USFWS as well as with the Louisiana Department of Wildlife and Fisheries to submit a Final Mitigation Report for congressional authorization at the earliest practicable date.

(5) Executive Order 11990, Protection of Wetlands, has been a guiding force in project planning. Impacts on wetland areas have been avoided in most cases. Original project design proposed that Hog Lake, the major cypress-tupelo gum swamp along the river, be used as the primary dredged-material disposal area for work associated with Lock and Dam No. 2. Subsequent design has been for disposal to be on upland areas and avoid this swamp totally. Additionally, the lock and dam downstream guide levee would close off an artificial drainage ditch which is currently endangering the water retention capability of the area. One of the important factors in choosing the B-1 alternative was to avoid impacting a series of land locked cypress-tupelo swamps which would have been totally destroyed by construction of Lock and Dam No. 3 as sited with the B-3 alternative. These swamps are included in the proposed recreational master plan where they would remain a "natural" area. Increased soil saturation on lands adjacent to flooded areas (freeboard lands) could enhance existing wetland values and possibly encourage some wetland development. The B-1 plan is the best alternative regarding wetlands preservation, and future planning and design will continue to consider the importance of wetlands.

(6) There are pros and cons for selecting 145-foot as opposed to one of the lower pool elevations in Pool No. 5. One of the lower pools would have the obvious benefit of impacting fewer acres of land, 4,736 acres less in the B-1 alternative when comparing the 135-foot to the 145-foot elevation. Ground water impacts, as stated

previously, would be less. There are two quantifiable benefits for having a 145-foot pool. With the additional water, there would be an increase in both commercial and sport fish. For the B-1 Alternative, potential man-days of sportfishing, for the total project area, are projected to be 344,631 annually with a 135-foot elevation and 380,022 with a 145-foot pool. A slight increase for the higher pool elevation is also projected for commercial fish harvest. The hydropower benefits could be increased with a higher pool elevation. Also, the costs of providing navigation above Shreveport would be less with a 145-foot pool, assuming such navigation becomes economically and environmentally feasible.

(7) Adverse impacts common to either alternative, regardless of Pool No. 5 elevation, relate mainly to water quality and the general impacts of navigation. Dissolved oxygen (DO) levels are projected to occasionally fall below minimum acceptable levels in the lower levels of deep pools. Occasional fish kills, primarily impacting less tolerant species such as shad, are anticipated. These occasional kills are not expected to present long-term deleterious impacts to the total fish population. Increased pollution could be anticipated as a result of navigation-related spills and increased industrialization. Also, river traffic in the Atchafalaya River would be expected to increase as a result of providing navigation to Shreveport. Maintenance dredging in order to maintain navigation would cause a long-term impact on terrestrial and aquatic resources. Impoundment to support navigable depths would create shallow water areas that could be conducive to problem vegetation growth. However, vegetated shallow areas would be valuable to the fishery and vegetation growth is not expected to be severe enough to substantially hinder small boat access, fishing, or other uses.

(8) Economic analysis compared the impacts of each of the alternative plans on the benefits claimed in the Phase I-GDM (DM No. 2), May 1976. Projected land-use differences among the alternatives were deemed to be the only new benefit-related plan features of significance. These differences are comprised of varying land requirements for construction of the plans, and of various levels of flooding and freeboard allowances associated with each plan. Three classes of benefits attributed to the bank stabilization feature are: prevention of destruction of land, intensification, and inundation reduction. These benefits are impacted by the various land-use aspects of each alternative and the appropriate adjustment to those items has been made. In addition, revised fish and wildlife benefits and losses based on detailed studies conducted by the US Fish and Wildlife Service subsequent to the GDM have been included. Revised recreation benefits have also been included. Area redevelopment benefits, which are a function of project costs, have been revised based on cost estimates for each alternative. Ground water losses, also, have been revised based on detailed studies completed since the GDM was published. The net effect of these revisions are minor and result in no significant differences among plans based on B/C ratios. The B/C ratio of the tentatively selected

plan is 1.3:1. Plan economics are discussed in the Economic Analysis Appendix.

b. Outcome of Resolved Controversy

During the first several years of project construction, oxbow lake cutoffs were silting in and not being preserved. This caused adverse reaction from the Louisiana Department of Wildlife and Fisheries, as well as the public at large. Now the techniques to construct upstream closures in a timely manner have been refined and their construction has become a high priority.

c. Unresolved Disagreements

(1) State and Federal fish and wildlife agencies have urged the Corps to build gated lower closures on oxbow lakes in addition to upper closures in order to better manage the fishery resources. The Corps contends that lower closures would close naturally over time, not provide water manipulation capabilities because of very permeable soil, and be very costly. An open lower end to oxbows would also allow convenient access to fishing boats and would allow for water circulation which should benefit water quality.

d. Relationship to Environmental Requirements

REQUIREMENTS		ALTERNATIVES					
		B-1			B-3M		
FEDERAL POLICIES		135	137	145	135	137	145
Archeological and Historical Preservation Act	All Alternatives in PARTIAL Compliance ¹						
Clean Air Act	All Alternatives in FULL Compliance						
Clean Water Act	All Alternatives in PARTIAL Compliance ²						
Coastal Zone Management Act	Not Applicable						
Endangered Species Act	All Alternatives in FULL Compliance						
Estuary Protection Act	Not Applicable						
Federal Water Project Recreation Act	All Alternatives in FULL Compliance						
Fish and Wildlife Coordination Act	All Alternatives in FULL Compliance						
Floodplain Management (E.O. 11988)	All Alternatives in FULL Compliance						
Land and Water Conservation Fund Act	All Alternatives in FULL Compliance						
Marine Mammal Protection Act	Not Applicable						
Marine Protection Research and Sanctuaries Act	Not Applicable						
National Environmental Policy Act	All Alternatives in FULL Compliance						
National Historic Preservation Act	All Alternatives in PARTIAL Compliance ³						
Prime and Unique Farmlands	All Alternatives in FULL Compliance						
Protection and Enhancement of Cultural Environment (E.O. 11593)	All Alternatives in PARTIAL Compliance ⁴						
Protection of Wetlands (E.O. 11990)	All Alternatives in FULL Compliance						
Rivers and Harbors Appropriation Act	All Alternatives in FULL Compliance						
Water Resources Planning Act	All Alternatives in FULL Compliance						
Watershed Protection and Flood Prevention Act	All Alternatives in FULL Compliance						
Wild and Scenic Rivers Act	Subject Resource Not in the Study Area						
STATE POLICIES							
Air Control Act	All Alternatives in FULL Compliance						
Archeological Treasure Act	Not Applicable						
Historic Preservation Districts Act	Not Applicable						
Louisiana Scenic Streams Act	All Alternatives in FULL Compliance ⁵						
Water Control Act	All Alternatives in FULL COMPLIANCE ⁵						

LAND USE PLANS

Louisiana Coastal Zone Management Plan	Not Applicable
The Land-Use Element of the Area-Wide Comprehensive Plan	All Alternatives in FULL Compliance

¹ Will be in full compliance when inventory surveys are completed, sites tested, eligibility to the National Register of Historic Places assessed, and negative impacts mitigated.

² The provisions of Section 404 of the Clean Water Act will be satisfied prior to advertisement of construction contracts for work items. Public notices will be issued and State of Louisiana Water Quality Certificates obtained for those items.

³ Full compliance will not be complete until the Advisory Council on Historic Preservation has an opportunity to comment on project impact to the National Register of Historic Places properties.

⁴ Same as 1 above.

⁵ At present, DO levels occasionally fall below State of Louisiana stream standards during low-water periods. This condition would occur more often with the project in place.

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3. NEED FOR AND OBJECTIVES OF ACTION

a. Study Authorization

(1) Public Law 90-483, 90th Congress, approved 13 August 1968, authorized construction on the "Red River Waterway, Louisiana, Texas, Arkansas, and Oklahoma" project. A report of the Chief of Engineers, dated 11 May 1967, printed in House Document No. 304, 90th Congress, 2d Session, recommended: (1) Bank Stabilization to provide for realining and stabilizing the banks of the Red River in accordance with the plan of the District Engineer and (2) Navigation to provide a 9-foot slack water navigational channel and related recreational facilities extending from the Mississippi River through Old River and Red River to Shreveport, Louisiana, generally in accordance with the plan of the District Engineer, except that the navigational channels would be 200 feet wide and other such modifications, including changes in alinement, location, and dimensions may be advisable at the discretion of the Chief of Engineers.

(2) This report is being prepared in accordance with the National Environmental Policy Act of 1969, Public Law 90-190, and the Fish and Wildlife Coordination Act of 1958, Public Law 85-624.

b. Public Concerns

The primary concerns that have come to the Corps' attention either at public meetings or through personal contacts are as follows:

(1) The amount of agricultural lands that would be impacted as a result of construction, flooding, and raising ground water levels.

(2) The location of impacted farmlands - although most landowners support the project, each prefers the alternative that would not impact or would have the least impact on their own land.

(3) Adequate monetary compensation for condemned lands - some landowners are concerned about whether they would be adequately compensated for land that they would lose permanently or lands used temporarily during project construction.

(4) Sufficient recreational development - some people are concerned that recreation is not being developed or would not be developed to the extent intended in the authorizing document.

(5) Adequate pool elevation in Pool No. 5 to insure cost effective navigational development north and west of Shreveport - Many people are concerned because the selection of a 135-foot or 137-foot pool height in Pool No. 5, as opposed to a 145-foot pool, would increase the cost of navigation north of Shreveport, should such navigation ever be proven economically and environmentally feasible.

(6) Adequate pool elevation in Pool No. 5 for future water supply - Certain public officials believe that selection of a low pool alternative could have a negative impact on future water supply for the Shreveport area.

c. Planning Objectives

The overall planning objective for the RRWW, Mississippi River to Shreveport, Louisiana Reach, is to select lock and dam locations and pool elevations to provide benefits relative to navigation, bank stabilization, and recreation with the least economic and environmental costs.

4. ALTERNATIVES

a. Plans Eliminated from Further Study

Insofar as navigation is concerned, the available basic alternatives include waterway construction in other locations, and no action. Insofar as bank stabilization is concerned, the only basic alternative is no-action.

(1) The Overton-Red River Waterway Project - This project was authorized by Public Law 525, 79th Congress, on 24 July 1946. It would provide a navigational route from the Mississippi River to a turning basin in the vicinity of Shreveport via Old and Red Rivers to mile 31 and a land-locked channel about 175 miles long, 9 feet deep by 100 feet wide on the right descending bank of the Red River. Only the lower 31 miles of the Overton-Red project have progressed to the construction phase, and the remainder, the land-locked portion, has been classified as inactive due to lack of local assurances. Other features of the plan include nine locks, 56 feet wide and 650 feet long, three additional turning basins, 33 new highways and seven new railroad bridges, various pipeline and utility relocations, and a pumping station at the upper terminus to provide the needed lockage water. This alternative was eliminated from further study because it would:

- (a) Be more costly to construct, operate, and maintain;
- (b) Generate a lesser aggregate of transportation savings;
- (c) Involve more extensive adverse environmental impacts, principally by reason of the extensive cross-country dredging involved; and
- (d) Forego the opportunities for economies of multi-purpose construction in connection with the bank stabilization works.

(2) No-Action - The no-action alternative was a basic consideration and is applicable to both navigation and bank stabilization. With respect to the former, no-action would mean that the commerce identified for movement on the proposed project would move instead over existing alternative modes, including trains, trucks, pipelines, airplanes, and combinations of all four. The transportation savings attributable to the proposed action were evaluated as the net difference in transportation costs for the proposed project in place, and those for use of the least-costly alternative mode or combination of modes. One consequence of no-action would, therefore, be that an economic return at least equal to the aggregate transportation savings for the project would be foregone. No-action would also foreclose the opportunities for recreational development and bank stabilization provided by the proposed project.

b. Without Conditions

Without construction of the project, the Red River and associated environments would remain relative to present conditions. The aquatic ecosystems would remain in essentially the same conditions with regard to species diversity and population densities. Turbidity and bank erosion would continue to be a problem with regard to aquatic environments and water quality. Physical characteristics of the river such as flooding, channel widening, shoaling, and natural scouring would continue at essentially the same rate. Terrestrial ecosystems would remain in essentially the present state due to lack of large scale change in the physical character of the river. Water tables and overbank flooding would continue to exhibit the same factors of restraint or encouragement of plant succession that exists at the present time. It is very likely that land clearing and industrial development would proceed slowly if the project is not implemented. Without the proposed project, the economy of the project area is likely to continue with a prolonged period of below average incomes and relatively high unemployment, although planned lignite mining and road construction such as the North-South Expressway should cause a moderating influence. Increasing agricultural yields with decreasing labor inputs would continue. In the major urban areas, new industry would provide employment and income opportunities on a moderate scale; however, the rural areas would continue to languish. Over the long run, industries utilizing unskilled or semiskilled labor could be attracted to these low income areas; although it is unlikely that the project area would reach a level of development approaching that of the American mainstream.

c. Plans Considered in Detail

Two within channel alternatives have been evaluated to provide navigation and bank stabilization to Shreveport - the B-3M and B-1 Alternatives. Variations within each alternative relative to the pool elevation in Pool No. 5 have also been addressed. Either alternative or variation thereof would involve the development of a realigned channel 230 miles long with dimensions of 9-foot deep and 200-foot wide. Structurally, either alternative consists of five locks and dams which would furnish a maximum lift of up to 141 feet, depending on the selected pool elevation in Pool No. 5. Table EIS-1 presents a physical comparison as to river mile location and pool elevations for each of the alternatives. Either alternative or pool elevation would serve to provide navigation to Shreveport. The B-1, 145-foot alternative is the Corps' recommended plan.

TABLE EIS-1

PHYSICAL COMPARISON OF ALTERNATIVE PROJECT PLANS, B-1 AND B-3M,
RED RIVER WATERWAY, MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

Lock & Dam	B-1		B-3M	
	Location (19 67 river mile)	Pool Elevation	Location (19 67 river mile)	Pool Elevation
1	43	40	43	40
2	87	64	87	64
3	141	95	137	87
4	206	120	185	115
5	250	145	243	145
		137		137
		135		135

d. Comparative Impacts of Alternatives

<u>ALTERNATIVES</u>	<u>S I G N I F I C A N T R E S O U R C E S</u>	
	<u>Bottomland Hardwoods</u>	
Base Condition	Total of 3,038 acres* exists in the area which could be affected by the project.	
Without Condition (No Action)	Ten percent of the BLH would be cleared without project, leaving 2,734 acres.	
B-1, 135-foot	2,868 acres impacted. losses of \$11,253.	Annual wildlife related
B-1, 137-foot	2,952 acres impacted. losses of \$11,303.	Annual wildlife related
B-1, 145-foot	3,038 acres impacted. losses of \$12,332.	Annual wildlife related
B-3M, 135-foot	2,609 acres impacted. losses of \$9,367.	Annual wildlife related
B-3M, 137-foot	2,704 acres impacted. losses of \$9,529.	Annual wildlife related
B-3M, 145-foot	2,786 acres impacted. losses of \$10,555.	Annual wildlife related

*Exclusive of ground water related impacts.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SBaldcypress-tupelogram Swamps

Base Condition	Total of 925 acres* exists in the area which could be affected by the project.	
Without Condition (No Action)	Ten percent of the CT would be cleared without project, leaving 742 acres.	
B-1, 135-foot	800 acres impacted.	Annual wildlife related losses of \$2,580.
B-1, 137-foot	Same as B-1, 135-foot.	
B-1, 145-foot	Same as B-1, 135-foot.	
B-3M, 135-foot	919 acres impacted.	Annual wildlife related losses of \$2,589.
B-3M, 137-foot	Same as B-3M, 135-foot.	
B-3M, 145-foot	925 acres impacted.	

*Exclusive of ground water related impacts.

ALTERNATIVES**S I G N I F I C A N T R E S O U R C E S****Riverine Habitat (CWS and WSB)**

Base Condition	Total of 20,742 acres* of CWS and 3,300 acres of WSB exist in the area which could be affected by the project.
Without Condition (No Action)	Ten percent of the CWS would be cleared without project, leaving 18,668 acres.
B-1, 135-foot	18,896 acres of CWS and 3,159 acres of WSB impacted, a total of 22,055 acres. Annual wildlife related losses of \$25,039.
B-1, 137-foot	19,524 acres of CWS and 3,207 acres of WSB impacted, a total of 22,731 acres. Annual wildlife related losses of \$25,627.
B-1, 145-foot	20,742 acres of CWS and 3,300 acres of WSB impacted, a total of 24,042 acres. Annual wildlife related losses of \$29,246.
B-3M, 135-foot	18,427 acres of CWS and 3,020 acres of WSB impacted, a total of 21,447 acres. Annual wildlife related losses of \$25,667.
B-3M, 137-foot	18,962 acres of CWS and 3,068 acres of WSB impacted, a total of 22,030 acres. Annual wildlife related losses of \$26,936.
B-3M, 145-foot	20,660 acres of CWS and 3,086 acres of WSB impacted, a total of 23,746 acres. Annual wildlife related losses of \$31,490.

*Exclusive of ground water related impacts.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SPine Hardwoods

Base Condition	Total of 3,004 acres* exists in the area which could be affected by the project.
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Without Condition (No Action)	Ten percent of the pine/oak uplands would be cleared without project, leaving 2,700 acres.
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B-1, 135-foot	2,516 acres impacted. Annual wildlife related losses of \$3,235.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	3,004 acres impacted. Annual wildlife related losses of \$4,873.
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B-3M, 137-foot	Same as B-3M, 135-foot.
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B-3M, 145-foot	Same as B-3M, 137-foot.
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*Exclusive of ground water related impacts.

ALTERNATIVES**S I G N I F I C A N T R E S O U R C E S**

Agricultural Lands

Base Condition	Total of 20,979 acres* of agricultural lands in the area which could be affected by the project. Approximately 2/3 of the lands are pasture, the remaining 1/3 is soybeans. The majority of these lands is not considered prime or unique farmlands.
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Without Condition (No Action)	Agricultural lands would increase in acreage by approximately 10 percent due to forest lands being converted to agricultural uses.
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B-1, 135-foot	5,995 acres of soybeans and 10,381 acres of pasture impacted, a total of 16,376 acres. Annual wildlife-related gains of \$7,864.
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B-1, 137-foot	6,000 acres of soybeans and 10,626 acres of pasture impacted, a total of 16,626 acres. Annual wildlife-related gains of \$7,776.
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B-1, 145-foot	6,594 acres of soybeans and 12,455 acres of pasture impacted, a total of 19,049 acres. Annual wildlife-related gains of \$7,000.
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B-3M, 135-foot	5,428 acres of soybeans and 12,008 acres of pasture impacted, a total of 17,436 acres. Annual wildlife-related gains of \$8,233.
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B-3M, 137-foot	5,491 acres of soybeans and 12,444 acres of pasture impacted, a total of 17,935 acres. Annual wildlife-related gains of \$8,131.
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B-3M, 145-foot	5,777 acres of soybeans and 15,202 acres of pasture impacted, a total of 20,979 acres. Annual wildlife-related gains of \$7,181.
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*Exclusive of ground water-caused impacts.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SNational Register of Historic Places (NRHP)

Base Condition	Five National Register of Historic Places properties are listed as present in project impact zone.
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Without Condition	Present impact on sites 16RA76 (Fort Randolph,) 16RA89 (Fort Buhlow) and 16RA516/90 (Bailey's Dam) is slow erosion. Impact from erosion and revetment construction has already been mitigated for 16RR4 (Hanna Site). Site 16AV62 (Log Raft Site) has been destroyed by erosion since its determination of eligibility.
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B-1, 135-foot	Revetment construction would impact 16RA516/90. Sites 16RA76 and 16RA89 are to be incorporated into a public recreation area.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	Same as B-1, 135-foot.
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B-3M, 137-foot	Same as B-1, 135-foot.
----------------	------------------------

B-3M, 145-foot	Same as B-1, 135-foot.
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ALTERNATIVESS I G N I F I C A N T R E S O U R C E SSignificant Geological Features

Base Condition	River valley underlain by tertiary formations, valley fill of Pleistocene and Holocene deposits; important paleontological sites include Montgomery Landing, Saline Bayou, Belle Bluff, and Grand Ecore Bluff.
Without Condition (No Action)	Dynamic nature of river would alter paleontological sites over time. Periodic increases in river level inundates the same portions of bluffs as would be inundated by navigational pools.
B-1, 135-foot	Montgomery Landing, Saline Bayou, Belle Bluff inundated by 15 feet of water, lower 5 feet of Grand Ecore Bluff inundated.
B-1, 137-foot	Same as B-1, 135-foot.
B-1, 145-foot	Same as B-1, 135-foot.
B-1, 135-foot	Same as B-1, 135-foot.
B-3M, 137-foot	Same as B-1, 135-foot.
B-3M, 145-foot	Same as B-1, 135-foot.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SArcheological Sites

Base Condition	Sixty-five known terrestrial sites are in project area; and over 200 recorded magnetic anomalies.
Without Contition (No Action)	River meander changes would eventually destroy the majority of recorded sites and the unknown number of anomalies within the present meander belt.
B-1, 135-foot	Adversely impacts 46 sites and unknown number of anomalies.
B-1, 137-foot	Adversely impacts 47 sites and unknown number of anomalies.
B-1, 145-foot	Adversely impacts 48 sites and unknown number of anomalies.
B-3M, 135-foot	Adversely impacts 53 sites and unknown number of anomalies.
B-3M, 137-foot	Adversely impacts 54 sites and unknown number of anomalies.
B-3M, 145-foot	Adversely impacts 56 sites and unknown number of anomalies.

ALTERNATIVESS I G N I F I C A N T R S O U R C E SNavigation

Base Condition	Above Acme, Louisiana, only during seasonal periods of high flows does the Red River have sufficient depths to be navigable to shallow draft vessels. No navigational aids are in place.
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Without Condition (No Action)	No impact.
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B-1, 135-foot	Would allow navigation to mile 273. Approximately 332,000 CY of maintenance dredging required annually.
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B-1, 137-foot	Would allow navigation to mile 276, with approximately 323,000 CY of maintenance dredging required annually.
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B-1, 145-foot	Would allow navigation to mile 286.3 with approximately 323,000 CY of maintenance dredging.
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B-3M, 135-foot	Same as B-1, 135-foot except approximately 423,000 CY of maintenance dredging.
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B-3M, 137-foot	Same as B-1, 137-foot except approximately 414,000 CY of maintenance dredging required.
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B-3M, 145-foot	Same as B-1, 145-foot, except approximately 414,000 CY of maintenance dredging required.
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ALTERNATIVESS I G N I F I C A N T R E S O U R C E SHydropower

Base Condition	River falls 141 feet over project length, but there is no present utilization of this potential.	
Without Condition (No Action)	Hydropower development would not be likely without construction of locks and dams.	
B-1, 135-foot	Minimum provisions to protect potential of future hydro-electric generation would be designed; works for minimum provision do not mandate hydropower, but allow the option of hydropower. Installed megawatt capacity - 129.	
B-1, 137-foot	Same as B-1, 135 foot.	Installed megawatt capacity - 134.
B-1, 145-foot	Same as B-1, 135-foot.	Installed megawatt capacity - 142.
B-3M, 135-foot	Same as B-1, 135-foot.	Installed megawatt capacity - 129.
B-3M, 137-foot	Same as B-1, 135-foot.	Installed megawatt capacity - 134.
B-3M, 145-foot	Same as B-1, 135-foot.	Installed megawatt capacity - 154.

ALTERNATIVESS I G N I F I C A N T R E S O R C E SWater Quality

Base Condition	Traditional parameters such as temperature, DO and nutrients indicate water quality sufficient for fish and wildlife propagation, secondary contact recreation and water supply. Certain pesticides and heavy metals have exceeded EPA chronic toxicity criteria for aquatic life. Chlorides, sulfates, and dissolved solids are occasionally high. Indicator bacteria levels have exceeded standards in the project area. DO occasionally falls below 5 ppm during low-flow, high temperature periods.
Without Condition (No Action)	Water quality conditions in the project area should improve in the future with additional waste treatment and continued pesticide restrictions.
B-1, 135-foot	Water quality conditions during high to medium flows would be similar to that described in the base condition. Summer and early fall water quality would be impacted in subsurface waters during extended low-flow periods. Increased algae activity could lead to oxygen deficits in deeper waters. Coliform levels would be lower with the project.
B-1, 137-foot	Same as B-1, 135-foot.
B-1, 145-foot	Same as B-1, 135-foot.
B-3M, 135-foot	Same as B-1, 135-foot.
B-3M, 137-foot	Same as B-1, 135-foot.
B-3M, 145-foot	Same as B-1, 135-foot.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SMineral Resources

Base Condition	Petroleum, natural gas, sand, gravel, clay, quarry stone, carbon black, lignite, iron, ore, and gypsum occur in the area.
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Without Condition (No Action)	No impact.
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B-1, 135-foot	No direct impacts on mineral resources are anticipated.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	Same as B-1, 135-foot.
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B-3M, 137-foot	Same as B-1, 135-foot.
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B-3M, 145-foot	Same as B-1, 135-foot.
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ALTERNATIVES**S I G N I F I C A N T R E S O U R C E S****Timber**

Base Condition	Predominant forest type is hardwoods ranging from low grade cottonwood-willow-sycamore associations to hackberry-elm-ash complexes; pine forests on uplands - these woodlands comprise 6 million cubic feet of growing stock and 19 million board feet of sawtimber.
Without Condition (No Action)	No impact.
B-1, 135-foot	Changes (reductions) in timber resources range from 68% in 1990 to 55% in 2005 as stabilization and forestation of accreted lands offset early year losses.
B-1, 137-foot	Changes (reductions) in timber resources range from 72% in 1990 to 60% in 2005 as stabilization and forestation of accreted lands offset early year losses.
B-1, 145-foot	Changes (reductions) in timber resources range from 80% in 1990 to 68% in 2005 as stabilization and forestation of accreted lands offset early year losses.
B-3M, 135-foot	Changes (reductions) in timber resources range from 60% in 1990 to 53% in 2005 as stabilization and forestation of accreted lands offset early year losses.
B-3M, 137-foot	Changes (reductions) in timber resources range from 70% in 1990 to 57% in 2005 as stabilization and forestation of accreted lands offset early year losses.
B-3M, 145-foot	Changes (reductions) in timber resources range from 82% in 1990 to 68% in 2005 as stabilization and forestation of accreted lands offset early year losses.

ALTERNATIVES

S I G N I F I C A N T R E S O U R C E S

Fishery Resources

Base Condition (1975)	River and backwaters support moderate sport fishery with an annual man-day potential of 115,852 valued at \$173,778; river supports valuable commercial fishery - 290,557 pounds valued at \$63,921 harvested annually from river and backwater areas; backwater areas more productive.
Without Condition (No Action)	Due to dynamic nature of river system, fisheries will remain essentially the same.
B-1, 135-foot	Commercial fish harvest expected to rise from 290,557 pounds in 1975 to 822,085 pounds in 2040; potential man-days of sportfishing expected to rise from 115,852 in 1975 to 354,384 in 2040. Annual commercial harvest 498,277 pounds valued at \$104,638; annual sportfish man-days 344,631 valued at \$516,946.
B-1, 137-foot	Commercial fish harvest and man-days sportfishing slightly higher than B-1, 135-foot.
B-1, 145-foot	Commercial fish harvest expected to rise from 290,557 pounds in 1975 to 888,553, pounds in 2040; potential man-days of sportfishing expected to rise from 115,852 in 1975 to 402,404 in 2040. Annual commercial harvest 532,402 pounds valued at \$111,804; annual sportfish man-days 380,022 valued at \$570,033.
B-3M, 135-foot	Commercial fish harvest expected to rise from 290,557 pounds in 1975 to 916,803 pounds in 2040; potential man-days of sportfishing expected to rise from 115,852 in 1975 to 370,309 in 2040. Annual commercial harvest 549,883 pounds valued at \$115,475; annual sportfish man-days 359,703 valued at \$539,554.
B-3M, 137-foot	Commercial fish harvest and man-days sportfishing slightly higher than B-3M, 135-foot.

B-3M, 145-foot

Commercial fish harvest expected to rise from 290,557 pounds in 1975 to 888,161 pounds in 2040; potential man-days of sportfishing expected to rise from 115,852 in 1975 to 423,857 in 2040. Annual commercial harvest 531,551 pounds valued at \$111,626; annual sportfish man-days 406,405 valued at \$609,607.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E SWildlife Resources

Base Condition	Wildlife resources are abundant, particularly in the wooded areas below Lock and Dam No. 1, including rabbit, squirrels, deer, and game birds; raccoons, nutria, otter, and beaver are trapped.
Without Condition (No Action)	10 percent of remaining woodlands would be cleared by 1985 for agricultural expansion.
B-1, 135-foot	Would affect 45,000 acres* of habitat; 7,400 acres would be permanently lost as terrestrial habitat. Annual wildlife related losses of \$20,176.
B-1, 137-foot	Would affect 46,100 acres* of habitat; 7,800 acres would be permanently lost as a terrestrial habitat. Annual wildlife related losses of \$20,901.
B-1, 145-foot	Would affect 49,600 acres* of habitat; 11,000 acres would be permanently lost as terrestrial habitat. Annual wildlife related losses of \$26,225.
B-3M, 135-foot	Would affect 45,800 acres* of habitat; 8,000 acres would be permanently lost as terrestrial habitat. Annual wildlife related losses of \$20,595.
B-3M, 137-foot	Would affect 47,000 acres* of habitat; 8,600 acres would be permanently lost as terrestrial habitat. Annual wildlife related losses of \$22,128.
B-3M, 145-foot	Would affect 51,600 acres* of habitat; 12,900 acres would be permanently lost as terrestrial habitat. Annual wildlife related losses of \$28,660.

*Does not include ground water impacts.

NOTE: Wildlife related losses shown above does not reflect losses to commercial trapping revenues that amounted to \$12,815 annually. This value was derived from the 1978 mitigation report which was based on the old B-3 modified plan.

ALTERNATIVESSIGNIFICANT RESOURCESEndangered Species

Base Condition	Endangered species known to occur or that would occur in the area include the Florida panther, American alligator, bald eagle, red cockaded woodpecker, ivory-billed woodpecker, arctic peregrine falcon, Eskimo curlew, and Bachman's warbler.
Without Condition (No Action)	No impact except 10 percent reduction in habitat due to clearing of wooded areas.
B-1, 135-foot	American alligator would benefit by creation of oxbow lakes; bald eagle feeding areas would be created.
B-1, 137-foot	Same as B-1, 135-foot.
B-1, 145-foot	Same as B-1, 135-foot.
B-3M, 135-foot	Same as B-1, 135-foot except potential red-cockaded woodpecker habitat in Lock and Dam No. 3 area would be impacted.
B-3M, 137-foot	Same as B-3M, 135-foot.
B-3M, 145-foot	Same as B-3M, 135-foot.

ALTERNATIVES

S I G N I F I C A N T R E S O U R C E S

General Recreation

Base Condition	There are no developed recreation areas along the river in the project reach.
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Without Condition (No Action)	No impact.
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B-1, 135-foot	Same as B-1, 137-foot pool.
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B-1, 137-foot	Project provides for approximately 13,000 acres of recreational land. Twenty-six sites have been selected, five of which are basically wildlife management areas with minimal recreational facilities. The draft recreation Master Plan (DM No. 4) is based on this pool level.
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B-1, 145-foot	Same as B-1, 137-foot pool.
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B-3M, 135-foot	Similar to B-1, 137-foot pool.
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B-3M, 137-foot	Similar to B-1, 137-foot pool.
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B-3M, 145-foot	Similar to B-1, 137-foot pool.
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ALTERNATIVES

SIGNIFICANT RESOURCES

Ground Water

Base Condition	Red River aquifer is largest source of ground water in study area; annual water level fluctuations range from 30 feet near the river to a few feet in backwater areas.
Without Condition (No Action)	No impact.
B-1, 135-foot	Decreased yields on 28,440 acres of mostly agricultural lands; increased yields on 6,240 acres of mostly woodlands. Minimal urban impacts.
B-1, 137-foot	Decreased yields on 28,920 acres of mostly agricultural lands; increased yields on 6,360 acres of mostly woodlands. Minimal urban impacts.
B-1, 145-foot	Decreased yields on 29,720 acres of mostly agricultural lands; increased yields on 7,160 acres of mostly woodlands. Mild impact to 732 acres of urban vegetation; moderate impact to 155 acres of urban vegetation; severe impact to 50 acres of urban vegetation.
B-3M, 135-foot	Decreased yields on 25,720 acres of mostly agricultural lands; increased yields on 5,800 acres of mostly woodlands. Minimal urban impacts.
B-3M, 137-foot	Decreased yields on 26,520 acres of mostly agricultural lands; increased yields on 5,920 acres of mostly woodlands. Minimal urban impacts.
B-3M, 145-foot	Decreased yields on 30,360 acres of mostly agricultural lands; increased yields on 6,200 acres of mostly woodlands. Minimal impact to 732 acres of urban vegetation; moderate impact to 155 acres; and severe impact to 50 acres.

ALTERNATIVESS I G N I F I C A N T R E S O U R C E STributaries

Base Condition	Over 20 tributaries enter the river in the project area; tributaries are vital to replenishment of river, they have rapidly fluctuating flows due to seasonal variation, and are more productive than river project.
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Without Condition (No Action)	No impact.
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B-1, 135-foot	Stage level increases would occur in the lower portion of all tributaries, velocities would decrease, and slack water areas would be created, fisheries would benefit if eutrophic conditions do not cause problems; interior drainage should not be affected; most tributaries would remain in present bank lines.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	Same as B-1, 135-foot except Bayou Nantachie would require less flowage easement.
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B-3M, 137-foot	Same as B-3M, 135-foot.
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B-3M, 145-foot	Same as B-3M, 135-foot.
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ALTERNATIVES**S I G N I F I C A N T R E S O U R C E S**

Oxbow Lakes

Base Condition	Approximately 3,700 acres of oxbow lakes and other water bodies present in project area, ranging in size from a few to over 100 acres; more productive than river proper for fish and wildlife resources.
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Without Condition (No Action)	River is highly dynamic system and oxbows will vary in size, location, and productivity over time.
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B-1, 135-foot	840 acres of original 3,700 acres lost as aquatic habitat during construction leaving 2,860 acres--11,653 acres of oxbows created; 7,887 acres provided with closures, 5,454 acres will remain at end of project life (2040) in addition to the 2,860; annual harvest of commercial fish, 140,713 pounds by 2040; 23,893 man-days sportfishing by 2040.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	840 acres of the 3,700 will be lost during construction leaving 2,860 acres--11,365 acres of oxbows created; 8,099 acres provided with closures, 5,529 acres will remain in 2040 in addition to the 2,860; annual harvest of commercial fish, 153,706 pounds by 2040; 76,093 man-days sportfishing by 2040.
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B-3M, 137-foot	Same as B-3M, 135-foot.
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B-3M, 145-foot	Same as B-3M, 135-foot.
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ALTERNATIVES

S I G N I F I C A N T R E S O U R C E S

River Habitat

Base Condition	Total river area about 22,594 acres, highly dynamic meandering system; turbidity often high depending on stage and season; not as productive as oxbow lakes; commercial fishery harvest in 1975 was 290,557 pounds. Benthic productivity low due to unstable bottom habitat.
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Without Condition (No Action)	River is dynamic system; will change course over time.
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B-1, 135-foot	22,594 acres of natural river channel will be totally changed by 1990; these areas will become oxbows or be incorporated into navigation pools or navigation channels; conversion will be beneficial from environmental standpoint. Although river bottoms will be more stable, approximately 10 miles will be impacted annually by maintenance dredging.
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B-1, 137-foot	Same as B-1, 135-foot.
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B-1, 145-foot	Same as B-1, 135-foot.
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B-3M, 135-foot	Basically, the same as B-1, 135-foot.
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B-3M, 137-foot	Same as B-3M, 135-foot.
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B-3M, 145-foot	Same as B-3M, 135-foot.
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ALTERNATIVES	S I G N I F I C A N T R E S O U R C E S				
	Plan Economics				
	Gross Investment	Annual Costs	Annual Benefits	Excess Annual Benefits Over Cost	B/C Ratio
B-1, 135-foot	\$1,500,074,000	\$70,339,000	\$92,164,000	\$21,825,000	1.3
B-1, 137-foot	\$1,505,459,000	\$70,550,000	\$92,381,000	\$21,831,000	1.3
B-1, 145-foot	\$1,527,235,000	\$71,639,000	\$92,068,000	\$20,429,000	1.3
B-3M, 135-foot	\$1,518,357,000	\$71,211,000	\$92,464,000	\$21,253,000	1.3
B-3M, 137-foot	\$1,532,923,000	\$79,937,000	\$92,455,000	\$20,518,000	1.3
B-3M, 145-foot	\$1,555,598,000	\$72,992,000	\$91,709,000	\$18,717,000	1.2

5. AFFECTED ENVIRONMENT

a. Environmental Conditions

The area pertinent to this environmental study includes that portion of the Red River Basin within the State of Louisiana between Shreveport on the north and the confluence of the Red and Mississippi Rivers on the south, a distance of some 275 river miles. Riparian towns include Alexandria, Bossier City, Campti, Clarence, Colfax, Coushatta, Pineville, Montgomery, Natchitoches, and Shreveport. The topography of the basin is gently rolling to level. Elevations vary from a maximum of 320 feet National Geodetic Vertical Datum (NGVD) in the uplands west of Shreveport to 35 feet NGVD in the Mississippi River alluvial plain at Old River. Elevation of the Red River flood plain varies from approximately 160 feet NGVD at Shreveport to about 45 feet NGVD just east of the Marksville Hills in the Mississippi River flood plain. Local relief generally is no more than 50 to 100 feet. Riverine woodlands dominated by cottonwood-willow-sycamore (CWS) are the dominant wooded habitat of the immediate project area. Other woodland types are bottomland hardwoods (BLH), mixed pine-hardwoods (PH), and cypress-tupelo swamps. Most of the project area lands have been cleared for agriculture - soybean and pasture being the dominant uses. Although oil and gas discoveries shortly after the turn of the century stimulated industrial development in the Shreveport area, the economic base of the rest of the project area historically has been agricultural. With the development of highly mechanized farming practices, employment opportunities, and income stability, particularly in rural areas, have diminished. The area's transition from an agrarian to a mixed industrial economy has also caused changes in demographic patterns. Petroleum, natural gas, sand, gravel, and clay are the most important minerals currently being produced. The Red River of the project area has been classified by the Louisiana Stream Control Commission as suitable for secondary contact recreation, propagation of fish and wildlife, and as a domestic raw water supply. The fish of the river and associated backwater areas are rich and diverse. The most common species in the project area, in order of abundance, are: gizzard shad, threadfin shad, club shiner, channel catfish, blue catfish, red shiner, carp, emerald shiner, river carpsucker, white bass, and white crappie. Many important game and nongame animals are found in the project area and provide an important resource as far as hunting, trapping, and other wildlife-oriented activities are concerned. The primary recreational activities associated with the river involve hunting and fishing. Low river stages with unpredictable bottom depths, limited river access, and lack of recreational development along the river have discouraged other recreational activities. Numerous archeological and historical sites listed in the National Register of Historic Places exist along the river, and a number of historically important shipwrecks are suspected to be located in the river.

b. Significant Resources

(1) Bottomland Hardwoods

(a) A total of 3,038 acres of BLH exists in the area which could be affected by the project. The hackberry-elm-ash species association is the most prevalent bottomland type of the project area though numerous other overstory species can be found. These include bitter pecan, overcup oak, Nuttall oak, willow oak, water oak, sweetgum, Drummand red maple, sycamore, and box elder. Ground cover and understory plants include roughleaf dogwood, trumpet creeper, ladies eardrops, peppervine, rattan vine, French mulberry, lizard's tail, dayflower, panicums, and carex.

(b) This is the most significant habitat type available to many species of wildlife. Game animals which do particularly well in hardwood bottomlands include white-tailed deer, eastern cottontail, swamp rabbit, gray squirrel, raccoon, American woodcock, and Eastern wild turkey. Other wildlife species commonly found in these bottomlands include opossum, shrews, coyote, armadillo, beaver, mink, mice and rats, hawks, owls, woodpeckers, songbirds, crows, and numerous species of herptiles and invertebrates.

(2) Baldcypress-Tupelo Swamps (CT)

(a) Up to 925 acres of swamps could be impacted by the project depending on the selected plan. Plants most commonly observed in project area swamps include baldcypress, tupelogum, buttonbush, Virginia willow, green ash, Drummond red maple, boghemp, climbing hempweed, and duckweed. Spanish moss is common and adds to the natural beauty of these southern wooded swamps.

(b) Users of the swamp include white-tailed deer, wild turkey, wood duck and other waterfowl, and herptiles, the most notable being the American alligator. The swamp also provides habitat for warm-water fishes and numerous aquatic invertebrates. Heron rookeries are often associated with the swamp. Water storage and water quality are primary beneficiaries of these areas.

(3) Riverine Habitat [CWS and willow-sandbar (WSB)]

(a) This habitat type, which is geologically the most recent of origin of wetland types, is found throughout the project area. Approximately 3,300 acres of the potentially impacted riverine habitat has been classed as a WSB association. This association varies from very sparsely vegetated sandbar to sandbar dominated by black or sandbar willow. Ground cover, which might occur, includes salt cedar, false nettle, cocklebur, goldenrod, dog fennel, and Bermuda grass. The more mature riverine habitat usually consists of a mix of willows with cottonwoods and, usually, sycamore. Up to 20,742 acres of CWS could be affected by project activities. This association may include young boxelder, hackberry, or other

hardwoods. Typical ground cover and understory include poison ivy, peppervine, dewberry, grape, trumpet creeper, and Virginia creeper.

(b) WSB, being recently accreted lands and because of frequent flooding, has very little diversity of plant species and, with the exception of willows, low plant density. For this reason, it has less wildlife value than other habitat types in the project area. Shorebirds, such as sandpipers and plovers, frequently utilize the more open sandbar areas. Because pockets of water are often associated with WSB, and because these areas are adjacent to the river, there is some value for aquatic furbearers as well as waterfowl. Raccoon, American woodcock, and other game species can meet some of their life requirements in this habitat. Invertebrates and herptiles, most notably the American alligator, find great use of this habitat type.

(c) The more mature riverine habitat, CWS, has value for white-tailed deer, raccoon, swamp rabbit, woodcock and numerous species of herptiles, invertebrates, and birds. During high-water periods, such species as beaver and wood duck, benefit. Most wildlife species found in BLH are found in CWS but in fewer numbers.

(4) Pine Hardwoods

(a) Approximately 3,000 acres of this habitat could be impacted by project activities. Rather than being spread throughout the project area, this woodland type is concentrated primarily in the vicinity of Colfax at the B-3M site for Lock and Dam No. 3 and is actually part of the Kisatchie Hill area. Characteristic of well-drained soils, the pine-oak forests of the project area contain a large variety of flora and fauna. Dominant overstory vegetation includes loblolly pine, mockernut hickory, sweetgum, sycamore, tuliptree, cedar elm, Carolina beech, hackberry and winged elm. Oaks most commonly found in the overstory include blackjack, willow, southern red, post, cow, and white. Common understory plants include persimmon, blackcherry, red mulberry, huckleberry, hawthorn, flowering dogwood, roughleaf dogwood, red cedar, wax myrtle, sparkleberry, sassafras, hophornbeam, French mulberry, viburnum, black locust, and saplings of the overstory. Some of the herbaceous species found in the project uplands include peppervine, muscadine, greenbriars, poison ivy, dewberry, maypop, trumpet creeper, Virginia creeper, winged sumac, horsenettle, ragweed, yankeeweed, bedstraw, wild cucumber, wild lettuce, ground cherry, iron weed, wooly croton, croton, pokeweed, elderberry, broomsedge, elephant's foot, rattanvine, ladies eardrop, beggar's lice, foxtails, and various grass species.

(b) This habitat is of significant value to many game species, the more notable of which are white-tailed deer, eastern cottontail, fox and gray squirrels, raccoon, and bobwhite quail. Some of the other mammals found in this habitat include bobcat, opossum, striped skunk, gray fox, coyote, armadillo, shrews, and species of rats and mice. Birds found in this habitat include vultures, hawks,

owls, woodpeckers, songbirds, crows, loggerhead shrike, redwing blackbird, common grackle, cattle egret, and greater roadrunner. Toads, frogs, snakes, skinks, turtles, and numerous species of invertebrates are found in the pine-oak forest complex.

(5) Agricultural Lands (soybeans and pasture)

Up to 20,979 acres of agricultural lands, approximately two-thirds of which are pasture, might be impacted by the project. The primary grass found in pastures is bermuda, although bahia, carpet, rye, dallis, bent, and Johnson grass are also present. Clovers, broomsedge, various legumes, and many other species might occur in this habitat type. Pastureland is a food source for many insect species and, if not grazed too heavily, provides abundant habitat to insects as well as succulent growth for herbivorous mammals. Songbirds most common to the pasture are easternland meadowlark, bobolink, and loggerhead shrike, although numerous bird species, at times, utilize the habitat. Pastureland is most beneficial to wildlife where a diversity of habitat occurs. This diversity creates an "edge" which enhances the food and cover value. Soybean is, for all practical purposes, the only crop of the affected project area. Mostly because of economic reasons, cotton, which was quite prevalent only 10 or 15 years ago, has been replaced by soybean. Soybeans, when associated with other habitat types, can increase the nutritional food source available to wildlife and, thus, have a beneficial impact on their populations. White-tailed deer, for example, benefit measurably from this legume. However, many of the soybean fields in the project area are expansive, and not enough quality woodlands are present to maintain a significant deer population. In any case, many species of animals utilize soybean fields at one time or another.

(6) National Register of Historic Places

The National Register of Historic Places, as published in yearly and weekly supplements of the Federal Register, was consulted through 6 July 1982. Of the recorded sites within the project boundaries, Bailey's Dam (16RA516/90), Fort Randolph (16RA76) and Fort Buhlow (16RA89), have been nominated to the National Register. The Hanna Site (16RR4) and the Log Raft Site (16AV62), have been determined eligible for nomination to the Register. Forts Buhlow and Randolph are Confederate earthworks, constructed after the Union retreat down the Red River in 1864. They are located on the left descending bank of the river in the vicinity of Pierson Lake, just north of the Alexandria rapids. The anticipated third Union assault did not materialize. Neither installation was ever involved in the conflict. Bailey's Dam, a set of wing dams which once straddled either side of the channel at Alexandria, was constructed in the spring of 1864 by Lt. Col. Joseph Bailey of the 4th Wisconsin Cavalry to allow Admiral Porter's gunboats to escape downriver over the Alexandria rapids following an attempted assault on Shreveport. The rapids were removed as a navigational hazard in the 1890's. The wing dams were partially destroyed at that time. The Hanna Site, located on

the right descending bank, east of the village of Hanna, Louisiana, was excavated in 1977 by New World Research prior to revetment construction. The site is an example of an Alto focus, Caddo hamlet, dating from A.D. 800 to 1000. The Log Raft Site is located on the right descending bank at Long Lake, just above the confluence of the Red and Atchafalaya Rivers. The site is a pine log raft dating anywhere from 1844 to 1927 and was an example of larger rafts used by the logging industry to transport uncut timber downriver throughout the 19th century. Since its listing as eligible for nomination to the National Register, the raft has eroded from the bank.

(7) Geological Features

The Lower Red River Valley within the confines of the study area is underlain by Tertiary formations which crop out in bands roughly at right angles to the axis of the Red River. This out-crop pattern is in conformity with a dip toward the Gulf. The Tertiary strata are all of sedimentary origin, and nearly all of the formations were deposited in a shallow northward extension of the Gulf of Mexico. The remainder was laid down by rivers emptying into the gulf. In the study area, the Tertiary is exposed in the uplands and at intervals along the valley walls and lies buried beneath Quaternary age alluvium and terrace deposits elsewhere. The valley fill consists of both Pleistocene and Holocene alluvial deposits, both of which exhibit sequences of deposition that grade from coarser materials at the base to finer materials at the surface. In effect, the alluvium is divided that extend beyond the study area boundaries. Important paleontological sites having historical as well as scientific significance occur within the study area at Montgomery Landing, Saline Bayou, Bell Bluff, and Grand Ecore Bluff. Additional information regarding geological features of the area may be found in Supplement No. 1, pages II-1 to II-17, plus II-26 and II-27, paragraphs 2, 3, and 5.

(8) Archeological Sites

In addition to National Register properties, New Orleans District site files include approximately 65 recorded prehistoric and historic terrestrial sites in the immediate project vicinity and at least 112 recorded steamship wrecks from the mid to late 19th century. The majority of the terrestrial sites are historic. Many have been tested to assess their significance. Once the final project plan is selected, a more accurate separation of sites within and without the project right-of-way will be possible. Although extensive investigations have been completed, surveys of several revetments, disposal areas, alternate channels, and of all year around and seasonally flooded lands (particularly in Pools 4 and 5) must be conducted prior to construction. All affected sites will be evaluated to determine precise project impacts, site significance, and eligibility to the National Register of Historic Places. Because of dramatic changes in the position of the Red River channel over the last century, efforts to identify specific shipwrecks will continue to be conducted on a site-specific basis. It is hypothesized that many

recorded wrecks will be situated on relict channels outside of the project impact zone. Appendix I contains a summary of the results of completed investigations, and a discussion of area geomorphology, and cultural history.

(9) Navigation

Only during seasonal periods of high flows does the Red River above Acme, Louisiana, have sufficient depth to be navigable to modern shallow draft traffic. No navigational aids are in place at this time. Report No. 2, Existing Bridges, April 1972, details the existing conditions of bridges crossing the Red River within the Mississippi River to Shreveport reach. Navigation on the Red River is covered in considerable detail in the General Design Memorandum Supplement No. 1.

(10) Hydropower

There is no hydropower production on the project reach of the river.

(11) Water Quality

(a) The Red River is classified by the State of Louisiana, Department of Natural Resources, Division of Water Pollution Control, as suitable for secondary contact recreation, propagation of fish and wildlife, and domestic raw water supply. Specific numerical standards have been established by the State of Louisiana for Red River, Arkansas State Line to Three Rivers. General criteria applicable to the Red River, dealing with substances included in man-induced waste discharges as opposed to natural phenomena, have also been established. The US Environmental Protection Agency (EPA) has developed aquatic-based and health-based water quality criteria applicable to the Red River in the project area.

(b) Monthly sampling of water quality parameters has been conducted by the United States Geological Survey (USGS) at four stations on the Red River mainstem between the Mississippi River and Shreveport. Dissolved oxygen (DO) levels generally meet or exceed minimum requirements for aquatic life. Dissolved solids, including chlorides and sulfates, have historically been high as a result of upstream brine discharges. Fecal coliform levels have also been consistently above the primary contact recreational standard, although the Red River is not presently classified for primary contact. Controls of upstream discharges and improved wastewater treatment facilities should bring about improved water quality conditions with respect to dissolved solids and fecal coliforms within a few years. Pesticides, heavy metals, and PCB concentrations are important because of their toxic effects on aquatic organisms. Dissolved concentrations interact continually with suspended sediments and bottom deposits through complex processes. USGS measurements of constituent concentrations in the dissolved and suspended aqueous phases have been

compared to EPA criteria for the protection of freshwater aquatic life. Eight constituents (cadmium, chromium, copper, mercury, lead, zinc, PCB's, and DDT) have been found to exceed EPA criteria during recent measurements at most USGS sampling stations. EPA restrictions on pesticide usage, however, will continue to cause changes in observed concentrations in water and sediments of the Lower Red River Basin.

(12) Mineral Resources

Petroleum, natural gas, lignite, sand, gravel, and clay are the most important minerals which occur in the project area. In addition, quarry stone, carbon black, iron ore, and gypsum also occur.

(a) Petroleum and Natural Gas - A total of 68 different oil and/or gas fields lie either completely or partially within the project area, the majority of which lie north of the Red River - Natchitoches Parish line. A summary of oil and gas field statistics, 1967 to 1972, may be found in Supplement No. 1 beginning on page II-17, Economic geology. Data through 1976 were obtained from Louisiana Annual Oil and Gas Reports, published by the Department of Conservation. These data are on file at the New Orleans District, but were too lengthy to include in this report.

(b) Lignite - Commercial lignite deposits occur in the Tertiary formations that crop out in the northern half of the project area and underlie the floodplain and terrace deposits in large areas of DeSoto and Red River Parishes. Applications for both open-pit mining and a lignite burning powerplant are in the permit stage in the project area. The Louisiana Geological Survey conducted a survey in two areas of Sabine and DeSoto Parishes. ^{1/} These parishes are located on the eastern part of the Sabine Uplift, a large geological structure present in most of northwest Louisiana and northeast Texas in which Wilcox group sediments are common. The Wilcox group contains some of the principal lignite beds in the Gulf Coast Province. In the southeastern part of DeSoto Parish, the Louisiana Survey examined the Chemard Lake lignite lentil. This deposit covers an area of about 52,000 acres and ranges in thickness from 5 feet to 7 feet with an overburden-thickness ratio of approximately 15 to one. Based on an assumed average thickness of 6 feet and a lignite density of 1,750 tons per-acre foot, a resource base of 546 million tons of lignite can be estimated. The Chemard Lake lignite in many locations is overlain with sands of the Dolet Hills formation. Where present, this sand is the primary source of fresh ground water in the survey area. In the opinion of Louisiana Geological Survey personnel, the lignite resource base in the parishes of interest exceeds one billion tons. Except for

^{1/}"Lignite Evaluation of Near Surface Deposits in Northwest Louisiana", Bulletin No. 2.

exploration. Exploratory drilling by private companies has been extensive, and considerable acreage is under lease. One test mine in Red River Parish was in operation in May 1978, its purpose being to establish dewatering and mining cost parameters. The published Louisiana lignite reserve data are summarized below.

Parish	Million Tons
Bienville	50
DeSoto	546
Natchitoches	150
Red River	<u>50</u>
Total	796

The range of technical properties for the Chemard Lake lignite is shown below.

Moisture	16-45 percent
Volatile matter	20-34 percent
Fixed carbon	20-40 percent
Ash	4-19 percent
Sulfur	0.4-1.9 percent
Heating value	5450-9730 Btu/pound

Analysis of only those core samples from seams 6 feet or greater in thickness and at depths of 150 feet or less indicate a mean heating value of approximately 7,020 BTU per pound, moisture of 31 percent, volatile matter of 27 percent, fixed carbon of 29 percent, ash of 14 percent, and sulfur of 0.7 percent. The material's sulfur content relative to its heating value is high.

(13) Timber

The predominant forest type in the alluvial portion of the project area is hardwoods, which range from low grade CWS to a hackberry-elm-ash complex, with an association of willow and sycamore. In the hills and on ridges, pine forests predominate with mixed stands of pine and hardwoods found along draws and on moderately drained uplands. Because of their high inherent fertility, many of the forest lands have been cleared for agricultural purposes where flood hazards and drainage problems have been surmounted. Total woodlands in the direct project impact area represent less than 1 percent of commercial forestlands within the parishes adjacent to the Red River below Shreveport.

(14) Fishery Resources

(a) The project area portion of the Red River supports a moderate sport fishery. Some bank fishing takes place along accessible reaches of the river. Tributary streams provide some sportfishing although access to them along the river is restricted by

posted private property in many instances. The lack of adequate public boat launching facilities along the Red River is a limiting factor affecting the fisheries harvest in the river proper. Principal game species harvested include largemouth bass, black crappie, bluegill, redear sunfish, warmouth, channel catfish, blue catfish, white bass, yellow bass, and green sunfish. Striped bass and their hybrids are found in the river primarily because of stocking from the Natchitoches National Fish Hatchery.

(b) The Red River, particularly the lower Red River, supports a valuable commercial fishery. Approximately 300,000 pounds of fish are harvested annually between Lock and Dam No. 1 and Shreveport. Principal commercial fish landed include channel catfish, blue catfish, gars, smallmouth and bigmouth buffalo, gizzard shad, carp, flathead catfish, and freshwater drum. Hoop nets are the predominant fishing gear employed, although trotline, trammel nets, and gill nets are also used.

(c) The backwater areas associated with the Red River, such as Spring Bayou and natural oxbow lakes like Old River, near Powhatan, support high fish populations. The species harvested in these backwater areas are similar to those found in the river proper, mentioned above, but are generally found in greater abundance.

(d) Fish sampling conducted in July, 1979, by representatives of the Louisiana Department of Wildlife and Fisheries, New Orleans District, Corps of Engineers, and US Fish and Wildlife Service in selected oxbow lakes within the Red River project area indicated that the average standing crop of all fishes totaled 341 pounds per acre. Of this total, 211 pounds of commercial and game fishes were of harvestable size. Game fish made up 21.6 percent of this total, while 39.9 percent was forage fish.

(e) The high fish populations found in the Red River drainage areas, especially the oxbow lakes and backwater areas, are partially the result of seasonal flooding which generally occurs in late winter and early spring. This flooding and the subsequent release of nutrients is important in the productivity of microscopic organisms which form the base of complex and interrelated food chains. This process produces the forage species that contribute significantly to the high fish populations. Overbank flooding also provides essential spawning areas for many species of fish.

(15) Wildlife Resources

The greatest potential for hunting, trapping, and other wildlife-related activities is between Lock and Dam No. 1 and Old River Control Channel, which is the end of the project area. Although wildlife-oriented activities abound throughout the project area, much of the wooded lands above Lock and Dam No. 1 have been cleared for agriculture and, thus, provide an overall lower quality wildlife habitat. Considering the limited amount of woodlands, but the large

amount of pasture with fence rows and brushy woodlots, rabbits probably offer the greatest hunting potential in the project area. Cottontail rabbits would dominate this habitat with swamp rabbit being more prevalent in the lower lying CWS or WSB areas. Fox squirrel is the dominant squirrel of the project area. They prefer the more open understory resulting from the periodic flooding of the river. Gray squirrels are common in the wooded bottomlands that have a more dense growth of understory and ground cover. Deer are observed throughout the project area though they are, naturally, more prevalent in the extensive woodlands below Lock and Dam No. 1. Significant game birds of the project area are bobwhite quail, American woodcock, snipe, mourning dove, and numerous species of ducks. Raccoon, followed by nutria, are the most extensively trapped furbearers of the project area. Others are trapped occasionally in some of the tributaries. Beaver are trapped, but more as a nuisance control than for pelts.

(16) Endangered Species

Federally listed endangered species which are present or potentially in the project area are: Florida panther, American alligator, red-cockaded woodpecker, bald eagle, arctic peregrine falcon, Eskimo curlew, ivory-billed woodpecker, and Bachman's warbler. The American alligator is the most prevalent endangered species in the project area. They are found throughout the project area from the backwaters and swamps to the river itself. Gulf South Research Institute had five alligator sitings during their biological inventory of the project area in 1974. An April 1980 field trip of Fish and Wildlife Service and Corps biologists produced one field siting. The reptile is commonly observed by people who spend a great deal of time on the river. Panther sitings have been made throughout central Louisiana close to the area of project impact. The expansive woodlands and low population density characteristic of the area below Lock and Dam No. 1 would be the area most likely to support the panther. Although no bald eagles have been sited during field surveys along the Red River, they are found on nearby lakes and could certainly be expected to be present as transients. One of the possible sites for Lock and Dam No. 3 has some mature pines and borders on being suitable habitat for the red-cockaded woodpecker. The only habitat suitable for the ivory-billed woodpecker and Bachman's warbler is located in the extensive woodlands adjoining the lower reach of the project area. In view of the fact that there has been no confirmed sitings of these birds in recent years, it is unlikely that they are present. The Eskimo curlew and peregrine falcon could be transient to the project area.

(17) General Recreation

Twenty-one parishes comprise the 50-mile market area (zone of influence) that would be affected by recreational development on this project. These parishes are Allen, Avoyelles, Bienville, Bossier City, Caddo, Catahoula, Concordia, DeSoto, Evangeline, Grant, Jackson, LaSalle, Natchitoches, Point Coupee, Rapides, Red River, Sabine, St.

Landry, Vernon, Webster, and Winn. Existing recreational facilities of all types were inventoried according to parish tabulations supplied by the State of Louisiana, Department of Culture, Recreation and Tourism. In addition to the parish inventories, the Louisiana State Parks Plan, Louisiana Department of Wildlife and Fisheries publications, and US Forest Service plans were reviewed during the analysis of existing recreational facilities. Numerous Federal, state, and local recreational areas exist within or near the market area, but adequate public access and facilities are lacking at most areas. Existing Federal recreational land within the market area includes Kisatchie National Forest, Caney Lakes, Cloud Crossing, Kincaid Reservoir, Fullerton Lake, and Wallace Lake. Existing state-owned recreational land within the market area includes Toledo Bend, Lake Bistineau State Park, Alexandria State Forest/Indian Creek Reservoir, and Chicot State Park. Several state wildlife management areas, totaling about 170,000 acres, are located near the mid to lower reaches of the Red River. These areas have minimal recreational facilities, but do offer informal outdoor recreational opportunities. A number of state lakes, including Lake Buhlow, Caddo Lake, Black-Clear-Saline Lakes, Lake Edwards, and Lake Nantachie offer potential water recreation within the region; however, they are generally lacking in public access and facilities. Existing local/parish recreational land within the market area includes Cooked Creek Reservoir and Cotile Lake.

(18) Ground Water

The Red River alluvial aquifer is the largest source of fresh ground water in the project area. It can yield freshwater in sufficient quantity for most uses except in local saltwater areas. This water has a low and constant temperature, but its quality varies with both area and depth. Recharge is by lateral movement from adjacent Pleistocene and Tertiary formations, by upward movement from underlying formations, and by rainfall seepage. The Red River and its major tributaries recharge the alluvial aquifer in local zones near the river during high stream stages, but noticeable water quality changes occur only following periods of prolonged high stages. Annual water level fluctuations range from 30 feet near the river to only a few feet in interstream backwater areas.

(19) Tributaries

Numerous tributary systems enter into the Red River within the project area. These tributaries are vital to the replenishment of the river. The streams are characteristically of low gradient, with rapidly fluctuating flows due to seasonal variation. These areas are generally more productive than the river. They are usually of lower velocity and turbidity and support higher planktonic and benthic populations than the river, although the practice of clearing tributary banks has increased sediments, nutrients, and pesticides due to agricultural runoff in recent years. These tributaries are important as spawning and nursery areas for many species of sport and commercial fishes. A list of these tributary streams is shown in Table EIS-2.

TABLE EIS-2
TRIBUTARY STREAMS

Stream	1967 Mileage	Stream	1967 Mileage
Wiggin Bayou	72.5	Tyrounge Bayou	152.3
Lick Bayou	89.7	Trestle Branch	164.3
Bayou Maria	102.0	Saline Bayou	167.8
Huffman Creek	102.7	Chevreuille Bayou	168.2
Bayou Rapides	105.4	Bayou Pierre	187.2
Bayou Rigolette	106.6	Simms Bayou	193.7
Bayou Jean De Jean	127.1	Bayou Nicholas	206.3
Cane River	135.0	Posey Branch	221.2
		Coushatta Bayou	228.5
Bayou Nantachie	148.3	Loggy Bayou	239.7
Falcon Bayou	150.9	Cross Bayou	277.8

(20) Oxbow Lakes

Approximately 3,700 acres of oxbow lakes and other water bodies are found within the project area. These water bodies vary from a few acres to over 100 acres in size. The water quality of the aquatic habitats is related to the characteristics of the watershed where each water body is located. Streams and lakes in agricultural areas usually tend to be more heavily polluted than water bodies located in forested areas. These natural oxbow lakes and other backwater areas support high fish populations. Species harvested in these areas are similar to those found in the river proper, but are usually found in greater abundance. Fish sampling conducted in July 1979 by representatives of the Louisiana Department of Wildlife and Fisheries, US Army Corps of Engineers, and US Fish and Wildlife Service in selected oxbow lakes within the study area indicated the average standing crop of all fishes was 341 pounds per acre. These high fish populations are primarily the result of seasonal flooding during the late winter and early spring. Overbank flooding provides spawning areas for many species of fish and also causes release of nutrients important to the productivity of microscopic organisms which form the base of complex and interrelated food chains. In addition, turbidity is usually reduced in oxbow lakes which can lead to increased phytoplankton populations. Benthic populations and growth of vegetation are also higher in oxbows than in the river proper due to more stable substrate conditions. Oxbows also provide snags and cover which are beneficial to fish populations. Oxbow lakes and other water bodies are also of value to a variety of wildlife species including migratory waterfowl, wading birds, furbearers, and numerous reptiles and amphibians.

(21) River Habitat

The natural river channel or riverine area includes the most significant aquatic acreage within the 275-mile project reach. Total

river area is about 22,594 acres. River habitat, by virtue of its large area, is perhaps the most important aquatic habitat in the project reach. The river system is highly dynamic and varies from shallow, productive areas to deep, less productive, turbulent areas. The meandering river is constantly cutting away at one bank and creating a shallow point bar on the opposite side of the river. Turbidity in the Red River varies significantly with river stage and season and is an important factor in the productivity of the river. Commercial fishery harvest in 1975 was 290,557 pounds worth \$63,921. The river proper is not as productive as the oxbow lakes and other water bodies within the system, primarily due to the dynamic nature of the river which leads to unstable bottom conditions and often high levels of turbidity. Productivity of phytoplankton and benthic populations are lower in the river than in existing oxbow lakes. Pounds per acre of available size sport fish in 1975 in the river was only 10 as compared to 36 for oxbow lakes and other water bodies.

6. ENVIRONMENTAL EFFECTS

Most of the impacts on the significant resources discussed in this section do not include impacts resulting from anticipated ground water changes. Terrestrial and aquatic resources impacted (exclusive of the river) range from approximately 47,000 acres for the B-1, 135-foot Alternative to approximately 54,000 acres for the B-3M, 145-foot Alternative. These impacts include recreational development and induced clearing as well as construction-related impacts such as revetments, new channel cuts, disposal areas, freeboard, and flooding. Freeboard is the area no greater than 3 feet in elevation above the navigation pool, and generally, adjacent to the navigation pool, expected to be affected by increased soil saturation and/or wave action. Although there are only two alternative plans, with variation dependent on their pool elevation in Pool No. 5, they are discussed as though there were six alternative plans. Thus, when discussing impacts on the B-1, 135-foot Alternative, the impacts on the total project are addressed, but only as a 135-foot pool would impact the resources above Lock and Dam No. 5. Ground water impacts are only briefly discussed herein. D'Appolonia discussed ground water impacts over an area of 855,000 acres in their report, "Groundwater Impact Study, Agricultural and Urban Area, Red River Waterway Project, October 1980." Many of the resources discussed in this section are also discussed in the Main Report or appendixes thereto. Most of these resources have been addressed in previous Corps' documents which are at times cited.

a. Bottomland Hardwoods (BLH)

(1) B-1, 135-foot - A total of 2,868 acres of BLH would be impacted by this alternative. It is estimated that 735 acres would be lost to induced clearing, and 646 acres used for dredged-material disposal. Those acres would be committed to agricultural lands initially, and a portion of the disposal areas would eventually be developed into recreational areas. Approximately 600 acres of BLH have been planned for recreational development. These acres are classified as a "scenic" area, so their integrity should be assured. It is estimated that 141 acres of BLH would be impacted by freeboard. This might result in changes regarding species composition but should not change the basic habitat type. The remaining 746 acres of BLH would be lost to construction impacts such as revetments, new channel, and flooding.

(2) B-1, 137-foot - A total of 2,952 acres would be impacted. Induced clearing, dredged-material disposal area, and recreational acreage are the same as B-1, 135-foot. It is estimated that 213 acres would be impacted by freeboard and 758 acres lost due to construction activities.

(3) B-1, 145-foot - A total of 3,038 acres would be impacted. Induced clearing, dredged-material disposal area, and recreational acreage are the same as B-1, 135-foot. It is estimated that 1,057 acres would be lost due to project construction.

(4) B-3M, 135-foot - A total of 2,609 acres would be impacted. Induced clearing and recreational acreage are the same as B-1, 135-foot. It is estimated that 352 acres would be used for dredged-material disposal and 224 affected by freeboard. Construction would cause a loss of 698 acres.

(5) B-3M, 137-foot - A total of 2,704 acres would be impacted. Induced clearing, dredged-material disposal area, and recreational acreage are the same as B-3M, 135-foot. It is estimated that 289 acres would be affected as freeboard and losses due to construction would be 728 acres.

(6) B-3M, 145-foot - A total of 2,786 acres would be impacted. Induced clearing, dredged-material disposal area, and recreational acreage are the same as B-3M, 135-foot. It is estimated that 194 acres would be affected by freeboard, and losses due to construction would amount to 905 acres.

b. Baldcypress-Tupelo Swamps

(1) B-1, 135-foot - A total of 800 acres of this habitat type would be impacted. Induced clearing for agriculture would account for 267 acres. Dredged material would be disposed on 324 acres. These acres would be used primarily for agriculture, although some could be used for recreational development. One hundred acres are planned for a recreational "scenic" or "natural" area. This would only serve to protect the habitat's integrity. Losses of 109 acres are anticipated due to construction activities such as revetments, new channel, and flooding.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - A total of 919 acres would be impacted. Recreational acres (100) and induced clearing acres (267) are the same as the B-1, 135-foot. Dredged material would cause the conversion of 373 acres to agricultural areas, although a portion could be used for recreational development. Nine acres were mapped in a freeboard zone. This would probably only assist in maintaining the wet condition necessary for the habitat. One hundred seventy acres are projected to be lost as a result of construction.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 135-foot, except six more acres would be impacted by freeboard.

c. Riverine Habitat [Cottonwood-Willow-Sycamore (CWS) and Willow-Sandbar (WSB)]

(1) B-1, 135-foot - A total of 18,896 acres of CWS and 3,159 of WSB would be impacted. The breakdown of impacts is as follows:

	CWS	WSB
Recreational Plan	3,334	556
Dredged-Material Disposal Areas	3,112	713
Induced Clearing	5,411	
Freeboard	1,927	<u>239</u>
Construction	5,112	1,641

Approximately 2,100 acres of the CWS lands and 300 acres of the WSB proposed for recreation would be developed into intense and low-use recreational areas. This development along with increased people use would diminish the wildlife value of these lands. The other recreational areas are planned for wildlife or natural areas or related development and should increase in value to wildlife. Dredged-material disposal areas and CWS lands impacted by induced clearing would become agricultural lands. Some of the lands impacted by dredged-material disposal would be used for recreational development. Freeboard impacted lands would not decrease in value in most cases. Changes in species composition would encourage succession towards a higher habitat type. Acres impacted by construction would, for all practical purposes, lose its value to terrestrial wildlife.

(2) B-1, 137-foot - A total of 19,524 acres of CWS and 3,207 acres of WSB would be impacted. Recreational, dredged-material disposal and induced clearing acres are the same as B-1, 135-foot. Freeboard would impact 2,241 acres of CWS and 266 of WSB. The remaining 5,426 CWS and 1,662 WSB would be impacted by project construction.

(3) B-1, 145-foot - A total of 20,742 acres of CWS and 3,300 acres of WSB would be impacted. Recreational, dredged-material disposal, and induced clearing acres would be the same as B-1, 135-foot. Freeboard would impact 2,019 acres of CWS and 184 of WSB. Acres lost permanently to construction features would be 6,866 for CWS and 1,837 of WSB.

(4) B-3M, 135-foot - A total of 18,427 acres of CWS and 3,020 acres of WSB would be impacted. Induced clearing and recreational impacts would be the same as B-1, 135-foot. Dredged material would be disposed on 3,215 acres of CWS and 887 of WSB. Freeboard would impact 1,270 acres of CWS and 289 of WSB. The remaining 6,340 acres of CWS and 1,278 of WSB would be lost due to construction.

(5) B-3M, 137-foot - A total of 18,962 acres of CWS and 3,088 acres of WSB would be impacted. Recreational, induced clearing, and dredged-material disposal impacts would be the same as B-3M, 135-foot. Freeboard would impact 1,430 acres of CWS and 316 of WSB. The remaining losses to construction would be 5,572 acres for CWS and 1,299 for WSB.

(6) B-3M, 145-foot - A total of 20,660 acres of CWS and 3,086 acres of WSB would be impacted. Recreational, induced clearing, and dredged-material disposal impacts would be the same as B-3M,

145-foot. Freeboard would impact 1,138 of CWS and 234 of WSB. Losses due to construction would be 7,562 for CWS and 1,381 for WSB.

d. Pine Hardwoods (PH)

(1) B-1, 135-foot - A total of 2,516 acres would be impacted. However, the vast majority of these impacts (1,882 acres) would be due to recreational development. Approximately 1,400 of the 1,882 acres would be placed in a natural area where the overall habitat quality would, over time, improve. The remaining recreational acres would be placed in intensive and low-use development and the overall quality of habitat would decrease. An estimated 267 acres would be lost to induced clearing for agriculture and 203 acres would be used for dredged-material disposal. Freeboard would affect 62 acres. These acres would probably degrade initially to CWS and succeed over time to BLH. The remaining 102 acres would be impacted by revetment and new channel construction.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - A total of 3,004 acres would be impacted. Recreational and induced clearing impacts are the same as B-1, 135-foot. An estimated 646 acres would be used for dredged-material disposal and 28 acres would be affected by freeboard. The remaining 183 acres would be impacted by revetment and new channel construction. It should be pointed out that many of the construction and recreational impacts overlap in the evaluation of any of the B-3M Alternatives. If a B-3M Alternative is chosen, recreational development on these PH acres would not occur. However, the intent of recreational planning would be that comparable acres elsewhere be developed. Therefore, total impacts, as just discussed, should accurately reflect impacts of the project on PH.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 145-foot.

e. Agricultural Lands (Soybeans and Pasture)

(1) B-1, 135-foot - An estimated 5,995 acres of soybeans and 10,381 acres of pasture for an agricultural total of 16,376 acres would be impacted. Recreational development would take place on 3,244 acres of agricultural lands. Dredged material would be disposed on 6,140 acres. The majority of this land would return to agricultural production within 2 to 3 years after use. Some of the disposal acreage would be committed to recreational development. An estimated 962 acres would be impacted by freeboard. Although it is difficult to predict, freeboard could cause any of the following: decreased yields, change in agricultural use, or abandonment of agriculture, in which case there would be succession from old field to CWS. The

remaining 5,980 acres would be lost due to project construction. The vast majority of an estimated 6,680 acres of project-induced clearing would be used for agricultural purposes.

(2) B-1, 137-foot - An estimated 6,000 acres of soybeans and 10,626 acres of pasture, for a total of 16,626 acres, would be impacted. Recreational development and dredged-material disposal would impact the same as B-1, 135-foot. Freeboard would impact 1,233 acres. Losses due to project construction would amount to 6,059. Increases due to induced clearing are the same as B-1, 135-foot.

(3) B-1, 145-foot - An estimated 6,594 acres of soybeans and 12,455 acres of pasture, a total of 19,049 acres, would be impacted. Losses to recreational development and dredged-material disposal areas and gains due to induced clearing are the same as B-1, 135-foot. Freeboard would impact 2,123 acres. Losses due to construction would amount to 7,492 acres.

(4) B-3M, 135-foot - An estimated 5,428 acres of soybeans and 12,008 acres of pasture, a total of 17,436 acres, would be impacted. Losses to recreational development and gains due to induced clearing are the same as B-1, 135-foot. Dredged material disposal would take place on 7,144 acres. Freeboard would impact 754 acres. The remaining 6,244 acres would be lost due to project construction.

(5) B-3M, 137-foot - An estimated 5,491 acres of soybeans and 12,444 acres of pasture, a total of 17,935 acres, would be impacted. Losses due to recreational development and dredged-material disposal and gains because of induced clearing would be the same as B-3M, 135-foot. Freeboard would impact 1,088 acres. Losses to construction would be 6,409 acres.

(6) B-3M, 145-foot - An estimated 5,777 acres of soybeans and 15,202 acres of pasture, a total of 20,979 acres, would be impacted. Losses due to recreational development and disposal areas and gains due to induced clearing are the same as B-3M, 135-foot. Freeboard would impact 1,928 acres. Losses to construction would be 8,613 acres.

f. National Register of Historic Places

(1) B-1, 135-foot - At one time, Fort Randolph (16RA76) was maintained as part of a small park but in recent years has been incorporated within the boundaries of a state hospital and is now overgrown with vegetation. Fort Buhlow (16RA89) is in a small roadside park and has been slightly modified by walkways to accommodate pedestrian traffic. Both of these forts fall within a proposed recreation site which would make them accessible for public viewing. Interpretive markers and signs would be added at each site. Bailey's Dam (16RA516/90) is in fragile condition. The remainder of the right bank wing dam would be directly impacted by revetment construction. Tentative plans include developing a small museum featuring the

construction of the dam and its role in the Union campaign on the Red River. The project will have no impact on the Log Raft Site (16RA62) because it no longer exists in situ. The site listing, however, has not yet been removed from the National Register.

The project would have no further impact on the Hanna site (16RR4), which was excavated in 1977 prior to revetment construction.

- (2) B-1, 137-foot - Same as B-1, 135-foot.
- (3) B-1, 145-foot - Same as B-1, 135-foot.
- (4) B-3M, 135-foot - Same as B-1, 135-foot.
- (5) B-3M, 137-foot - Same as B-1, 135-foot.
- (6) B-3M, 145-foot - Same as B-1, 135-foot.

g. Geological Features

There is no evidence that either plan for the project would impact any significant geological structure along its route. Important paleontological sites having historical, as well as scientific significance, occur within the project area at Montgomery Landing, Saline Bayou, Bell Bluff, and Grand Ecore Bluff. Under existing plans, access for future paleontological studies would be limited, at least in the lower portions, at each site.

(1) B-1, 135-foot - Under this plan, Montgomery Landing, Saline Bayou, and Bell Bluff would be adversely impacted by approximately 15 feet of water. At Grand Ecore, only the lower 5 feet would be inundated.

- (2) B-1, 137-foot - Same as B-1, 135-foot.
- (3) B-1, 145-foot - Same as B-1, 135-foot.
- (4) B-3M, 135-foot - Same as B-1, 135-foot.
- (5) B-3M, 137-foot - Same as B-1, 135-foot.
- (6) B-3M, 145-foot - Same as B-1, 135 foot.

h. Archeological Sites

Through time, the most destructive agent affecting cultural resources and their discovery in the Red River Valley has been the river itself. Aggradation of point bars, removal of earlier deposits by meandering, changes in channel course, reoccupation of portions of old channels, log rafting, and the associated creation of extensive lakes and alternate drainage patterns by the mid-19th century have all contributed to alternate burial and scouring of hundreds of floodplain

sites. Study of Red River geomorphology indicates that much of the floodplain land surface is less than 6,000 years old. Accordingly, examples of earlier occupations are largely limited to upland terraces and terrace edges such as those adjacent to Porter's Island (which would be directly impacted by Lock and Dam No. 4, Plan B-1) and Grand Ecore (alternatively impacted by Lock and Dam No. 4, Plan B-3M). While later occupations would be found on upland surfaces, they appear with predictable regularity on relict point bars in the floodplain. The greatest problem in inventorying floodplain sites is detection and prediction of buried resources. Locating buried shipwrecks in relict channels is an additional variable. In general, placement of dredged material would impact the greatest number of sites. Such disposal areas are frequently located in meander bends on recently accreted land where the majority of impacted sites date from the late 19th into the 20th century. Channel realignments, revetment, and dam construction which cross relict point bars would have the greatest impact on prehistoric sources. Despite the direct impact to particular sites, there are long-term benefits to cultural resources from artificial maintenance of the river's present channel and prevention of future bank cutting and meandering. Shipwrecks are expected to be impacted by channel realignments crossing relict channels and by dredging upstream from dam sites. Because the project is designed for future low maintenance within the channel, dredge impacts on wrecks or other magnetic anomalies should be kept to a minimum.

(1) B-1, 135-foot - A total of 46 known sites would be disturbed by the following project-related activities: revetment construction (15 sites), channel excavation (19 sites), placement of dredged material (10 sites), and permanent or seasonal flooding (two sites). Appendix I contains a table listing these sites by number and impact for each of the plan alternatives discussed. Calculation of numbers of sites subject to indirect impacts, such as access to construction areas for heavy equipment or development of recreational and industrial sites, will not be possible until more detailed plans are available. The most dramatic difference between the three B-1 variations is the number of freeboard and permanently flooded acres. There is a high potential for impacting buried prehistoric sites and steamship remains in the 145-foot pool and to lesser extent at the 137-foot elevation. Until surveys of all proposed inundation and freeboard acres are completed and the number of affected sites determined, the 135-foot pool is the most preferable of the plan B-1 variations with regard to cultural resource preservation.

(2) B-1, 137-foot - A total of 47 sites would be impacted in the same manner and distribution described for plan B-1, 135-foot. In Pool No. 5, one additional site would be affected by fluctuations within the freeboard area.

(3) B-1, 145-foot - A total of 48 sites would be impacted in the same manner and distribution described for B-1, 135-foot. In Pool No. 5, two additional sites would be affected by permanent flooding or fluctuations in the navigational pool elevation. There are slight

impact variations between construction sites suggested for the placement of Lock and Dam Nos. 4 and 5 which pertain to each of the B-1 Alternatives. Channel excavation above Lock and Dam No. 4 would impact a maximum of four resources. Based upon test excavations, one resource (16RR42) appears to be a significant Cole's Creek site.

(4) B-3M, 135-foot - A total of 53 known sites would be disturbed by the following project-related activities: revetment construction (12 sites), channel excavation (12 sites), placement of dredged material (27 sites), and permanent or seasonal flooding (two sites). The major difference between the three B-3M Alternatives is the number of freeboard and permanently flooded acres. The same impact potential as that described for alternative B-1 exists for alternative B-3M. From an historic preservation viewpoint, the lowest pool elevation is preferable. Overall, flooding and freeboard fluctuation would impact approximately 2,000 fewer acres under alternative B-1. Likewise, the number of sites that would be buried beneath excavated material by alternative B-3M is double that potentially affected by the alternative B-1. The selected site for Lock and Dam No. 4 under alternative B-3M is a potentially sensitive upland area. Both B-1 and B-3M would impact site 16NA100 north of Grand Ecore. The site is an in situ house foundation dating to circa A.D. 1760. Surface-collected material included French faience and Mexican Puebla wares. Also in the project area is Fort Selden (16NA235), above Bayou Pierre. The fort was built in 1821 to house the Seventh US Infantry under the command of Lt. Col. Zachary Taylor. The site has been impacted by vandalism, gravel mining, and pipeline construction. However, preservation of faunal material in buried midden deposits is reported to be excellent. Construction activities in the area would introduce probable secondary impacts such as increased traffic, vandalism, and disturbance by heavy machinery which would further destroy an important resource.

(5) B-3M, 137-foot - A total of 54 sites would be impacted in the same manner and distribution described for B-3M, 135-foot. In Pool No. 5, one additional site would be affected by pool fluctuations.

(6) B-3M, 145-foot - A total of 56 sites would be impacted in the same manner and distribution described for B-3M, 135-foot. In Pool No. 5, two additional sites would be affected by freeboard flooding.

1. Navigation

(1) B-1, 135-foot - This alternative would allow navigational depths to mile 273.

(2) B-1, 137-foot - Would allow navigation to mile 276.

(3) B-1, 145-foot - Navigational depths would be provided to mile 286.3.

(4) B-3M, 135-foot - Same as B-1, 135-foot.

(5) B-3M, 137-foot - Same as B-1, 137-foot.

(6) B-3M, 145-foot - Same as B-1, 145-foot.

j. Hydropower

(1) As recommended by the Federal Energy Regulatory Commission (FERC) and Southwest Power Authority (SWPA), a report will be submitted for congressional action. The impacts of proposed works for run of the river powerplants would occur during construction and would be limited to the areas of existing project construction. There would be no induced development to cause damage to potential hydropower development. Minimum provisions to protect the potential of future hydroelectric generation would be designed to be submerged as on the overflow dams which would be displaced. Works for minimum provision do not mandate hydropower installation, but allow the option of such installation. Prior to installation of any hydroelectric facilities, whether by Federal or non-Federal interests, an EIS would be required.

(2) Given 1980 economic and political conditions, future hydroelectric power generation can be projected based on the physical potential of each alternative. Table EIS-3 summarizes the hydropower potential of the B-1 and B-3M Alternatives by pool elevation.

TABLE EIS-3

SUMMARY OF HYDROPOWER POTENTIAL FOR THE B-1 AND B-3M ALTERNATIVES

Alternative	Total Lift Over 225 Miles (Feet)	Dependable Capacity (Megawatts)	Excess Benefits Over Costs (\$/yr)
B-1			
135-foot	131	75.4	\$6,673,000
137-foot	133	78.7	6,915,000
145-foot	141	85.2	7,747,000
B-3M			
135-foot	131	75.5	\$6,530,000
137-foot	133	78.7	6,848,000
145-foot	141	91.2	8,003,000

k. Water Quality

(1) B-1, 135-foot - Project construction impacts such as increased turbidity, would be detrimental to aquatic life; however, these initial impacts would be ameliorated with time. The impoundments would most noticeably affect algal-dissolved oxygen system interactions and reaeration. Effects harmful to aquatic life would be associated with low dissolved oxygen concentrations which could seasonally occur in the subsurface pool waters. Seasonally occurring low oxygen levels could restrict the development of bottom communities. General water quality conditions in the post-project system should be such that they would enhance the productivity of the aquatic habitat. An analysis of water quality data indicates that toxic constituents are present in the Red River water and sediments. Contaminants which appear to be of most concern at the present time are cadmium, copper, lead, DDT, and diazinon. Increased controls and restrictions on the uses of pesticides should reduce their permeation in the environment in the long run; however, these substances are known for their persistence. Increased population and industrialization ancillary to the project could result in continued introduction of some trace contaminants into the environment. The project's potential for increasing the ability of toxic materials to bioconcentrate in the trophic levels of the aquatic ecosystem through the simultaneous establishment of productive aquatic habitat and pollutant sinks has not been determined. Average fecal coliform levels will be reduced in the post-project pools. Suspended sediments will also be reduced in impounded waters.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - Same as B-1, 135-foot.

(5) B-3M, 137-foot - Same as B-1, 135-foot.

(6) B-3M, 145-foot - Same as B-1, 135-foot.

1. Mineral Resources

(1) B-1, 135-foot - Implementation of this alternative is not expected to have any direct impacts on mineral resources in the area. Oil and gas fields lie at considerable depths below the alluvial valley and would not be impacted. However, surface equipment necessary for petroleum exploration and production, as well as pipelines that lie within or cross the project area, could be adversely affected. The gas field at Red Oak Lake Cutoff at Lock and Dam No. 4 would be affected by this proposed alignment. The total impact will have to be determined from a more detailed analysis of positions of drilling platforms and associated equipment as well as pipeline depths relative to project construction plans. It is possible that some directional drilling might be necessary in the future as a result of

the project. The planned removal of lignite from beneath the alluvial would be controlled primarily by economic factors such as environmental costs and energy benefits. The project would not alter these factors.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - Same as B-1, 135-foot except gas field at Red Oak Lake would not be affected.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 135-foot.

m. Timber

The primary impacts of the various plans on timber resources are project-induced clearing, and stabilization of woodlands which might appear on accreted sandbars. Land-use studies conducted during preparation of Design Memorandum, No. 2, May 1976, projected that slightly less than 16,000 acres of woodlands would exist in the direct impact area by the base year of the project in the without project condition. Based on average volumes and yields for commercial hardwoods in the western parishes of Louisiana, it is estimated that these acreages comprise about 6 million cubic feet of growing stock and 19 million board feet of sawtimber. Various levels of clearing induced by project construction have been estimated as shown elsewhere in this section. The estimated percent change in timber under each project alternative is shown in Table EIS-4.

TABLE EIS-4

ESTIMATED PERCENTAGE CHANGE FROM
THE BASE CONDITION IN TIMBER RESOURCES¹

Alternative	Year			
	1990	1995	2000	2005 ²
Future Without Project	0	0	0	0
B-1, 135-foot	-68	-64	-59	-55
B-1, 137-foot	-72	-72	-64	-55
B-1, 145-foot	-80	-76	-72	-68
B-3M, 135-foot	-66	-62	-57	-53
B-3M, 137-foot	-70	-66	-61	-57
B-3M, 145-foot	-82	-77	-73	-68

¹ The reductions in resource shown are offset to a small degree by a qualitative increase in some woodlands as a result of project implementation.

² No changes are projected beyond the year 2005, as woodland acreages are expected to have stabilized by that time.

As shown in the table, for given Pool No. 5, elevations, timber resource reductions among plans is not significant, typically 2 percent or less; however, changes from the 135-foot to 145-foot elevation result in as much as a 16 percent further reduction in the resource.

n. Fishery Resources

(1) B-1, 135-foot - Fisheries impacts associated with this and all other alternatives are beneficial in the long-term. Total pounds of commercial fish harvested with this alternative are expected to increase from 290,557 in the year 1975 (baseline data) to 822,085 in year 2040, the end of project life. The annualized value of these landings is \$104,638. Total potential man-days of sportfishing are expected to increase from 115,852 in 1975 to 354,384 in 2040. Detailed information on commercial and sport fishery resources by aquatic habitat type for this and other alternatives are found in Tables D-14 through D-21 of Appendix D. A variety of short-term impacts would occur due to construction-related activities. Construction of revetments, locks, and dams, as well as dredging of new channels would temporarily increase turbidity and suspended sediments in adjacent areas. Turbidity interferes with biological systems

primarily through reduction in penetration of sunlight and reduced visibility. Turbidity limits phytoplankton populations and has also been shown to interfere with productivity and behavior patterns of fishes. Suspended sediments can remove certain types of phytoplankton populations from suspension and can interfere with respiratory and filter-feeding mechanisms of zooplankton, aquatic insects, larval fishes, and other forms of aquatic life. Implementation of this or any other alternative would have a long-term impact on species composition and abundance due to the conversion of lotic (running water) to more lentic (standing water) habitat. Velocity is probably the single most important factor affecting aquatic life in a lotic system. The navigational pools and oxbow lakes created by the project would have some flow, but the velocities would be less than that of the river proper. Reduced velocities would result in a finer textured bottom sediment in the pools which would generally support a higher standing crop of benthos. Turbidity and suspended sediment would decrease in these areas, thus leading to increased productivity of phytoplankton. Both of these groups are important components of the aquatic food chain. Decreases in turbidity and creation of a more stable bottom would also lead to increases in attached aquatic vegetation. The revetment of unstable riverbanks would destroy the substrate and associated benthic assemblages on the river banks. The bank areas are among the more productive areas of the river. Benthic organisms would, however, recolonize the areas following construction. The transition from a riverine system to the navigational pools and oxbows would alter the species composition and abundance of fishes. Sport fishes would be more abundant in the lentic habitats than in the riverine system, particularly during the first five to seven years following construction. Principal sport fish would include largemouth bass, black crappie, bluegill, redear sunfish, warmouth, channel catfish, blue catfish, white bass, yellow bass, and green sunfish. Catfish and crappie might show marked increases in abundance. Commercial fishes including bigmouth and smallmouth buffalo, carp, freshwater drum, catfish, gars, and gizzard shad would also increase in abundance, particularly catfish and gizzard shad. The primary reason for increased productivity in the navigational pools and oxbows as compared to the river proper is the increase in littoral areas which provide valuable spawning, nursery, and feeding habitat. In addition, increases in vegetation, snags, and other cover over time in the more lentic habitats would be beneficial to fisheries. Low dissolved oxygen levels which are projected to occur in deep pool areas during certain low-flow conditions could present problems to the fishery. Species most impacted would be less tolerant species such as shad. Pelagic (open water) species and others which would often occupy these areas would suspend at a level above the anoxic zone. Most sport fishes would occupy littoral areas or avoid the areas of environmental stress. Occasional fish kills should not cause a long-term deleterious impact on the overall fishery. A major adverse impact on the fishery would be the hinged pool operation for Lock and Dam No. 3. Hinging is a method whereby adjustments can be made at the dam to lower the elevation of the navigational pool during the time of high river discharges. This is done to avoid raising

post-project flood heights on about 7,004 acres of lands above the normal pool height. During a typical year, an average of four hinges lowering the pool elevation by 7 feet would occur. Each hinge would normally last from 2 to 4 weeks and occur during the months of February through June which is the usual high water season for the Red River. Approximately 920 acres of pool bottom would be exposed during peak spawning season for many species of fish. Although greater than 2,700 acres are flooded in pool 3 in addition to the navigational channel and severed oxbows, the bottom habitat dewatered by hinging would be the shallowest and, therefore, most productive fishery habitat. It is difficult to estimate the impact to the fish populations of the pool. Although spawning would be severely impacted, recruitment from upstream pools could adequately replenish losses. Fishing effort might be severely hindered during and following pool hinging due to destabilization of the system. Benefits normally associated with water drawdown are not anticipated due to the short duration of bottom exposure. Future Corps planning concerning hinged pool will involve investigating methods to minimize impacts. These might include strategically located low-level weirs to restrict the amount of bottom dewatered, lessening the amount of hinge, and others.

(2) B-1, 137-foot - The impacts of this alternative are very similar to those of the B-1, 135-foot Alternative. Actual productivity and harvest of commercial and sport fishes can be expected to be slightly higher due to the increased areal extent of the navigational pools and the increased littoral area. Quantitative data on pounds of commercial and sport fish harvested and their dollar values are not available for this alternative.

(3) B-1, 145-foot - The fisheries impacts of this alternative are similar to those described in the discussion of the B-1, 135-foot Alternative, although abundance and harvest of fishery resources would be somewhat greater due to the much greater area of the navigational pool at Lock and Dam No. 5. Total pounds of commercial fish harvested with this alternative are expected to increase from 290,557 in 1975 to 532,402 in 2040, with an annualized value of \$111,804. Total potential man-days of sportfishing are expected to increase from 115,852 in 1975 to 402,404 in 2040.

(4) B-3M, 135-foot - Fisheries impacts for the B-3M Alternatives are comparable to those of the B-1 Alternatives. A comparison of annualized values for commercial and sport fishery resources for the B-1 and B-3M, 135- and 145-foot Alternatives are shown in Tables D-14 through D-21 in Appendix D. Total pounds of commercial fish harvested with this alternative are expected to increase from 290,537 in 1975 to 916,803 in 2040. Total potential man-days of sportfishing are expected to increase from 115,852 to 370,309 in 2040. In the B-3M alternatives up to 245 acres in pool 3 could be dewatered by hinging. This represents the majority of the flooded area in pool 3, exclusive of the river channel and severed oxbows, and therefore, the pool's most productive habitat. Hinging

would also expose 450 acres in pool 4 and 114 acres in pool 5. Hinging for this alternative would avoid raising post-project flood heights on 835 acres.

(5) B-3M, 137-foot - The impacts of this alternative are very similar to those of the B-3M, 135-foot Alternative. Actual productivity and harvest of commercial and sport fishes can be expected to be slightly higher due to the increased littoral area. Quantitative data on pounds of commercial and sport fish harvested and their dollar values are not available for this alternative.

(6) B-3M, 145-foot - Fisheries impacts of this alternative are similar to those for the B-3M, 135-foot Alternative. Total pounds of fish harvested with this alternative are expected to increase from 290,557 in 1975 to 886,161 in 2040. Total potential man-days of sportfishing are expected to increase from 115,852 in 1975 to 423,257 in 2040. Impacts of hinging are same as B-3M, 135-foot for pool 4. An estimated 464 acres would be dewatered in pool 5. Hinging would avoid raising post-project flood heights on 770 acres above the normal pool height.

o. Wildlife Resources

Impacts to wildlife and wildlife-related activities are directly related to the loss of terrestrial habitat associated with each project alternative. Since the B-3M Alternative with the 145-foot pool elevation in Pool No. 5 would cause the greatest loss of terrestrial habitat, and since habitat types impacted would be at least equal in higher pool alternatives, it would have the greatest negative impact on wildlife. Losses of wildlife habitat and associated monetary losses are discussed in the Environmental Appendix (Appendix D). Land acquisition and management necessary to offset these losses are discussed in the Mitigation Appendix (Appendix E). Although impacts are significant, wildlife management and habitat preservation on some of the proposed recreational lands helps offset some of the project caused losses. Losses to trapping would occur. The US Fish and Wildlife Service (USFWS), Vicksburg Field Office, estimated an annual harvest of .17 pelts per acre for BLH in the Sicily Island area in Catahoula Parish, Louisiana. Pelts taken from BLH were valued at \$6.88 per pelt based on a December, 1978 price list published by the Northeast Louisiana Furtakers Association. Even assuming a somewhat lower yield for the CWS of the Red River area, since that is the most impacted woodland type, losses would be high. Based on a yield of .15 pelts per acre and a real loss of 13,635 acres of CWS for the B-1, 135-foot Alternative, an annual loss of 2,045 pelts worth approximately \$14,000 would occur. Some of this loss would be offset by trapping that could occur in association with agricultural lands that were preproject CWS. The best way to present wildlife losses associated with each project alternative is to do so in terms of habitat lost.

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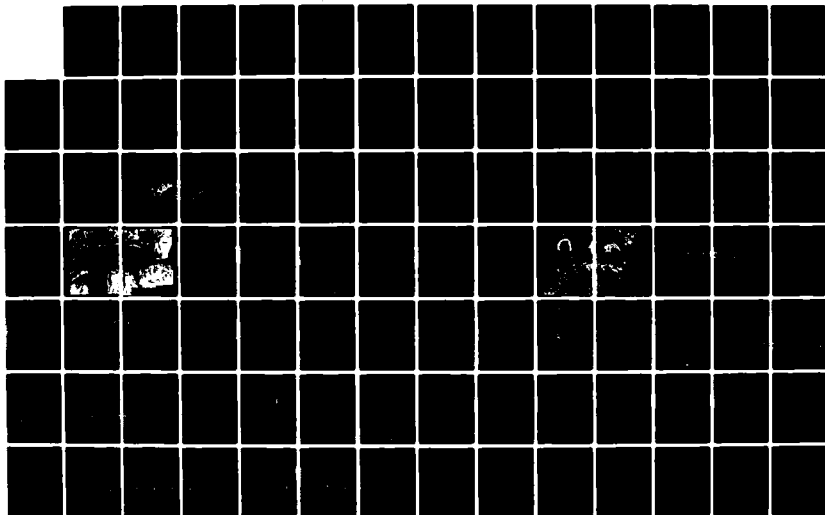
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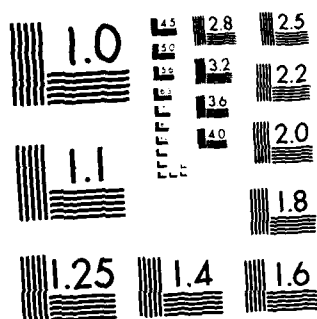
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(1) B-1, 135-foot - This alternative would affect approximately 45,000 acres of terrestrial habitat, including 18,896 acres of CWS, the dominant habitat type in the area. Of the total acres impacted, 13,611 would be permanently lost due to revetment, new channel, and flooding and 14,548 would be affected by dredged material or freeboard. Some young or slow-moving animals would be directly killed by construction or flooding. Other wildlife would be able to move to adjacent areas, but would be faced with increased inter- and intra-specific competition. The permanent loss of terrestrial habitat would lower wildlife populations in the project area. Wildlife would eventually be able to repopulate areas affected by dredged-material, but habitat value would be low for a number of years. Accretion of oxbow lakes over the project life would create 5,200 acres of terrestrial habitat.

(2) B-1, 137-foot - Would affect 46,000 acres of terrestrial habitat, including 19,524 acres of CWS. Of the total acres impacted, 14,028 would be permanently lost due to revetment, new channel, and flooding and 15,231 acres would be affected by dredged material or freeboard. Accretion of oxbow lakes - same as B-1, 135-foot.

(3) B-1, 145-foot - Would affect 49,600 acres of terrestrial habitat, including 20,742 acres of CWS. Of the total acres impacted, 17,162 would be permanently lost to revetment, new channel, and flooding and 15,733 would be affected by dredged material or freeboard. Accretion of oxbow lakes - same as B-1, 135-foot.

(4) B-3M, 135-foot - Would affect 45,800 acres of terrestrial habitat, including 18,427 acres of CWS. Of the total acres impacted, 13,780 would be permanently lost to revetment, new channel, and flooding and 15,179 would be affected by dredged material or freeboard. Accretion of oxbow lakes would add 5,800 acres of terrestrial habitat over the project life.

(5) B-3M, 137-foot - Would affect 47,000 acres of terrestrial habitat, including 18,962 acres of CWS. Of the total acres impacted, 14,371 would be permanently lost to revetment, new channel, and flooding and 15,765 would be affected by dredged material or freeboard. Accretion of oxbow lakes - same as B-3M, 135-foot.

(6) B-3M, 145-foot - Would affect 51,600 acres of terrestrial habitat, including 20,660 acres of CWS. Of the total acres impacted, 18,676 would be permanently lost to revetment, new channel, and flooding and 16,196 would be affected by dredged material or freeboard. Accretion of oxbow lakes - same as B-3M, 135-foot.

p. Endangered Species

(1) B-1, 135-foot - Although there would be a loss of the natural river, there would be a gain in oxbow lakes and overall aquatic habitat. The American alligator population could be enhanced by this action. Impoundment of the river could create bald eagle

feeding areas. The quality of these feeding areas in terms of biomagnification of toxic substances is, however, uncertain. No other endangered or threatened species would be impacted.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - Same as B-1, 135-foot except that the Lock and Dam No. 3 site would impact some pine areas approaching a stage of development where there could be potential habitat for the red-cockaded woodpecker.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 135-foot.

Additional information concerning endangered species is contained in the Endangered Species Report in Appendix D.

q. General Recreation

This plan provides for 12,758 acres of recreational land on 26 sites. Of these sites, six are designated wildlife management areas. A concept of resource use was adopted that provides for urban, suburban, and rural recreational situations in the context of estimated recreational demands and cultural and environmental opportunities. The Red River Waterway Master Plan is based upon this plan using the B-1 plan and the 137-foot pool elevation in Pool No. 5.

(1) B-1, 135-foot - This pool elevation will have essentially no adverse impact upon the proposed recreational resources.

(2) B-1, 137-foot - Similar to B-1, 135-foot pool. DM No. 4 is based on this plan and pool elevation.

(3) B-1, 145-foot - Similar to B-1, 135-foot pool.

(4) B-3M, 135-foot - Similar to the B-1, 135-foot in pool elevation only. However, if this plan is selected, the Master Plan should be modified due to its treatment of the Red River Waterway as an integrated recreational resource. The different lock and dam locations in this plan will require restudy of the recreational plan in pools 3, 4, and 5. The B-3M plan would probably require about 13,000 acres of land on about 26 sites as would the B-1 plan. Therefore, the impacts of recreational development for both the B-1 and B-3M plans are essentially the same.

(5) B-3M, 137-foot - Similar to B-3M, 135-foot pool.

(6) B-3M, 145-foot - Similar to B-3M, 135-foot pool.

r. Groundwater

Ground water impacts are thoroughly addressed in the report Ground-water Impact Study, Agricultural and Urban Area, Red River Waterway Project, published by D'Appolonia in October 1980. A copy of this report is available for review in the New Orleans Corps of Engineers District Library. Their study area encompassed approximately 855,000 acres of the Red River alluvial plain between the Red River's confluence with the Black River and Shreveport, Louisiana. Acreage where ground water is permanently at land surface is predicted to increase by approximately 1,200 acres for all navigational alternatives. Generally, the B-1 Alternative was projected to impact more lands than the B-3M. Where decreased yields were projected, the majority of impacted lands were soybean areas. Increased yields were primarily on woodland areas. Impacts to urban areas were considered minor regardless of selected alternative.

(1) B-1, 135-foot - Has decreased yields on 26,440 acres and increased yields on 6,240 acres.

(2) B-1, 137-foot - Has decreased yields on 26,920 acres and increased yields on 6,360 acres.

(3) B-1, 145-foot Has decreased yields on 29,720 acres and increased yields on 7,160 acres.

(4) B-3M, 135-foot - Has decreased yields on 25,720 acres and increased yields on 5,800 acres.

(5) B-3M, 137-foot - Has decreased yields on 26,520 acres and increased yields on 5,920 acres.

(6) B-3M, 145-foot - Has decreased yields on 30,360 acres and increased yields on 6,200 acres.

s. Tributaries

(1) Presentation of the impacts on tributaries in the same format used for most of the significant resources would be very lengthy and cumbersome. Instead, the impacts are being presented in tabular form. With both the B-1 and B-3M Alternatives, portions of each tributary listed in Table EIS-5 would experience increases in stage levels and would be converted from natural, free flowing conditions to slack water pools for varying distances upstream, depending on the slope of the tributary and the Red River pool elevation at the mouth of the tributary. The range in stage level increases at the confluence of each tributary is based on no flow conditions in the tributaries and flows of 5,000, 20,000 and 40,000 cubic feet per second (cfs) in the Red River.

Based upon Table EIS-5, it is evident that increases in stage levels would occur in all of the tributaries. Flows would, for the most

part, be contained within present bank lines. However, with the B-1 Alternative, Bayou Nantachie would require additional flowage easements above the pool, plus 3 feet.

TABLE EIS-5
INCREASES IN STAGE LEVELS AT THE CONFLUENCE OF
TRIBUTARIES OF THE RED RIVER (SHOWN FOR 5, 20, and
40 THOUSAND CFS FLOWS IN THE RED RIVER)

Tributary	River Mile	Stage Increases (feet)					
		B-1			B-3M		
		5	20	40	5	20	40
Wiggin Bayou	72.5	4	3	3	4	3	3
Lick Bayou	89.7	27	18	11	27	18	11
Bayou Maria	102.0	19	14	9	19	14	9
Huffman Creek	102.7	19	13	8	19	13	8
Bayou Rapides	105.6	18	12	7	18	12	7
Bayou Rigolette	106.6	18	12	7	18	12	7
Bayou Jean De Jean	127.1	22	5	2	22	5	2
Cane River	135.0	7	3	1	7	3	1
Bayou Nantache	148.3	29	23	18	21	15	10
Falcon Bayou	150.3	28	22	17	20	14	9
Tyrourge Bayou	152.3						
Trestle Branch	164.3	23	16	11	15	8	5
Saline Bayou	167.8	20	15	10	13	7	4
Chevreuille Bayou	168.2	20	14	6	12	7	4
Bayou Pierre	187.2	11	5	3	30	24	19
Simms Bayou	193.7	7	2	0	27	20	15
Bayou Nicholas	206.3	27	20	15	22	15	10
Posey Branch	221.2	24	15	9	19	10	5
Coushatta Bayou	228.5	23	15	8	18	10	5
Loggy Bayou	239.7	12	6	3	7	3	1
Cross Bayou	277.8	7	3	1	7	3	1
Willow Boy Bayou	228.5	18	11	6	13	7	3

(2) The increases in stage levels and decreased flow velocities in the tributaries should have overall beneficial effects on fishery resources. Littoral areas, which are utilized by fish as spawning and feeding areas, would increase. Plankton populations would increase due to decreases in turbidity and benthos would benefit due to the more stable bottom conditions which would develop in these areas. Some tributary mouths might exhibit seasonal eutrophic conditions. Delta formations could result at the mouths of tributaries due to stage level increases. The magnitude of activity would be largely dependent on the sediment load of respective tributaries.

(3) Studies have been completed that determined the impacts of both the B-1 and B-3M Plans upon interior drainage into the Red

River from Lock and Dam No. 1 to the upper pool of Lock and Dam No. 5. The studies cover the impacts to sewage outfalls and drainage culverts, as well as tributary streams. Results show there would be no significant difference in impacts regardless of the plan selected.

t. Oxbow Lakes

(1) B-1, 135-foot - Approximately 3,700 acres of oxbow lakes and other water bodies which are presently distinct entities would become incorporated into the navigational pools or otherwise impacted by the project. It is estimated that 840 acres of this 3,700 acres would become terrestrial habitat because of dredged-material disposal. The B-1 Plan, regardless of pool elevation, would create 11,653 acres of oxbow lakes. Of these, 7,887 acres of oxbow lakes would be provided with closures to prevent the newly created lakes from silting in at a rapid rate. The remaining 3,766 acres would not be provided with closures and would be completely silted in by year 2000. The oxbows with closures would be reduced in size over time, but 5,454 acres would remain in 2040. Pounds of commercial fish harvested annually in these oxbows is expected to be 140,713 by 2040 and the lakes would support 73,893 man-days of sportfishing in that same year. The reasons for the high productivity of these lakes have been discussed previously.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - The impacts the B-3M Plan on oxbow lakes and other water bodies are very similar to those discussed for B-1, 135-foot Alternative; however, the B-3M Plan would create a few more acres of oxbows. Of 11,365 acres of oxbows created by the B-3M Plan, regardless of pool elevation, 8,099 would be provided with closures and 5,529 acres of oxbows would remain the year 2040. These areas would provide 153,706 pounds of commercial fish harvest in 2040 and 76,693 potential man-days of sportfishing.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 135-foot.

u. River Habitat

(1) B-1, 135-foot - The 22,594 acres of natural river channel present in year 1975 would be reduced to 15,063 acres in 1980, 7,531 acres in 1985, and totally eliminated by 1990. These acres of natural river channel would be converted to oxbow lakes or become incorporated into the navigational pools and navigational channels. Habitat classified as natural river would no longer exist. This habitat conversion would be beneficial from an environmental standpoint. Most of the fisheries benefits as a result of these habitat changes have been discussed under fisheries impacts in both

the EIS and Appendix D. Some of the impacts which have not yet been discussed relate to certain types of structures which would be constructed as a result of the project. Dikes, structures perpendicular to the flow which contract channel width, and revetments, structures parallel to the flow and constructed along cutting banks to prevent erosion, would provide some habitat diversity, which might also be beneficial to fisheries. These structures provide firm substrate for attachment of invertebrate organisms and also serve to stabilize bottom sediments, which benefit benthic organisms. Revetments might also decrease turbidity in localized areas. Approximately 10 miles of channel bottom would be impacted by annual maintenance dredging.

(2) B-1, 137-foot - Same as B-1, 135-foot.

(3) B-1, 145-foot - Same as B-1, 135-foot.

(4) B-3M, 135-foot - The 22,594 acres of natural river channel would undergo essentially the same changes with the B-3M plan as discussed for the B-1, 135-foot Alternative.

(5) B-3M, 137-foot - Same as B-3M, 135-foot.

(6) B-3M, 145-foot - Same as B-3M, 135-foot.

7. LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement (EIS):

NAME	DISCIPLINE/EXPERTISE	EXPERIENCE	ROLE IN PREPARING EIS
Mr. David L. Reece	Fish and Wildlife Ecology	2 years Research Associate, 4 years Biologist, Florida Game and Fish Commission; 4 years Environmental, New Orleans District	EIS Coordinator, Effects on Fish and Wildlife Resources
Mr. Alfred C. Naomi	Engineer/Civil Engineer	11 years, Corps of Engineers, Orleans District	Study Manager, Engi- neering Input to EIS
Mr. C.W. Shelton	Engineer/Civil Engineer	29 years, Corps of Engineers, Little Rock and New Orleans Districts	Project Manager, Red River Waterway Project
Mr. Terral J. Broussard	Engineer/Civil Engineer	15 years, Corps of Engineers, New Orleans District	Groundwater Impacts/ Hydropower
Mr. Don Alette	Engineer/Hydraulic Engineer	6 years, Corps of Engineers, New Orleans District	Hydrology/Tributary Study
Mr. Frederick L. Smith	Geology/Alluvial Morphology	26 years, Corps of Engineers, Waterways Experiment Station Vicksburg, MS	Physical Environment and Minerals
Mr. Dennis L. Chew	Fishery Biology/Management	4 years, Marine Biologist, Gulf Coast Research Lab, Ocean Springs, MS; 3 years, Marine Programs Administrator, MS Marine Conservation Commission, Biloxi, MS; 1 1/2 years EIS Studies, Corps of Engineers, New Orleans District	Effects on Aquatic Re- sources
Mr. Marvin A. Drake	Engineer/Environmental	13 years, Hydraulic and Environmental Engineer, Corps of Engineers, New Orleans District	Effects on Water Quality

NAME	DISCIPLINE/EXPERTISE	EXPERIENCE	ROLE IN PREPARING EIS
Mr. Eugene G. Buglewicz	Limnologist	10 years, Environmental, General Biological and Limnological Work Walla Walla District, Waterways Experiment Station, and Lower Mississippi Valley Division, Corps of Engineers	Water Quality Appendix
Ms. Carroll H. Kleinhans	Archeology	4 years, Field and Analysis experience; 2 years HCRS, Department of Interior; 2 year Corps of Engineers, Memphis and New Orleans Districts	Effects on Cultural Resources
Mr. Stephen F. Finnegan	Recreation Planning/Resource Development	4 years, Corps of Engineers, New Orleans District	Recreation Planning
Mr. Everett K. Johnson	Supervisory Economist/Branch Chief	31 years, Corps of Engineer, New Orleans District	Economic Projections
Mr. Nicholas G. Constan	Regional Economist/Navigation, Flood Control	12 years, Corps of Engineers, New Orleans District	Bank Stabilization Benefits, Land-Use Projections
Mr. Charles B. O'Connell	Regional Economist/Navigation	33 years, Corps of Engineers, New Orleans District	Navigation Benefits
Mr. Henry P. Glaviano	Technical Writing/Editing	4 years, Technical Writer/Editor, The Boeing Company; 11 years, Technical Writer/Editor, Corps of Engineers, New Orleans District	Review and Editorial

8. PUBLIC INVOLVEMENT

a. Public Involvement Program

A public/landowners meeting was held on 17 November 1978 in Natchitoches, Louisiana, to discuss the effects of constructing Lock and Dam No. 4 as proposed by the B-3M Plan. This meeting was held because new topographic surveys showed that several thousand acres of agricultural and other lands would be impacted by floodwaters which were not previously addressed. As a result of that meeting and other public and personal correspondence, the need for a restudy of the alternative lock and dam locations and pool elevations in the Pool 5 area was, thus, presented at scoping meetings held on 19 and 20 May 1980, in Shreveport and Alexandria, Louisiana, respectively. The opinions of the public ranged from being opposed to the project to being for the project regardless of the selected plan. Most participants favored the project but expressed a preference to the overall alternative and the pool height above Lock and Dam No. 5. Preferences were generally based on whose and how much land would be affected, and on whether the selected plan would have an influence on the potential for navigation above Shreveport. As a result of these scoping meetings, the need to thoroughly reevaluate the alternative plans was established. Responses received at or subsequent to the May 1980 meetings were as follows:

- | | |
|---|----|
| (1) Prefer the B-1 Plan | 24 |
| (2) Prefer the B-3M Plan | 2 |
| (3) Prefer Pool 5 at elevation 145' | 36 |
| (4) Prefer Pool 5 at elevation 135' or 137' | 2 |
| (5) Prefer B-1 Plan with Pool 5 at 135' or 137' | 5 |
| (6) In favor of project | 1 |
| (7) Anti-project | 1 |

As stated in Sections 3.b. and 8.a., the reasons for the various preferences were varied. The wishes of the public were of primary concern in selecting a plan with the least adverse social, economic, and environmental impact.

b. Remaining Required Coordination

Circulation of this draft EIS will accomplish the remaining required coordination with the appropriate state, regional, and metropolitan clearinghouses. It will also allow Federal, state, and local agencies, and other interested groups or individuals further participation in the plan selection process.

c. Statement Recipients

FEDERAL

J. Bennett Johnston, US Senator

Russell B. Long, US Senator

Corinne C. Boggs, US Congresswoman

John B. Breaux, US Congressman

Jerry Huckaby, US Congressman

Robert L. Livingston, US Congressman

Gillis W. Long, US Congressman

W. Henson Moore, US Congressman

William "Billy" Tauzin, US Congressman

Buddy Roemer, US Congressman

US Department of the Interior, Assistant Secretary for Program
Development and Budget, Office of Environmental Project Review

US Fish and Wildlife Service, Regional Director, Atlanta, Georgia

US Fish and Wildlife Service, Field Supervisor, Lafayette,
Louisiana

Environmental Protection Agency, Regional Administrator, Region VI

Environmental Protection Agency, Administrator, Washington, DC

US Department of Commerce, Deputy Assistant Secretary for
Environmental Affairs

US Department of Commerce, National Oceanic and Atmospheric
Administration, Office of Ecology and Conservation

US Department of Commerce, Director, National Oceanic and
Atmospheric Administration, National Ocean Survey

US Department of Commerce, Meteorologist in Charge, National
Weather Service, New Orleans Area

US Department of Commerce, Regional Director, National Marine
Fisheries Service

US Department of Commerce, Area Supervisor, National Marine
Fisheries Service, Water Resources Division

US Department of Agriculture, Regional Forester, Forest Service

US Department of Agriculture, State Conservationist, Soil
Conservation Service

US Department of Transportation, Division Engineer, Federal
Highway Administration

US Department of Transportation, Commander, Eighth Coast Guard District

US Department of Health, Education, and Welfare, Regional Director, Public Health Service, Region VI

US Department of Health, Education, and Welfare, Water Resources Activity, Vector Biology and Control Division

Federal Energy Administration, Director, Environmental Impact Division, Office of Environmental Programs

Federal Power Commission, Acting Advisor on Environmental Quality, Washington, DC

Federal Maritime Commission, Office of Environmental Analysis

US Department of Housing and Urban Development, Regional Administrator, Region VI, Dallas, Texas

US Department of Housing and Urban Development Area Office, Director, New Orleans, Louisiana

Advisory Council on Historic Preservation

STATE

Louisiana Department of Health and Human Resources, Office of Health and Environmental Quality

Louisiana Department of Transportation and Development, Office of Public Works

Office of Intergovernmental Relations, Office of Governor

Louisiana Department of Highways, Public Hearings and Environmental Impact Engineer

Louisiana Department of Agriculture, Commissioner

Louisiana Department Wildlife and Fisheries, Secretary

Louisiana Department Wildlife and Fisheries, Coordinator, Ecological Studies Section

Louisiana State Parks and Recreation Commission

Louisiana Office of Environmental Affairs

Louisiana Public Service Commission

Louisiana Department of Natural Resources, Office of Forestry

Louisiana Department of Natural Resources, Office of Conservation

Louisiana Department of Natural Resources, Office of Environmental Affairs, Water Pollution Control Station

Louisiana Department of Commerce and Industry
Louisiana Department of Culture Recreation, and Tourism, State
Historic Preservation Officer
Louisiana Assistant Attorney General
Louisiana Department of Justice, Environmental Section
Louisiana Joint Legislative Committee on Environmental Quality,
Louisiana Legislature
Louisiana State Land Office Register
Louisiana State Planning Office
Louisiana State Soil and Water Conservation Committee
Louisiana State University, Associate Director, Sea Grant Program,
Center for Wetland Resources
Louisiana State University, Curator of Anthropology, Department of
Geography and Anthropology
University of New Orleans, Coordinator, Environmental Impact
Section, Department of Environmental Affairs
University of New Orleans, Department of Anthropology and
Geography

ENVIRONMENTAL

Ecology Center of Louisiana, Inc.
National Audubon Society, Southwestern Regional Office, Regional
Representative
Delta Chapter Sierra Club, New Orleans
National Wildlife Federation, Washington, DC
National Wildlife Federation, Southern Wetlands Project
Environmental Defense Fund

OTHERS

South Central Planning and Development Commission
Louisiana Shipbuilders and Repair Association

Red River Waterway Commission
President, Bossier Parish Police Jury
President, Caddo Parish Police Jury
President, Red River Parish Police Jury

President, Natchitoches Parish Police Jury
President, Winn Parish Police Jury
President, Grant Parish Police Jury
President, Rapides Parish Police Jury
President, Avoyelles Parish Police Jury
President, Catahoula Parish Police Jury
President, Concordia Parish Police Jury
President, West Feliciana Parish Police Jury
President, Pointe Coupee Parish Police Jury

LIBRARIES

Avoyelles Parish Library
Bossier Parish Library
Shreve Memorial Library
Concordia Parish Library
Grant Parish Library
LaSalle Parish Library
Natchitoches Parish Library
Rapides Parish Library
Red River Parish Library

TABLE 6 . INDEX, REFERENCES AND APPENDIXES

Subject	STUDY DOCUMENTATION		
	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
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Alternatives	pp. EIS-15 to 40	pp. 2, 4 to 10	App. A - all
Areas of Controversy	p. EIS-7		
Comparative impacts of alternatives	pp. EIS-18 to 40	pp. 2, 4 to 10	App. A - all; App. E, pp. E-13-14, App. D, pp. D-1 to 38
Economics	pp. EIS-6, 40	pp. 4, 5, 8, 13 to 16	App. A, p. A-4 to 6 App. G - all
Environmental conditions	p. EIS-41		App. F, pp. F-1 to 3
Environmental effects	pp. EIS-55 to 75	pp. 4 to 6, 9, 10, 16 to 19	App. E, pp. E-2 to 7; App. F, pp. 3 to 11; App. D - all
List of Preparers	pp. EIS-77 to 78		
Major Conclusions and Findings	pp. EIS-3 to 6	pp. 10, 20	App. E, p. E-14; App. A, p. A-9; App. D, p. D-53

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STUDY DOCUMENTATION

Subject	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
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Need for and objectives of action	p. EIS-13	pp. 1, 2	
Planning objectives	p. EIS-14	pp. 1, 2	
Plans considered in detail	pp. EIS-16, 17	pp. 4 to 10	
Plans eliminated from further study	p. EIS-15		
Public concerns	pp. EIS-13, 14	p. 10	App. C - all; App. A, p. A-9
Public involvement	p. EIS-79	p. 10	App. C - all; App. A, p. A-9
Public views & response	p. EIS-79	p. 10	App. C - all; App. A, p. A-9
Relationship of plan to environmental requirements	pp. EIS-8, 9		
Required Coordination	p. EIS-79		

STUDY DOCUMENTATION

Subject	Environmental		Main Report		Report Appendixes (References Incorporated)
	Impact Statement	(References Incorporated)	Impact Statement	(References Incorporated)	
Significant resources	pp. EIS-18 to 75				
Agricultural lands	pp. EIS-3, 4, 22, 44, 58	pp. 4, 17			App. D, pp. D-1 to 38
Archeological sites	pp. EIS-25, 41, 45, 60 to 62	p. 19			App. I, pp. I-10 to 12
Baldcypress-tupelo swamps	pp. EIS-5, 19, 42, 56				App. D, pp. D-1 to 38
Bottomland hardwoods	pp. EIS-5, 18, 42, 55, 56				App. D, pp. D-1 to 38
Endangered species	pp. EIS-34, 50, 70, 71	p. 17			App. D, pp. D-49 to 55
Fishery resources	pp. EIS-4, 31, 38, 39, 41, 48, 49, 51, 52, 53, 66 - 69, 74, 75	pp. 10, 18			App. D, pp. D-37 to 48; App. K
Groundwater	pp. EIS-4, 13, 36, 51, 72	pp. 2, 4 - 6			App. A, p. A-6
Hydropower	pp. EIS-6, 27, 46, 63	pp. 3, 8			App. J, - all; App. A, pp. A-7, 8
Mineral resources	pp. EIS-29, 41, 47, 48, 64, 65				
National Register of Historic Places	pp. EIS-23, 41, 44, 45, 59, 60				App. I, pp. I-13 to 18
Navigation	pp. EIS-13, 15, 16, 17, 26, 46, 62	All			App. A - pp. 3, 7, 8

STUDY DOCUMENTATION

Subject	Environmental		Main Report		Report Appendixes	
	Impact Statement		(References Incorporated)		(References Incorporated)	
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Pine hardwoods	pp. EIS-21, 43, 58				App. D, pp. D-1 to 38, 52	
Recreation	pp. EIS-35, 50, 51, 71		pp. 9, 11, 18		App. H - all; App. D-17 to 19	
River habitat	pp. EIS-39, 52, 74, 75				App. D, pp. D-37 to 48	
Riverine habitat	pp. EIS-20, 42, 43, 56-58				App. D, pp. D-1 to 38	
Significant geological features	pp. EIS-24, 45, 60				App. B - all	
Timber	pp. EIS-30, 48, 65					
Tributaries	pp. EIS-37, 51, 52, 72-74		p. 9			
Water quality	pp. EIS-28, 46, 47, 63, 64		p. 18		App. F - all	
Wildlife resources	pp. EIS-33, 49, 50, 69, 70		p. 17		App. K	
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Study authority	p. EIS-13		p. 1		App. E, p. E-1	

STUDY DOCUMENTATION

Subject	Environmental Impact Statement	Main Report	
		(References Incorporated)	Report Appendixes (References Incorporated)
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Unresolved issues	p. EIS-7		
Without conditions (no action)	p. EIS-16		

App. F, pp. F-1 to 3;
App. D, pp. D-2 to 38

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX A
POOL 5 ELEVATION STUDY

A-1

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT

APPENDIX A
Pool 5 Elevation Study

1. Purpose. The purpose of this appendix is to present the results of studies undertaken to review the appropriate elevation for Pool 5. These studies have included environmental and economic factors as well as engineering considerations. See Plate 1 of this appendix for general location data discussed herein.

2. Background. Prior studies have centered on two elevations for Pool 5: 135 feet and 145 feet, and consideration has also been given to the elevation 137 pool. Elevation 135 appeared in the authorizing document, and elevation 145 was presented and approved in the Phase I GDM (GDM No. 2). Pool elevation 137 was studied to provide information on an intermediate pool. cursory consideration established that detailed study of other pool elevations between 135 and 145 would contribute little to establishing an optimum pool. Accordingly, detailed consideration of pools other than 135, 137, and 145 was not undertaken.

a. General Design Memorandum No. 2 presented several plans for the development of navigation on the Red River between the Mississippi River and Shreveport. Of these plans, three plans (Group A) provided for a Pool 5 elevation of 135 and the construction of Lock and Dam No. 6 with a pool elevation of 150. Pool 6 elevation 150 would provide navigation on the Red River through the Shreveport metropolitan area and future navigation up Twelvemile Bayou to Caddo Lake Dam. Group B plans provided a Pool 5 elevation of 145. Navigation depths under the Group B plans could be extended to Caddo Lake Dam by accomplishing about 5 feet of additional dredging in Twelvemile Bayou between Red River and Caddo Dam, in lieu of constructing Lock and Dam No. 6, achieving an estimated net savings in first cost of \$60 million. One of the Group B plans, the B-3 Modified plan, was recommended and approved in GDM No. 2. This plan included five locks and dams in the Mississippi River to Shreveport reach with a Pool 5 elevation of 145.

b. More detailed analyses of the project have indicated that Plan B-1 will better accomplish the project purposes at lower cost and with less flooding. These analyses are presented in the main text of this report. Plan B-1, as presented in GDM No. 2, provides for a Pool 5 elevation of 145. In the referenced analyses comparing the B-1 and B-3M plans, it was concluded that the Pool 5 level should also be reviewed to insure proper optimization. The results of that review are presented in this appendix.

c. In authorizing the project in accordance with the report of the Chief of Engineers, Congress accepted the Board's recommendation "...to provide a 9-foot slack water navigation channel, with related recreation facilities, extending from the Mississippi River through Old River and Red River to

Shreveport, Louisiana, ... all generally in accordance with the plan of the District Engineer ... and with such modifications, including changes in alignment, location, and dimensions as in the discretion of the Chief of Engineers may be advisable, provided that, prior to construction of the navigation features in the reach from Shreveport to Daingerfield, The transportation economics be reanalyzed, taking into account all data pertinent to the movement of bulk commerce in the project tributary areas." That reanalysis has not been completed.

3. Pool elevations presented.

a. Pool elevation 135. As defined in GDM No. 2, dependable navigation extends to that point along the river where the navigation pool elevation is 2' above the historically derived average low water plane line (ALWP). The construction of Lock and Dam No. 5 to provide a pool elevation of 135 would, under the above definition and with reasonable maintenance dredging, allow dependable navigation up to river mile 273 (realigned mile 226).

b. Pool elevation 137. A Pool 5 elevation of 137 will provide dependable navigation depths to river mile 276 (realigned mile 228). Navigation would terminate at the St. Louis and Southwestern railroad bridge.

c. Pool elevation 145. A Pool 5 elevation of 145' will provide dependable navigation to river mile 283.5 (realigned mile 236). As stated in paragraph 2 of this appendix, this elevation was proposed in the Phase I GDM - Plan Formulation and Site Selection, which was approved in October 1976. As discussed in detail in the subject GDM and mentioned briefly in paragraph 2 of this appendix, the 145' pool and 5' of dredging in Twelvemile Bayou was considered a more feasible alternative for providing future navigation to Caddo Lake Dam than constructing Lock and Dam No. 6 below Shreveport with a pool elevation of 150'. Thus one of the factors recommending the 145' pool at that time was consideration of the least costly alternative for preserving the navigation potential to Caddo Lake Dam and eventually on to Daingerfield, Texas. Pool 5 elevations above 145' were not considered in this report due to large amounts of flooding that would probably occur with the higher elevation.

4. Comparative analyses.

a. General. To evaluate the effectiveness of these alternative pool elevations for the B-1 plan, quantifiable and non-quantifiable factors which would lead to a pool selection were identified and evaluated. A significant factor that was considered in this analysis was the location of the municipal port facilities for Shreveport and Bossier City. The site selected for these facilities is at mile 214 (realigned). Transportation benefits have been computed for providing navigation to the vicinity of Shreveport. Differences in transportation benefits between the 145', 137', and 135' pool elevations cannot be quantified. Costs that are presented in the comparative analyses are those costs that are necessary to provide navigation to the port facilities. Since costs and benefits are not presented beyond mile 214 in this analysis, the cost for the relocation of two railroad bridges upstream of the port site and the costs of maintenance dredging beyond mile 214 are not included. This does not preclude the relocation of the bridges or dredging above mile 214 at some future date. Should navigation beyond mile 214 in Pool 5 be required in the future, it could be achieved under the existing project

authorization and appropriate economic justification. In addition, limited navigation is feasible under the existing bridges. This analysis is presented in paragraph 4d.(1) of this appendix.

The following discuss the various factors considered in this comparative analysis.

b. Quantifiable factors. Table 1 presents a comparative breakdown of first costs for the alternative pools. The following is an explanation and discussion of differences by item.

(1) Lands and damages. Detailed real estate costs are presented in Appendix L.

(a) Construction right-of way. The lands required for actually constructing the navigation and complementary bank stabilization features of each pool alternative were considered the same. Any differences would be minor and insignificant in pool selection.

(b) Flowage easements. Easement acreage will be required between the taking line which is 3 feet above the pool elevation, and the pool elevation. Easement acres for the 145' pool would be 3,483 acres more than the 135' pool. The area covered and the value of the corresponding easements are shown below.

<u>ITEM</u>	<u>145'</u> ^{1/}	<u>137'</u> ^{1/}	<u>135'</u> ^{1/}
Lands	\$ 703,000	\$ 703,000	\$ 703,000
Flowage Easements (Easement Acreage)	2,557,000 (3,811 ac)	574,000 (763 ac)	227,000 (328 ac)
Contingencies	815,000	319,000	232,000
Acquisition Costs	126,000	126,000	126,000
TOTAL	\$4,201,000	\$1,722,000	\$1,288,000

^{1/} Flowage easement elevations are 3 feet above pool elevations. Item costs are rounded.

(2) Navigation locks and dams. The differences in lock and dam first costs are related to differences in the foundation and structural design associated for the varying pool heights and are shown in Table 1.

TABLE 1
POOL 5 ELEVATION
FIRST COST COMPARISON
(Oct 1981 price levels)

ITEM	135'	137'	145'
01. Lands & damages	\$ 1,288,000	\$ 1,722,000	\$ 4,201,000
02. Relocations			
.4 Railroads	0	0	0
.7 Utilities	182,000	182,000	182,000
04. & 05. Nav. lock and dam	105,966,000	108,927,000	121,529,000
08. Access road	889,000	889,000	889,000
09. Channels & canals	59,337,000	60,162,000	63,806,000
11. Levees	0	0	430,000
14. Rec. facilities	11,660,000	11,660,000	11,660,000
18. Cultural resources	15,000	15,000	15,000
19. Bldgs, grds, util.	820,000	820,000	820,000
20. Permanent Op. Equip.	123,000	123,000	123,000
Subtotal	\$180,280,000	\$184,500,000	\$203,655,000
30. Engineering Design	22,355,000	22,355,000	22,355,000
31. Supervisor & Administration	12,135,000	12,135,000	12,135,000
Navigation Aids	<u>827,000</u>	<u>827,000</u>	<u>827,000</u>
TOTAL	\$215,597,000	\$219,817,000	\$238,972,000

TABLE 2
 Remaining Annual Benefits (\$ x 1000)
 Red River Waterway Project
 Mississippi River to Shreveport, LA

Benefits Category	PLAN		
	B-1 Pool 5 @ 135'	B-1 Pool 5 @ 137	B-1 Pool 5 @ 145'
1. Navigation	61,821	61,821	61,821
2. Damages prevented by bank stabilization			
a. Levees	1,586	1,587	1,613
b. Utility & trans- portation facilities	4,386	4,390	4,465
c. Cropland	1,672	1,588	1,113
3. Intensification	664	632	507
4. Inundation reduction	151	139	69
5. Reduced maintenance on revetments	2,143	2,145	2,182
6. Security against levee crevasses	197	197	201
7. Irrigation	20	20	20
8. Reduced cost of M&I Water Supply	28	28	28
9. Reduced sedimentation	115	115	117
10. Fish and Wildlife	599	611	658
11. Recreation	6,300	6,300	6,300
12. Employment	12,482	12,808	12,974
13. Wildlife mitigation	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Total annual benefit:	<u>92,164</u>	<u>92,381</u>	<u>92,068</u>
Hydropower benefits, Pool 5	<u>1,988</u>	<u>3,224</u>	<u>5,547</u>
Total annual benefits: (w/hydropower Pool 5)	<u>94,152</u>	<u>95,605</u>	<u>97,615</u>

Table 3
 Remaining Annual Charges & Excess Benefits
 Red River Waterway
 Mississippi River to Shreveport, LA

Item	Remaining Annual Charges		
	Plan		
	B-1 Pool 5 @ 135' (000)	B-1 Pool 5 @ 137' (000)	B-1 Pool 5 @ 145' (000)
Gross Investment	\$1,500,074	\$1,505,459	\$1,527,235
<u>Annual Charges</u>			
Interest	48,753	48,927	49,634
Amortization	10,107	10,142	10,288
Operation and Maintenance	10,392	10,392	10,531
Replacements	224	224	224
Fish and Wildlife losses	33	34	39
Groundwater losses	830	831	923
Total annual charges:	\$ 70,339	\$ 70,550	\$ 71,639
Hydropower Charges	1,493	2,487	3,978
Pool 5			
Total annual charges:	\$ 71,832	\$ 73,037	\$ 75,617
<u>Excess Benefits</u>			
	B-1	B-1	B-1
	Pool 5 @ 135'	Pool 5 @ 137'	Pool 5 @ 145'
Total Annual Benefits	\$ 94,152	\$ 95,605	\$ 97,615
Total Annual Charges	71,832	73,037	75,617
Excess Benefits	\$ 22,320	\$ 22,568	\$ 21,998

(3) Channels and canals. The difference in these costs is related to the differences in design of river training works to accommodate the pool alternatives.

(4) Levees. The 145-foot pool would require some levee modification because the pool will be against the riverside slope in some locations.

c. Other costs.

(1) Wildlife losses. Wildlife losses generally increase as the amount of land required for project implementation increases.

(2) Groundwater. Raised groundwater will result in the reduction in agricultural yields on some lands along the pool reach. Severe impacts to 50 acres of intermediate trees is expected for the 145' pool. The groundwater costs increase with increasing pool level.

(3) Maintenance dredging. Estimates of annual maintenance dredging for each elevation show that annual dredging requirements for the 145' and 137' pools are negligible. For the 135' pool, dredging required annually is estimated to be 9,000 cubic yards. These estimates are computed for comparative purposes and indicate that the maintenance dredging decreases with increasing pool elevation. The actual maintenance dredging will be based on the justified needs for navigation in accordance with Federal policy. Although maintenance dredging costs decrease with increasing pool elevations, overall operation and maintenance costs are slightly higher for increasing pool elevations because a greater amount of channel stabilization works are required for the higher pools.

(4) Hydropower. Hydropower is not an authorized purpose for the Red River Waterway project. However, it is set forth in the authorizing report that the potential for hydropower development be analyzed at each lock and dam site. Studies conducted by the Federal Energy Regulatory Commission indicate that hydropower development at locks and dams is feasible and such can be expected. The first costs shown in Table 4 were derived from estimates prepared by the Federal Energy Regulatory Commission and were updated by the Corps of Engineers to October 1981 price levels. These estimates are based on the hydropower unit which will provide the greatest net benefit over cost for the pool elevation considered. Annualized hydropower costs are shown in Table 4.

d. Summary of analysis of quantifiable factors. Tables 1, 2, and 3 present the results of the analysis. These results indicate that the 145-foot pool has a higher first cost than the lower pool elevations. The remaining annual benefits for the Mississippi River to Shreveport reach are shown in Table 2 for each of the Pool 5 elevations under study. In addition, the annual hydropower benefits for each Pool 5 elevation are included in the analysis. Table 3 summarizes the remaining annual charges and the excess benefits for the project for each Pool 5 elevation. The results of this analysis indicate that the excess benefits for each Pool 5 elevation alternative are generally equal.

e. Other factors.

(1) Navigation, El. 145 pool. This pool, with modest additional dredging over that shown in the comparative analysis, would provide a dependable channel as far upstream as mile 286.3, or 2.7 miles upstream from the location where the authorized navigation channel to Daingerfield (an excavated canal) leaves the Red River channel. Thus the 145-foot pool would provide increased opportunities for future development as compared with the 135-foot and 137-foot pools. The 145-foot pool would, for example, provide the opportunity for navigation to port sites 1 and 2 at miles 284 and 281.5., respectively, which were studied for the Caddo-Bossier Port Commission. Also, this pool elevation would provide several other opportunities for port development upstream from the selected port site at mile 214(realined miles). In response to the public meetings on 19 and 20 May 1980, five firms requested that pool elevation 145 be selected because they were planning to establish port sites in Shreveport above mile 214.

The 145' pool would be more favorable for development and operation of the planned Caddo-Bossier Port (Site 4 at river mile 214), and, as a result, this pool is favored by the Caddo-Bossier Port Commission. The advantages of the

145-foot pool to this port include a lesser difference between pool level and pier deck, and lesser costs for development and subsequent maintenance of a proposed slackwater harbor for this port.

El. 182, and the 2 percent flow line is El. 159. The tabulation below gives the heights of all towboats on the Mississippi-Gulf Intracoastal Waterway systems which are powerful enough to use the Red River Waterway. With low steel at 182, and an allowance of 5 feet for safe passage, at least 352 of the 883 towboats could pass under the bridges at pool elevation 145. None of the towboats could pass under the bridge at pool elevation 152, which would be equalled or exceeded 8 percent of the time. Therefore, limited navigation would be possible under the railroad bridges for about 92 percent of the time for at least 352 towboats. See attached stage duration curve for more information (Plate 2). Early replacement of these bridges is, therefore, not mandatory.

TOWBOAT STATISTICS

	Number	Height
	182	25
	170	30
	224	35
	179	40
	111	50
	17	More than 50
TOTAL	883	

(2) Hydropower. Hydropower is not a specifically authorized purpose of the Red River Waterway project. However, the authorizing document is explicit in requiring that the potential for hydropower development be analyzed at each lock and dam site subsequent to authorization. Preliminary studies conducted by the Federal Energy Regulatory Commission (FERC) subsequent to authorization indicate that hydropower development at Pool 5 is economically feasible with each pool elevation. The first costs shown in Table 4 were derived from estimates prepared by the FERC and were updated by the Corps of Engineers to October 1981 price levels. These estimates are based on the hydropower unit which will provide the greatest excess benefits for the pool elevation in question. The value of hydropower produced with the 145' pool is more than twice as great as that with the 135' pool, and the 145' pool gives a higher benefit/cost ratio for hydropower.

TABLE 4
POOL 5 ELEVATION
HYDROPOWER COMPARISON

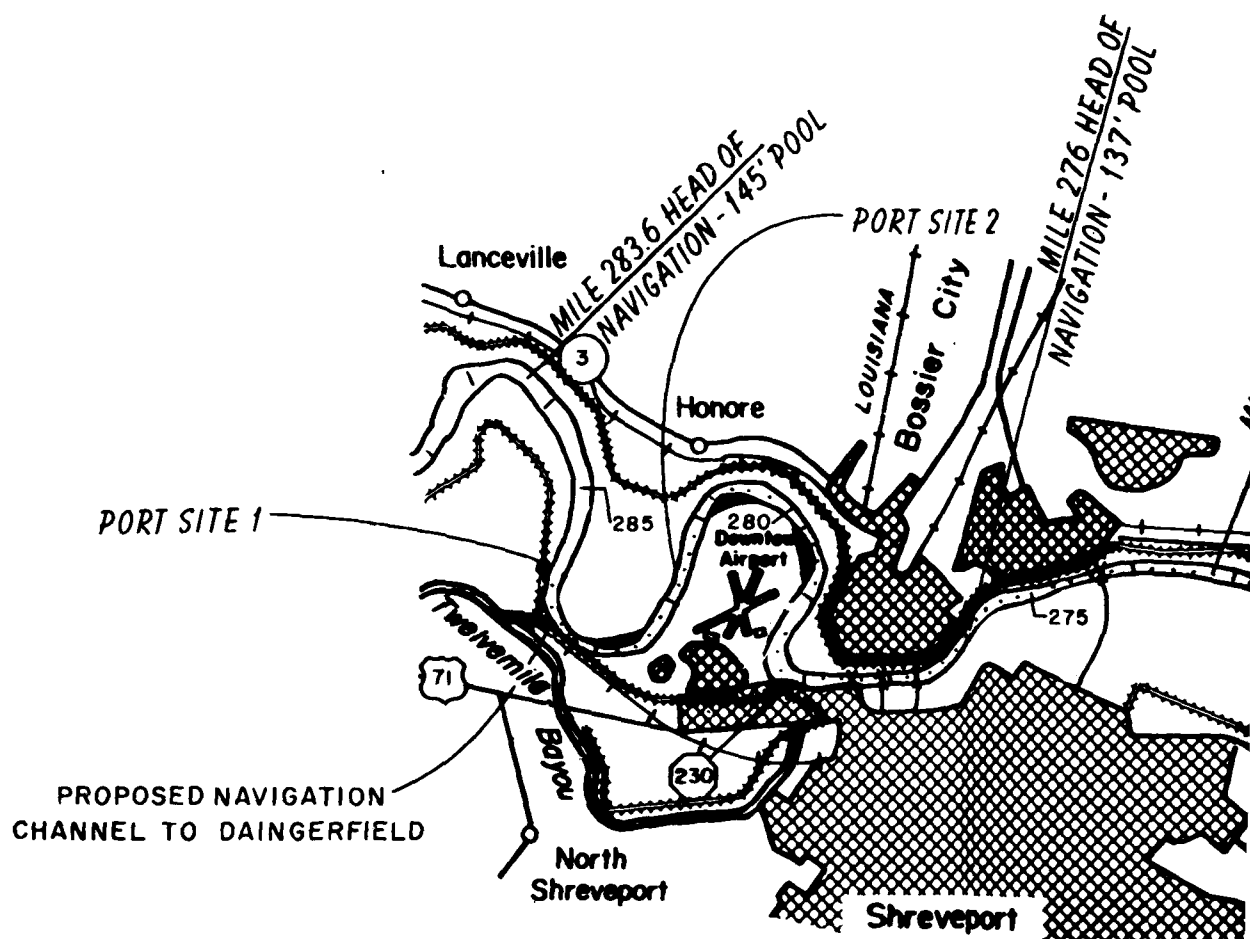
ITEM	135'	137'	145'
Investment	\$16,820,000	\$28,034,000	\$44,853,000
Average annual cost	1,493,000	2,487,000	3,978,000
Average annual benefit	1,988,000	3,224,000	5,547,000
Benefit/cost ratio	1.3	1.3	1.4
Net benefits	495,000	737,000	1,567,000

(3) Views of the public. Meetings were held in Shreveport and Alexandria on 19 and 20 May 1980 to allow the public to express their views concerning the alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5. The major concern expressed at these meetings related to the selection of a pool elevation for Lock and Dam No. 5. Approximately 70 written statements about the overall study of plan formulation and site selection were submitted during or after these meetings. Of this total, 36 were in favor of the 145' pool to provide navigation upstream to Shreveport. Of this 36, there were 14 representing Texas; 6 representing Arkansas; 1 representing Oklahoma; and 15 representing Louisiana. The type of representation included local government, chamber of commerce, port commissions, levee boards, economic development districts and private businesses interests. There were 5 statements submitted in favor of pools lower than 145'. Those favoring a lower pool were primarily landowners whose property would be adversely impacted by the higher pool.

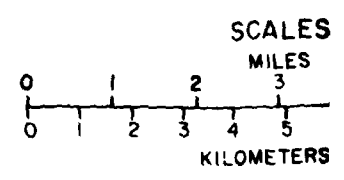
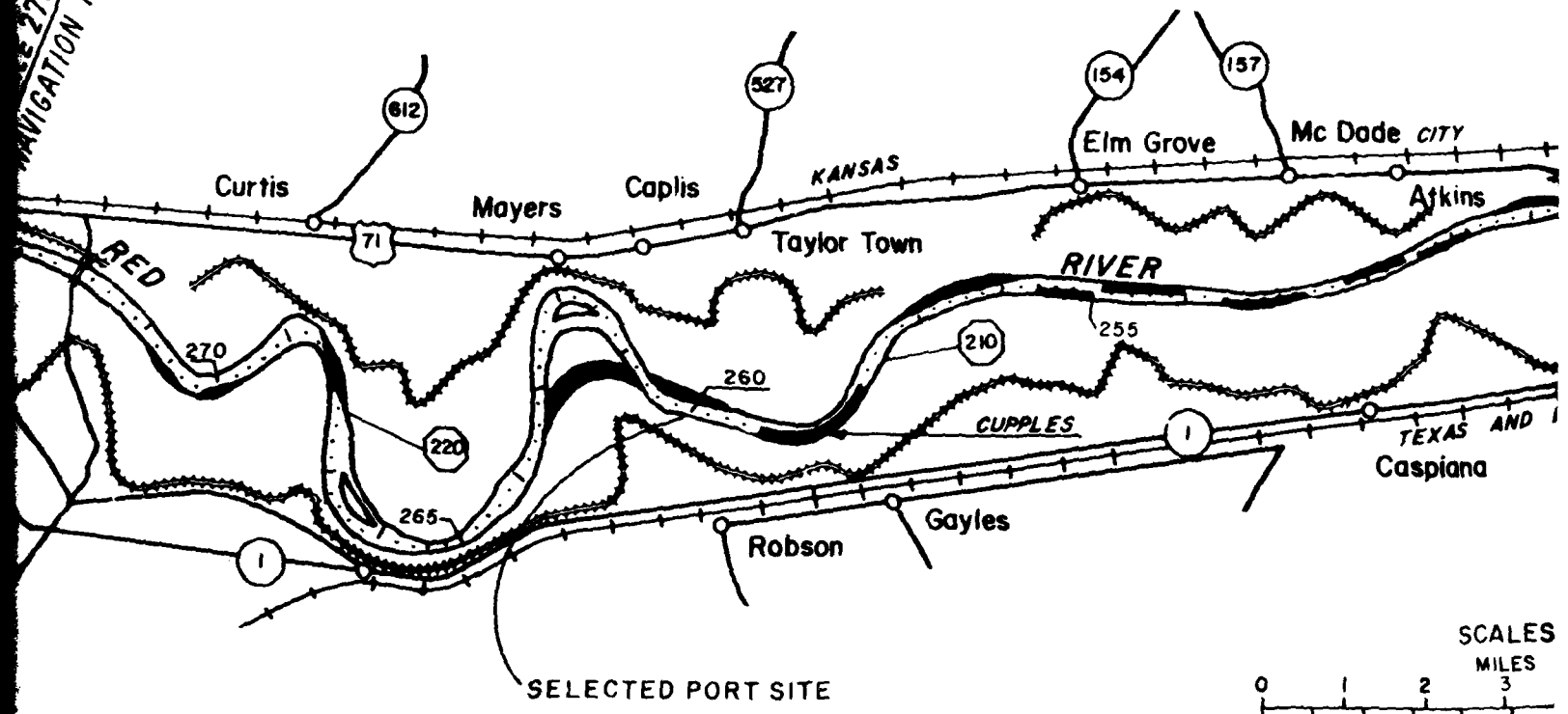
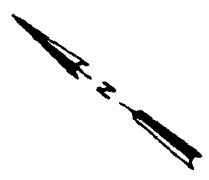
(4) Political views. To date, the views of all political interests (Federal, state, and local) in the states of Louisiana, Texas, Arkansas and Oklahoma have been overwhelmingly in favor of the 145' pool.

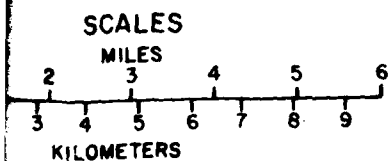
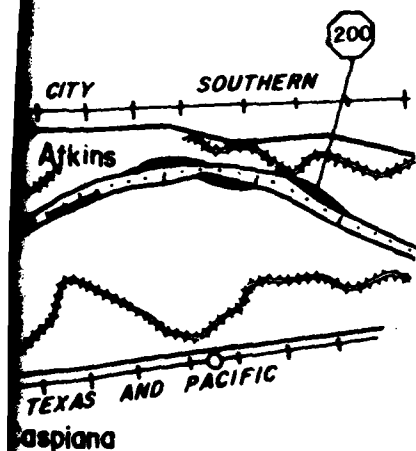
5. Conclusions. Based on the foregoing analyses, the following conclusions are warranted:

- a. Use of a pool elevation of 145 feet above Lock and Dam No. 5 will provide more waterfront mileage and access to additional port sites for possible future water transportation/dependent development than will the lower pools.
- b. Use of a pool elevation of 145 feet will provide the opportunity to maximize hydropower development. While installation of hydropower is economically feasible with each of the three pools, the excess benefits for hydropower with the higher pool would be greater than with the lower pools.
- c. Local interests in all categories obviously perceive major advantages in the 145' pool.
- d. Environmentally, the 145' pool would generate increased fishery benefits at the expense of lost wildlife habitat. The latter loss is susceptible to mitigation.
- e. Adverse groundwater effects would be greater with the 145' pool, and would reflect on estimated 2 percent reduction in the annual crop value in Pool 5, as compared with an estimated 0.9 percent reduction for the 135' pool.
- f. The 145' pool would greatly facilitate extension of future navigation to Daingerfield, should Congressionally mandated studies demonstrate such extension to be feasible and desirable.
- g. The 145' elevation will be used as the design elevation for this report.



HEAD OF
NAVIGATION 135' POOL





RED RIVER WATERWAY, LA., TEX., ARK., & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

**GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2**

POOL 5 STUDY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

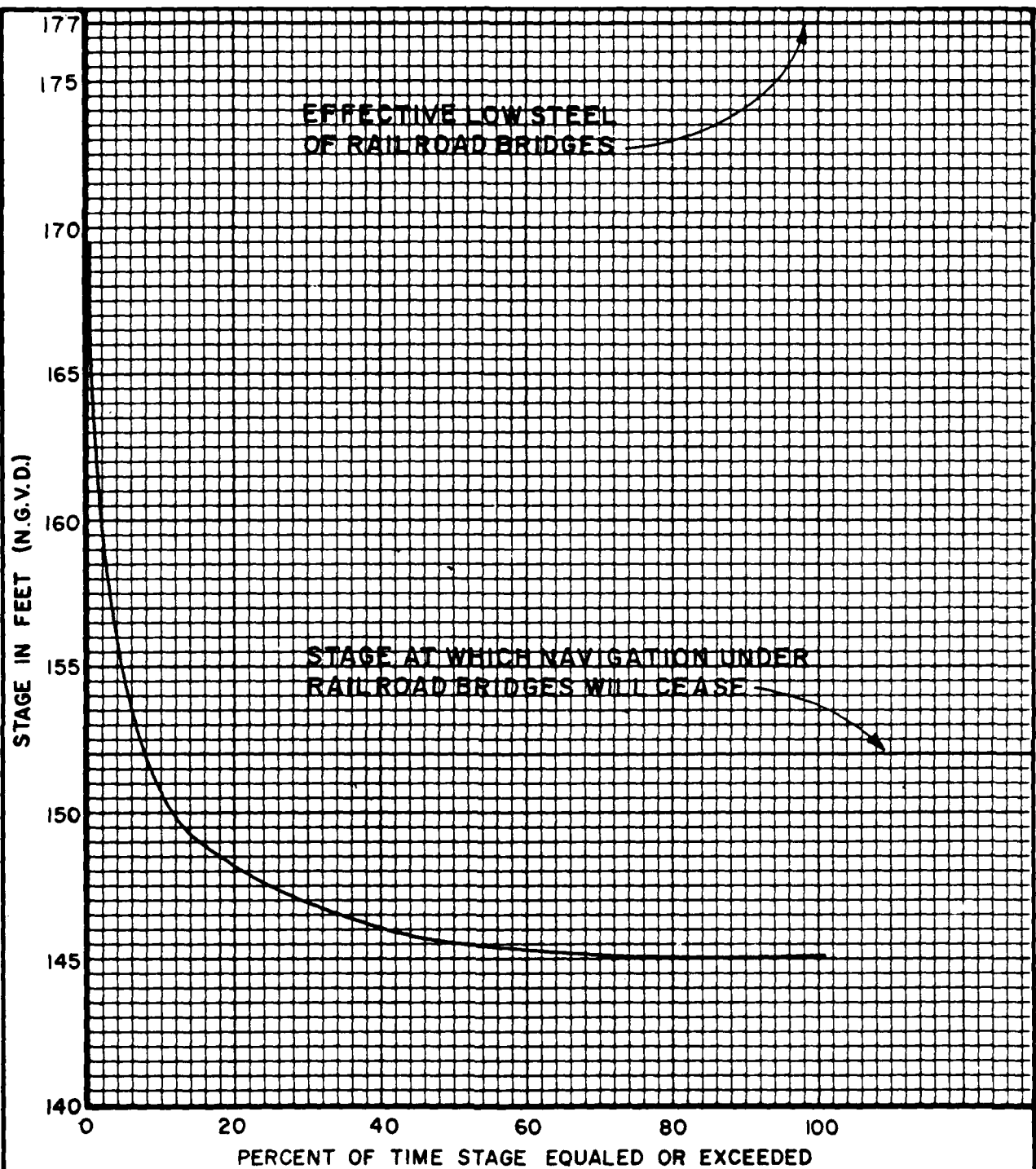
JAN. 1981

FILE NO. H-R-29230

APPENDIX A

PLATE 1

3



RED RIVER WATERWAY, LA., TEX., ARK., AND OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

STAGE DURATION SHREVEPORT
POST PROJECT, PLAN B-1

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JAN. 1981

FILE NO. H-2-29230

APPENDIX A

PLATE 2

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX B
SITE GEOLOGY

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX B
Site Geology

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT

APPENDIX B
Site Geology

1. Geology and soils. All of the sites considered for navigation structures lie within the Gulf Coastal Plain Physiographic Province, a region of low relief bordering the Gulf of Mexico. Within this Province, the Red River Basin contains alluvial sediments of Holocene age composed of sands, silts, and clays; terrace deposits of Pleistocene age composed of silts and stiff clays; and hills composed of sediments of Tertiary age which flank the valley throughout most of its length. The presence of numerous sand and silt layers in the subsurface at the proposed sites, indicates that seepage and uplift problems may be encountered. In addition, at some proposed sites, the underlying Tertiary may require special design to minimize the slaking characteristics of the material. Elevations range from about 35 feet above mean sea level (NGVD) in the southeastern alluvial sections to more than 400 feet NGVD in the more northerly portions of the Basin. Maximum local relief is confined to about 15 to 25 feet within the floodplain but reaches 60 feet or more in the adjacent uplands. Numerous sources of natural sand and gravel are available in the basin, but sources of riprap and crushed stone for aggregate are almost totally absent.

2. Lock and Dam No. 3.

a. General. Two site locations have been considered for Lock and Dam No. 3. They are the B-1 site at mile 141, right descending bank, and the B-3M site at mile 137, right descending bank, both being upstream of Boyce, Louisiana. Subsurface investigations were accomplished through the boring, logging, and testing of numerous undisturbed and general type borings at both sites. In addition, geologic data from other sources was used to determine geologic conditions at the two sites.

b. Site Geology B-1 Plan.

(1) Surficial Geology. This site is located in the floodplain at river mile 141 on the right descending bank of the Red River approximately 1 mile west of Colfax, Louisiana (see plate 1). The surface is characterized by natural levee and point bar deposits. Additionally, such other physiographic features as back swamps, and abandoned channel courses are present within the general area of the project. Relief is slight with

elevations in the area averaging approximately 95' NGVD. The highest elevations are located on the natural levee ridges.

(2) Subsurface Geology. The subsurface geology at the site was determined by making 42 general type and 5 undisturbed borings. As shown on plates 2 and 3, the subsurface consists generally of Holocene topstratum and substratum deposits underlain by the Tertiary aged Catahoula Formation. The Holocene deposits, averaging 120' in thickness, consist of approximately 60' of topstratum and 60' of substratum. The substratum, composed of coarse to fine sand, is in direct contact with the underlying Tertiary and the overlying topstratum which consists of fine grained silts and clays. The underlying Tertiary is composed of claystone, siltstone, sandstone, and unconsolidated soils, and is encountered at an average elevation of -25' NGVD. Due to the nature of the Holocene deposit, particularly the granular substratum, direct hydraulic influence by the Red River can be expected. The Tertiary deposits have several lenses and beds of coarse grained deposits, which may be hydraulically connected to the Holocene. Highly saline groundwater concentrations are in evidence from initial sampling within the Tertiary.

c. Site Geology B-3M Plan.

(1) Surficial Geology. The project site is located in Rapides Parish, at Red River mile 137, on the right descending bank, about 3 miles south of Colfax, Louisiana (see plate 4). It lies within the southern hills section of the Central Gulf Coastal Plain. Specifically, the site is located in the Kisatchie Hills on the western edge of the Red River Alluvial Valley, and traverses floodplain deposits of Holocene age and terrace deposits of Pleistocene age. The entire area is underlain by fluvio-deltaic deposits of Tertiary age. Elevations in the vicinity range from about +120' NGVD west of the alignment to about +85' NGVD across the river on the left bank. Local relief is less than 5 feet on the floodplain and about 30 feet on the moderately dissected adjacent terrace. Drainage is toward the Red River and then southeast through the Atchafalaya River to the Gulf of Mexico. The surficial deposits of the floodplain consist of point bar and back or rim swamp deposits.

(2) Subsurface Geology. The subsurface was investigated by making over 100 borings at the B-3M site. As shown on plates 5 and 6, the subsurface geology is composed generally of Pleistocene and Tertiary deposits. The Pleistocene consists generally of a fine grained topstratum of medium to hard clay, underlain by a granular substratum of sand, becoming gravelly in some areas. The Tertiary consists primarily of claystone with lenses of cemented and uncemented silts and sands. Probable hydraulic influence from the Red River can be expected at the B-3M site due to the proximity of the Red River and the granular nature of the deposits. Groundwaters may contain high saline concentrations in various Tertiary aquifers, although Tertiary influence with respect to the Pleistocene groundwater has not been determined. Highly saline groundwater concentrations are in evidence from initial sampling taken from within an areally limited Tertiary aquifer located beneath the structure at an average depth of 200 feet NGVD.

d. Conclusions. Geologic conditions are very different at the two sites. At the B-3M site, the outcropping Tertiary offers a good firm foundation for vertical loads, but its low resistance to horizontal loads would result in a relatively massive dam structure. The B-1 site can accommodate either a pile or soil founded structure. At the B-3M site, dewatering would be required of Holocene, Pleistocene, and Tertiary sands; however, no major problems are foreseen. Dewatering the Holocene at the B-1 site will present problems due to the direct influence of the Red River and the highly permeable nature of the substratum sand. All dewatering problems are considered surmountable. From a geologic standpoint the B-1 site is the better of the two.

3. Lock and Dam No. 4.

a. General. Two sites have been subjected to a thorough subsurface investigation to determine a suitable site for Lock and Dam No. 4. One, the B-3M plan site, is located on the right descending bank at river mile 185. The other, the site for the B-1 plan, is located at river mile 206 on the left descending bank. Information obtained from numerous borings and other geologic data sources was used in the investigation of the geology at both sites.

b. Site Geology B-1 Plan.

(1) Surficial Geology. The B-1 site lies on the left descending bank of the Red River at river mile 206 within a large bend in the river (see plate 7). Relief and elevation are lower at the tip of the point of the bend and increase inland. Surface elevations vary from approximately 115 NGVD at the river's edge to 160' NGVD on the terraces adjacent to the Red River floodplain. Dominant surficial features at the site are similar to that of the B-3M site and consist of point bars, low back river swamps, swags and swales and abandoned channel cuts.

(2) Subsurface Geology. Twenty-four borings were made at the B-1 site in support of the subsurface investigation program and 20 additional borings are scheduled for fall 1980. Generally, as shown on plates 8 and 9, the site consists of 40' to 100' of Holocene alluvium underlain by Tertiary sediments. The Holocene overburden material consists generally of a silt and clay sequence overlying a sand and gravel layer. Beneath the Holocene material is the Tertiary age Naborton Formation which consists of interbedded, soft claystones, siltstones, clayey sand layers, and sandy claystones with occasional thin lignite lenses. Groundwater quantities in the Holocene overburden range from moderate to large due to the thick sand sequence. Groundwater in the Tertiary sediments should exist only in small quantities except in isolated sand pockets where quantities may be greater. Several deep borings will be made at the B-1 site to determine if any aquifers exist in the upper Tertiary sequence that may affect dewatering or uplift stability.

c. Site Geology B-3M Plan.

(1) Surficial Geology. The B-3M site lies on the right descending bank of the Red River at river mile 185 near the mouth of Bayou Pierre (see plate 10). Relief is slight and elevations average approximately 100' NGVD. The site lies on the floodplain of the Red River and dominant surficial features consist of point bar deposits, low back river swamps, swags and swales, and abandoned channel cuts. Just to the south of the site are Tertiary aged uplands of the Grand Gulf Group. These hills have been highly dissected and range in elevation from 100 to 250 feet NGVD.

(2) Subsurface Geology. Approximately 56 borings were made at the B-3M site in support of the subsurface investigation programs. Generally, as shown on plates 11 and 12, the subsurface consists of 60 to 100 feet of Holocene point bar silts with some clay grading down to substratum gravely sands. Underlying the Holocene deposits are Tertiary deposits. The Tertiary deposits consist of 60 to 80 feet of thick bedded silts and claystones, underlain to an undetermined depth by more thinly bedded layers of silts and claystones containing several continuous layers of lignite and/or lignitic clay. Groundwater in the overburden material has a direct hydraulic connection to the Red River and piezometric levels fluctuate with the river stage. Groundwater in the upper Tertiary sediments should exist in only small amounts due to the low permeabilities of the siltstones and claystones encountered. However, high saline water was encountered in one boring within the Tertiary sediments, so the possibility of additional aquifers within the upper 100 to 150 feet of the Tertiary must be considered.

d. Conclusions. At the B-1 site, both the lock and dam structure would be founded on the Tertiary formation. At the B-3M site, the lock would be founded on the Holocene and the concrete dam would be founded on the Tertiary. Based on geologic considerations, neither site is clearly superior to the other for location of Lock and Dam No. 4. The B-3M site has several thick lignite beds in the Tertiary which could cause stability problems. In addition, the presence of a saline aquifer will increase dewatering costs. The B-1 site may also present foundation dewatering problems due to the presence of large amounts of sand in the overburden and sandy pockets and layers in the Tertiary material. However, the B-1 site is better suited for the use of a more economical slurry trench for dewatering purposes because of the relative thinness of the Holocene alluvium.

4. Lock and Dam No. 5.

a. General. Two sites have been investigated as possible locations for Lock and Dam No. 5, the B-1 plan site, located at river mile 250 and

the B-3M plan site at river mile 243, both on the Red River floodplain. Boring data and geologic file data were used in the investigation of the geology of both sites.

b. Site Geology B-1 Plan.

(1) Surficial Geology. The B-1 site is located at river mile 250, about 15 miles southeast of Shreveport, Louisiana (see plate 13). The surface is characterized by Holocene natural levees, point bar, and some abandoned channel deposits. Relief is slight with elevations in the area averaging about 140' NGVD.

(2) Subsurface Geology. Subsurface investigation at the site consisted of 38 borings as shown on plate 13. Generally, as shown on plates 14 and 15, the subsurface consists of Holocene natural levee deposits of silty sand, silt, and silty clay, ranging in thickness from 5 to 10 feet. The natural levee deposits are underlain by Holocene point bar material, silt, silty sand, and fine-to-medium sand, with occasional layers of soft clay. The point bar deposits generally coarsen with depth, often containing gravel in the lower portions. The Holocene deposits are underlain, at about elevation +70.0' NGVD, by Tertiary material consisting of interbedded claystone, sandstone, and siltstone, with occasional thin layers of lignite and/or lignitic clay. Groundwater levels in the permeable Holocene material will vary with Red River stage fluctuations. Based on experience at Lock and Dam Nos. 1 and 3 and on the indication of direct contact between Holocene and Tertiary sands, the possibility exists for water from the Tertiary strata to enter Holocene material. The possible presence of saline water in the Tertiary is indicated in the State Water Resources Bulletin No. 1 and others. Several deep borings will be made to determine if any aquifers exist in the upper Tertiary beds that might cause dewatering and/or uplift problems.

c. Site Geology B-3M Plan.

(1) Surficial Geology. The B-3M plan site is located at river mile 243, right descending bank, about 20 miles southeast of Shreveport, Louisiana (see plate 16). Relief is slight with surface elevations averaging about 140' NGVD. The surface is characterized by Holocene natural levee and point bar deposits and possibly some abandoned channel deposits.

(2) Subsurface Geology. The subsurface investigation at the site has consisted of approximately 30 borings, as shown on plate 16. Generally, the subsurface consists of Holocene natural levee deposits of silty sand, silt and silty clay, ranging in thickness from 5 to 10 feet, as shown on plates 17 and 18. Underlying the natural levee deposits are Holocene point bar deposits, consisting of silt, silty sand and fine-to-medium sand, with occasional layers of soft clay. The point bar deposits generally coarsen with depth, often containing gravel in the lower

portions. The Holocene sequence is underlain, at about elevation +55.0', by Tertiary material consisting of interbedded claystone, sandstone, siltstone, and lignite. A lignite layer, ranging in thickness from 1.0 foot to about 8.0 feet, exists at locations ranging from top of the Tertiary to elevation 36'. Groundwater levels in the permeable Holocene material will vary with the stage fluctuations of the Red River. The possibility exists for water (possibly saline) from the Tertiary strata to enter the Holocene material.

d. Conclusions At the B-1 and B-3M sites, the lock would be founded in the Holocene while the dam would be founded in the Tertiary. While both sites are geologically similar, the B-1 site, the top of Tertiary is about 15 feet (70 feet vs. 85 feet) higher than at the site B-3M. In addition, the larger amounts of lignite at B-3M present potential foundation stability problems. Dewatering conditions at both sites are similar. The granular nature of the point bar deposits indicate potentially high groundwater quantities in the overburden material at both sides. In addition, the potential exists at both sites for possibly saline groundwater from Tertiary strata to enter Holocene material as dewatering progresses.





BRANT
PARISH

E D

LOCK
AZ 819

R I V E R

CHART
RAPIDS
PARISH
PARISH

SCALE IN FEET
0 500 1000 1500

● 5-10 to elevation -80' NGVD
● 5-5 to elevation 80' NGVD (20' sea Turkey)

NOTES:
INSIDE THE PLAN AREA POLYCONIC PROJECTION 1927
NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS AND
LARGEST CONFORMAL CONIC PROJECTION IS SHOWN BY
DASHED TICKS
PREPARED FROM AERIAL PHOTOS FLOWN MARCH, 1979

PLAN B-1 BORING LAYOUT

2

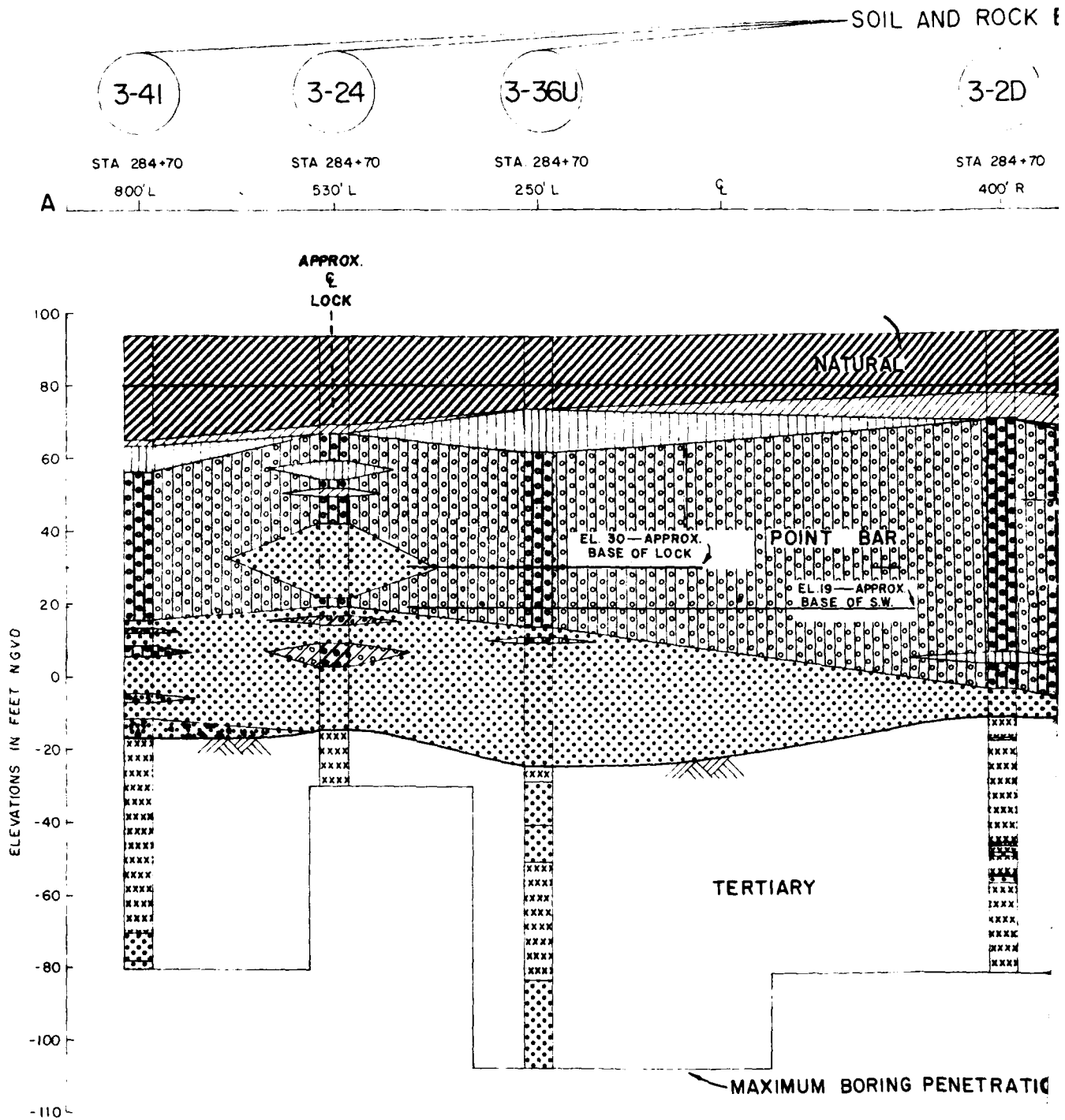
RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B-1 BORING LAYOUT, L&D 3

JANUARY 1980 FILE NO. H-2-29230

PLATE



D ROCK BORINGS

(3-2D)

3-39U

3-32

STA 284+70

STA 284+70

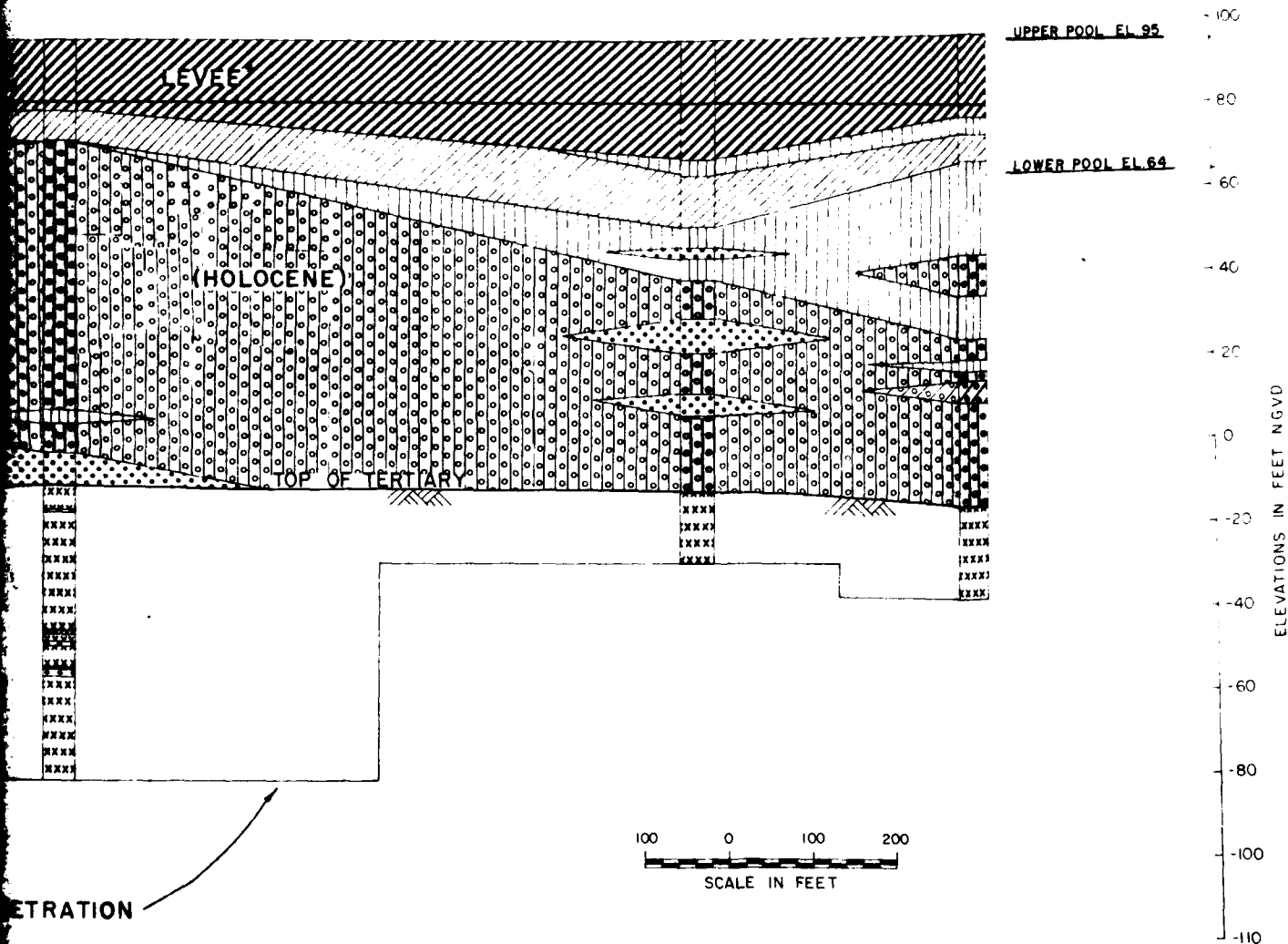
STA 284+70

400' R

1160' R

1500' R

A'

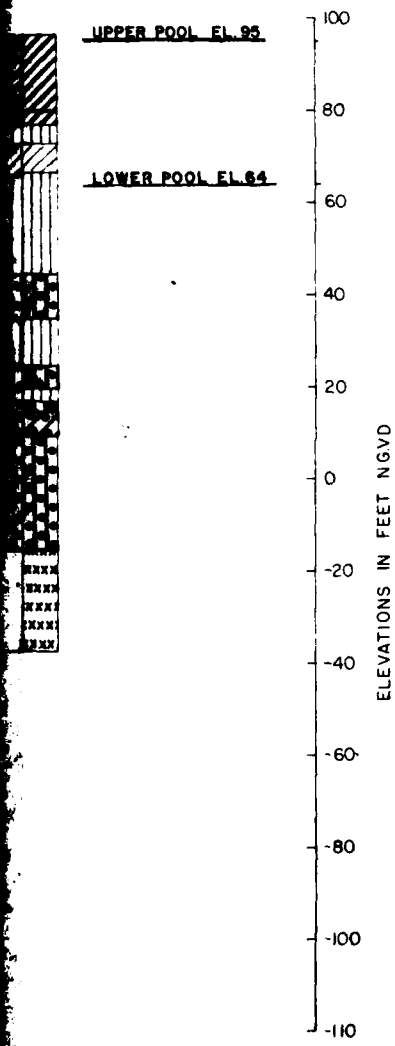


NOTE:

- *1. BASED ON REGIONAL TOPOGRAPHY
2. For boring locations see plate
3. For section location see plate

3-32

284+70
1500' R
A'



RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

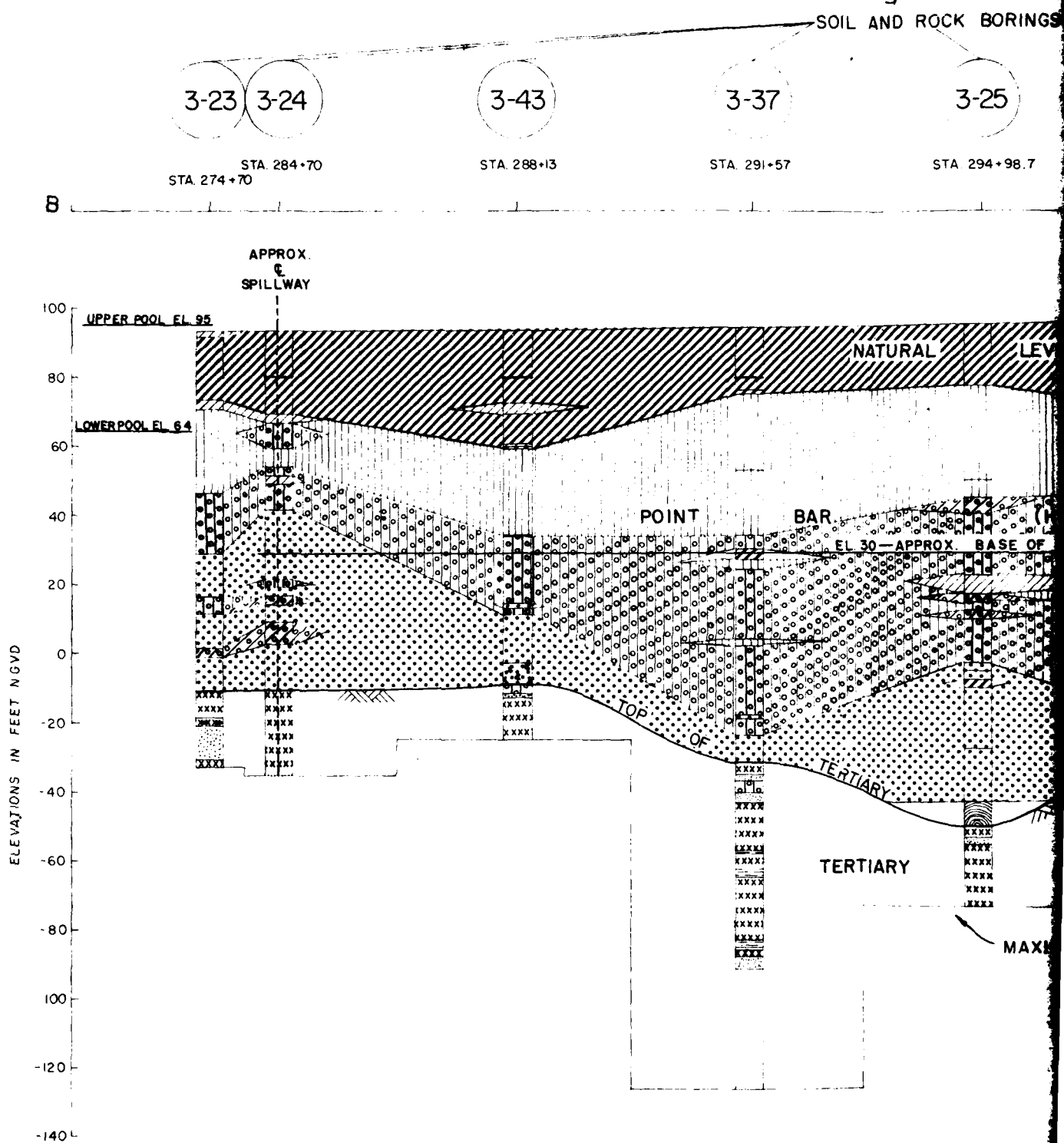
PLAN 3-1 GEOLOGIC SEC. A-A', LOTS

JANUARY 1980

FILE NO. H-2-29230

PLATE 2

3



NOTE:

1. FOR BORING

2. FOR LEGEND

SOIL AND ROCK BORINGS

3-25

STA. 294+98.7

3-44

STA. 298+33

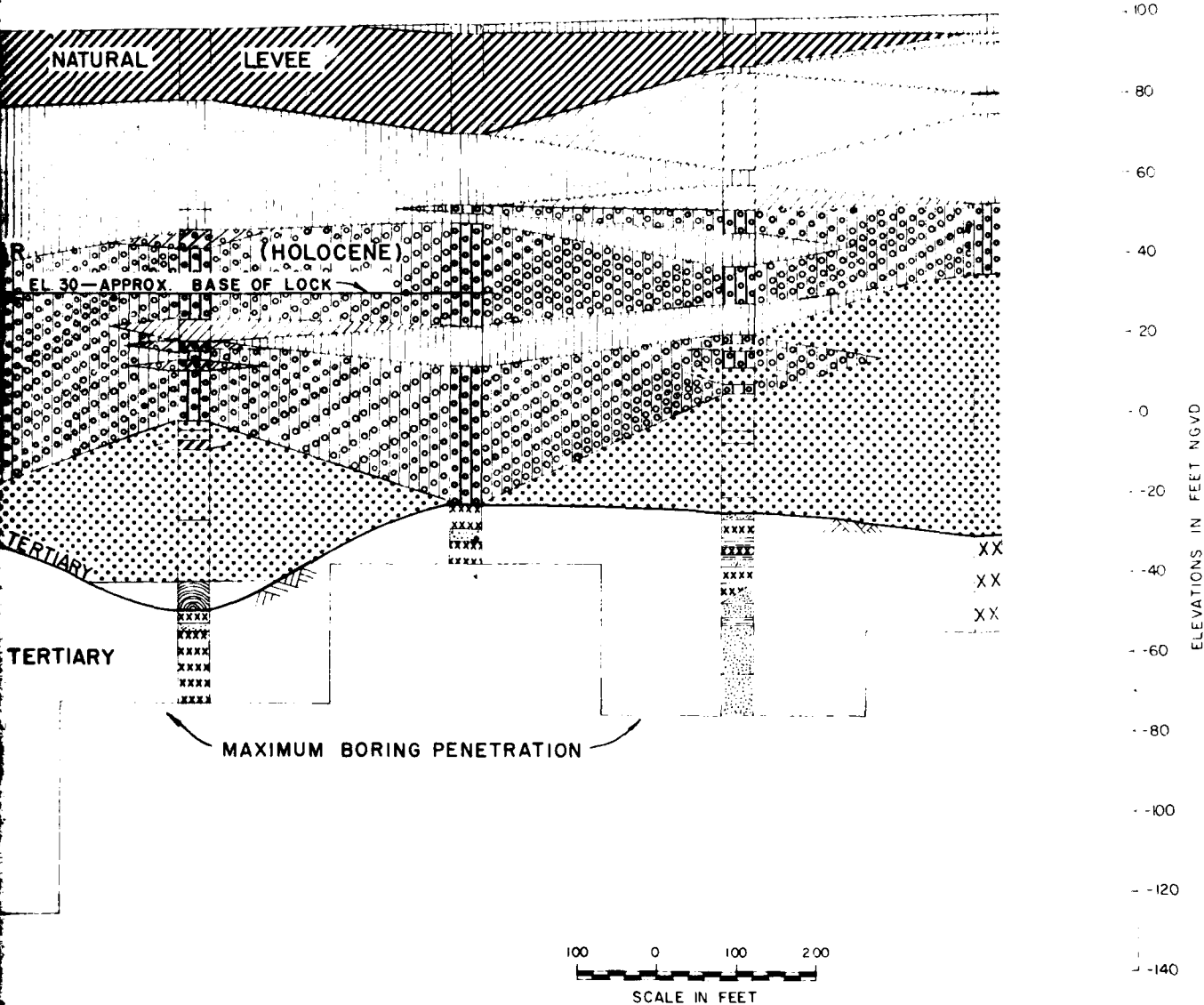
3-38

STA. 301+67

3-26

STA. 304+98.7

B'



NOTE:

1. FOR BORING AND SECTION LOCATIONS SEE PLATE 1.
2. FOR LEGEND SEE PLATE 5.

3-26

STA. 304+98.7

B'

100

80

60

40

20

0

-20

-40

-60

-80

-100

-120

-140

ELEVATIONS IN FEET NGVD

XX

XX

XX

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLANS-1 GEOLOGIC SEC. B-B', LOD 1

JANUARY 1980

FILE NO. H-2-29230

3 PLATE 3





- 3-13 (1" I.D. SPLIT- SPOON BORINGS)
- 3-8N (5" I.D. UNDISTURBED BORINGS)
- SITE 1 BORINGS (TAKEN FEB 74 - MAY 76)
- SITE 2 BORINGS (TAKEN NOV. 77 - FEB. 78)
- SITE 3 BORINGS (TAKEN JAN. 78 - FEB. 78)
- SITE 4 BORINGS (TAKEN JAN. 78 - DATE) 40,000

RED RIVER WATERWAY LA., TEX., ARK & OKLA
MISSISSIPPI RIVER TO SHREVEPORT, LA

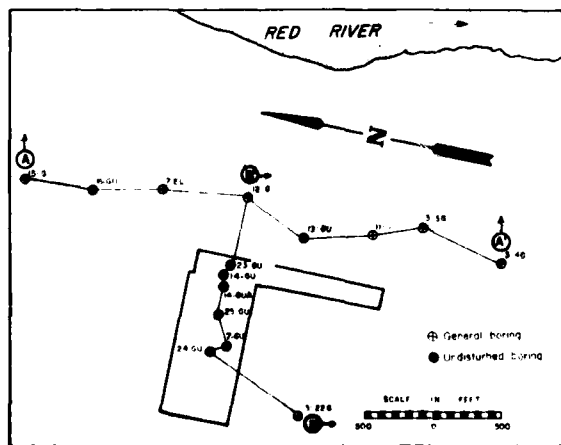
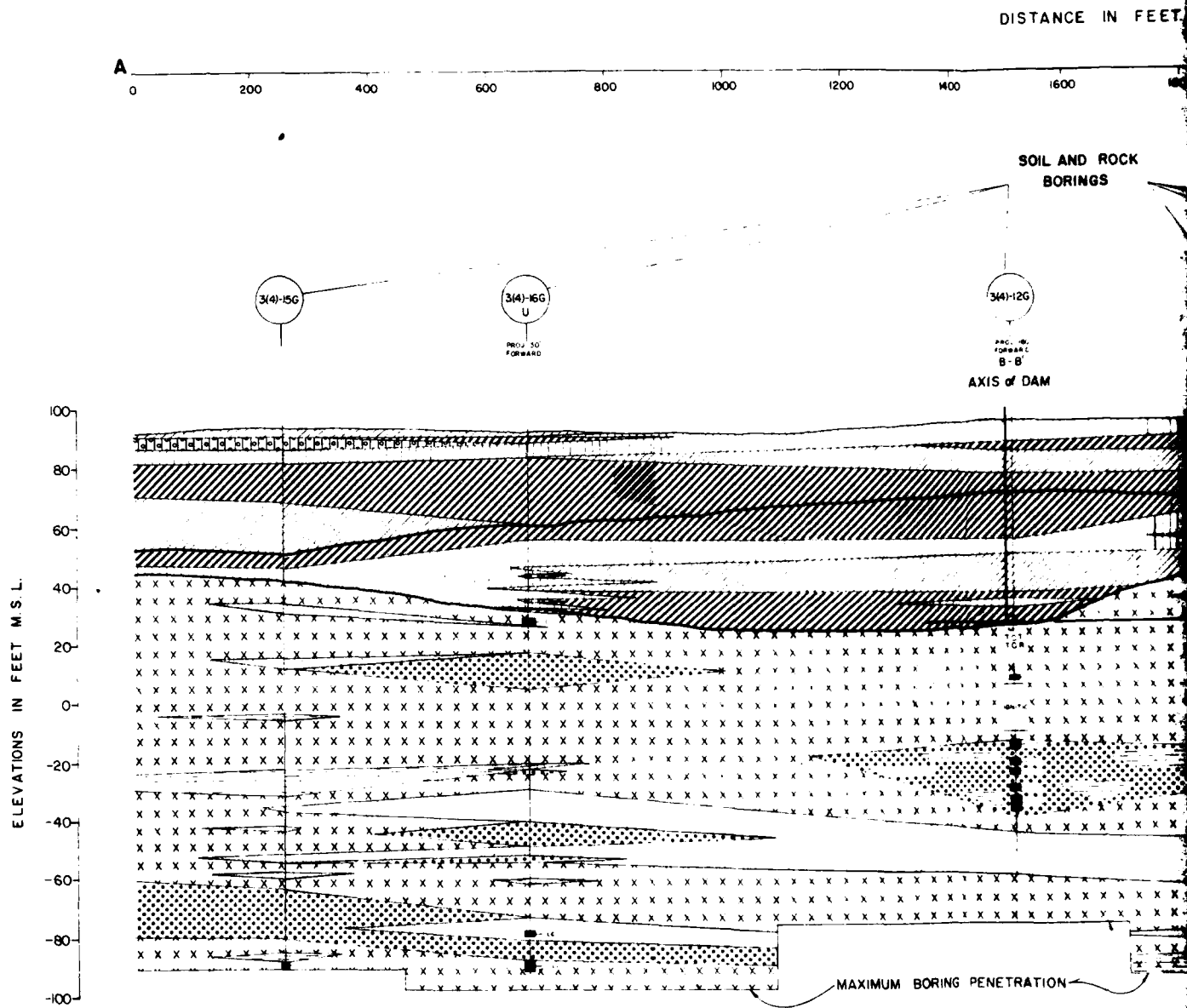
**GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2**

PLAN B-3M BORING LAYOUT, L&D 3

NOTES:
INSIDE THE PLAN AREA POLYCONIC PROJECTION-1987
NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS AND
LAMBERT CONFORMAL CONIC PROJECTION IS SHOWN BY
DASHED TICKS
PREPARED FROM AERIAL PHOTOS FLOWN MARCH 22 1978

1-250 (1" I.D. SPLIT- SPOON BORINGS)	REVISION	DATE	DESCRIPTION
3(4) 46 (1" I.D. SPLIT- SPOON BORINGS)			
3-8N (5" I.D. UNDISTURBED BORINGS)			
3-13 (1" I.D. SPLIT- SPOON BORINGS)			

JANUARY 1980 FILE NO. 1 2-29 30



DISTANCE IN FEET

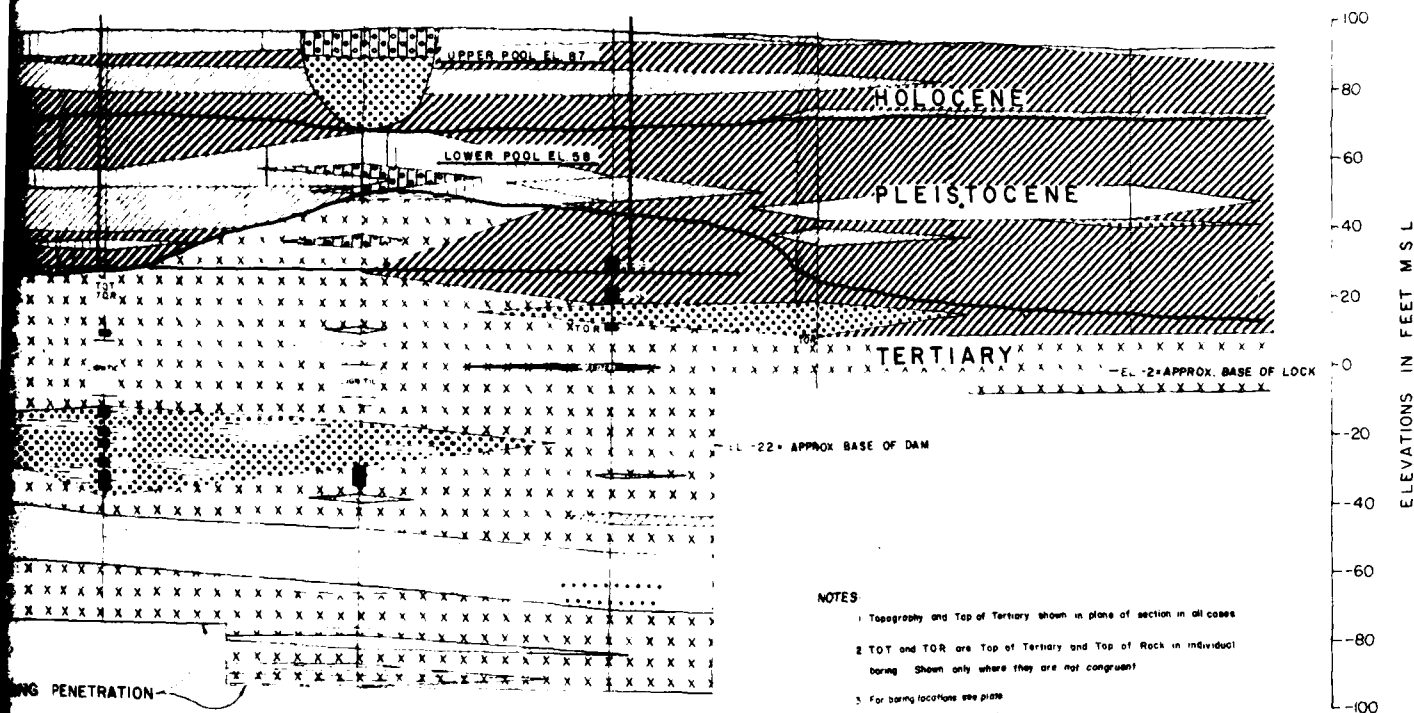
1400 1600 1800 2000 2200 2400 2600 2800 3000 3200

A'

SOIL AND ROCK
BORINGS



AXIS of DAM

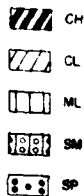


NOTES

1. Topography and Top of Tertiary shown in plane of section in all cases
2. TOT and TOR are Top of Tertiary and Top of Rock in individual boring. Shown only where they are not congruent
3. For boring locations see plate
4. For section location see plate

LEGEND

SOIL
From "Unified Soil
Classification"



ROCK
See "Section
Geology"



Symbols may be combined in cases where materials are interbedded or border line between two types.

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA

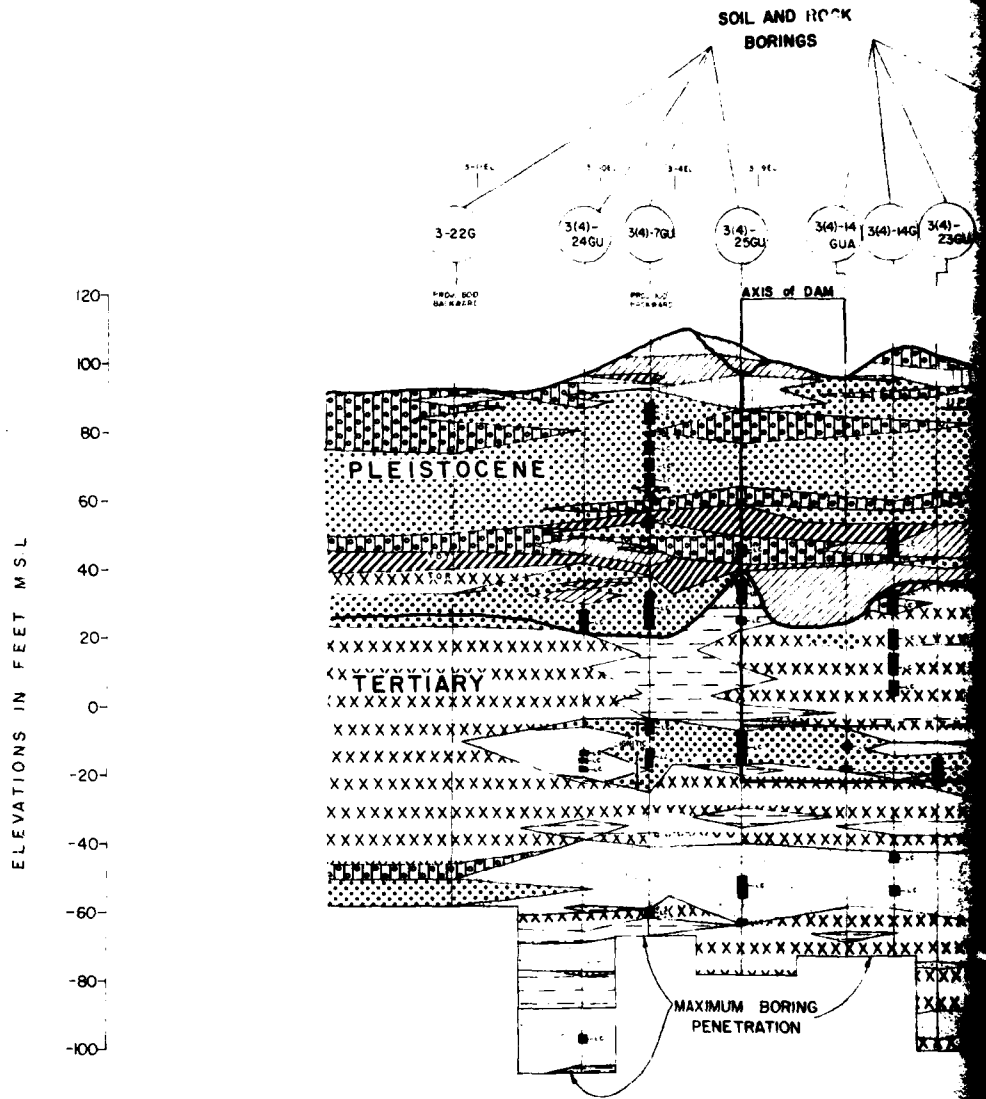
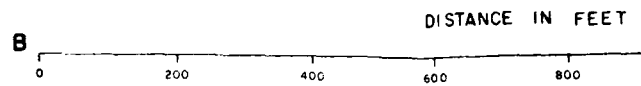
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B-3M GEOLOGIC SEC. A-A', L&D 3

JANUARY 1980

FILE NO. H-2-29230

PLATE 5



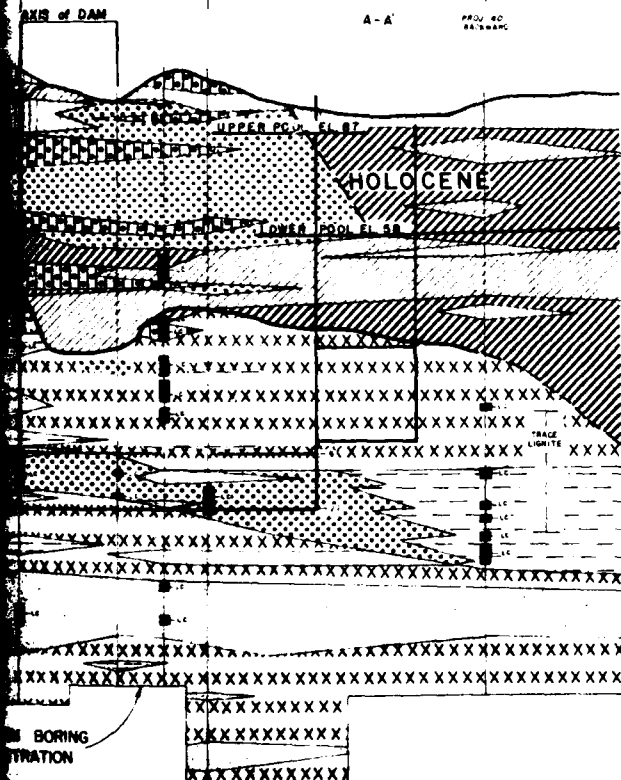
DISTANCE IN FEET

800 1000 2000 4000

B'

SOIL AND ROCK BORINGS

3(4)-M
20GU
3(4)-M
GUA
3(4)-M
23GU
3(4)-H
2G
PROJ. 40
RE. SWAMP
A-A'



120

100

80

60

40

20

0

-20

-40

-60

-80

-100

ELEVATIONS IN FEET MSL

NOTES:

1. Topography and Top of Tertiary shown in plane of section in all cases
2. TOT and TOR are Top of Tertiary and Top of Rock in individual boring. Shown only where they are not congruent
3. For legend see Plate
4. For boring locations see plate
5. For section location see plate

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA

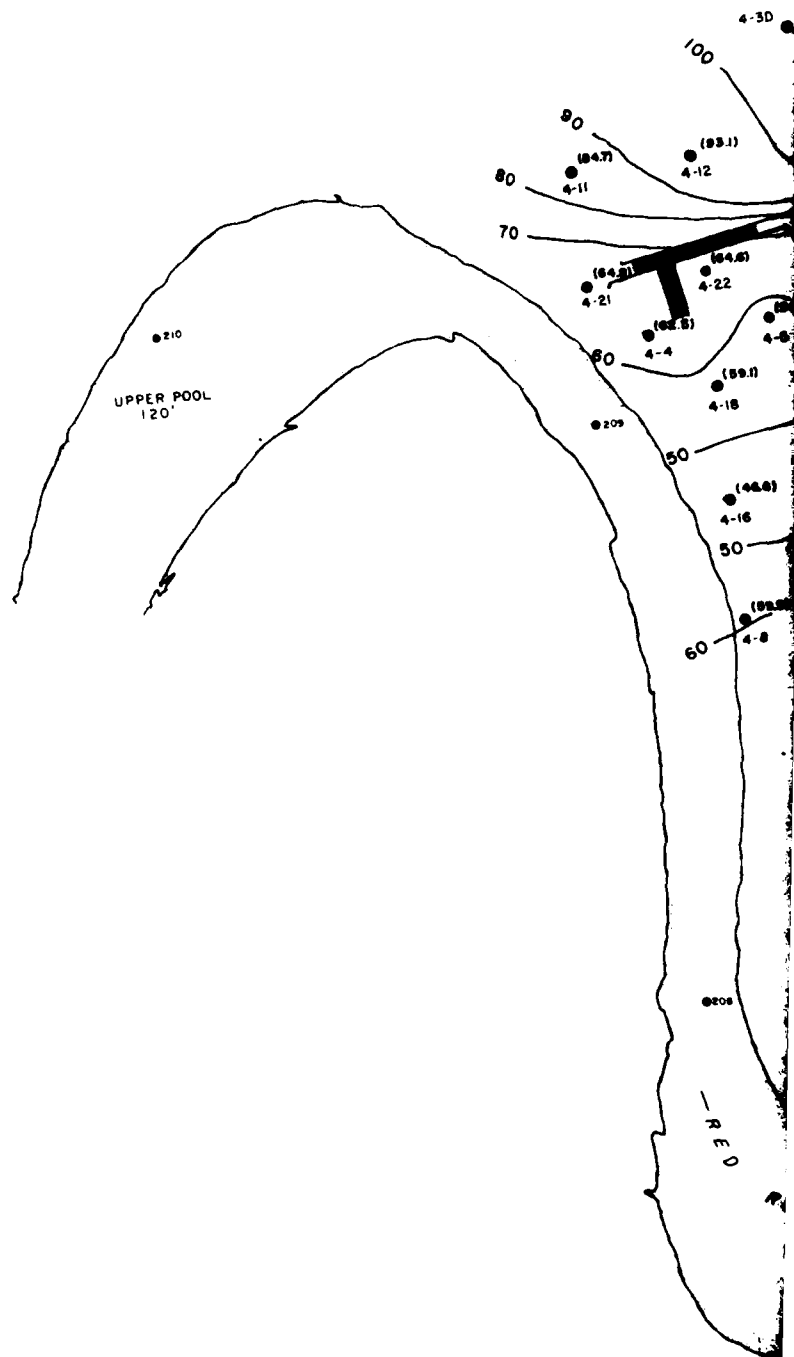
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

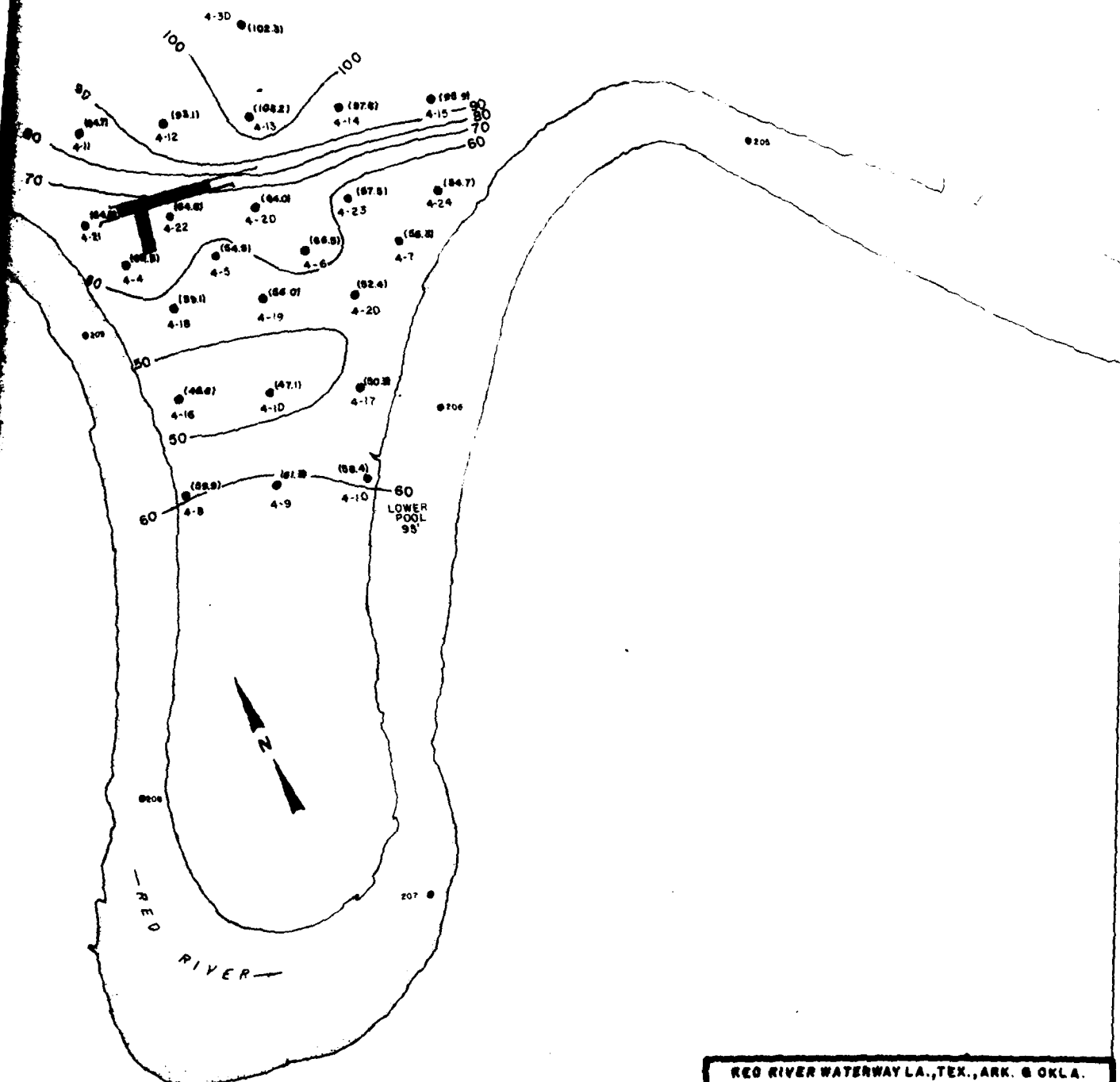
PLANS - GEOLGIC SEC. B-5, 1981

JANUARY 1980

FILE NO. H-2-29230

PLATE 6





RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

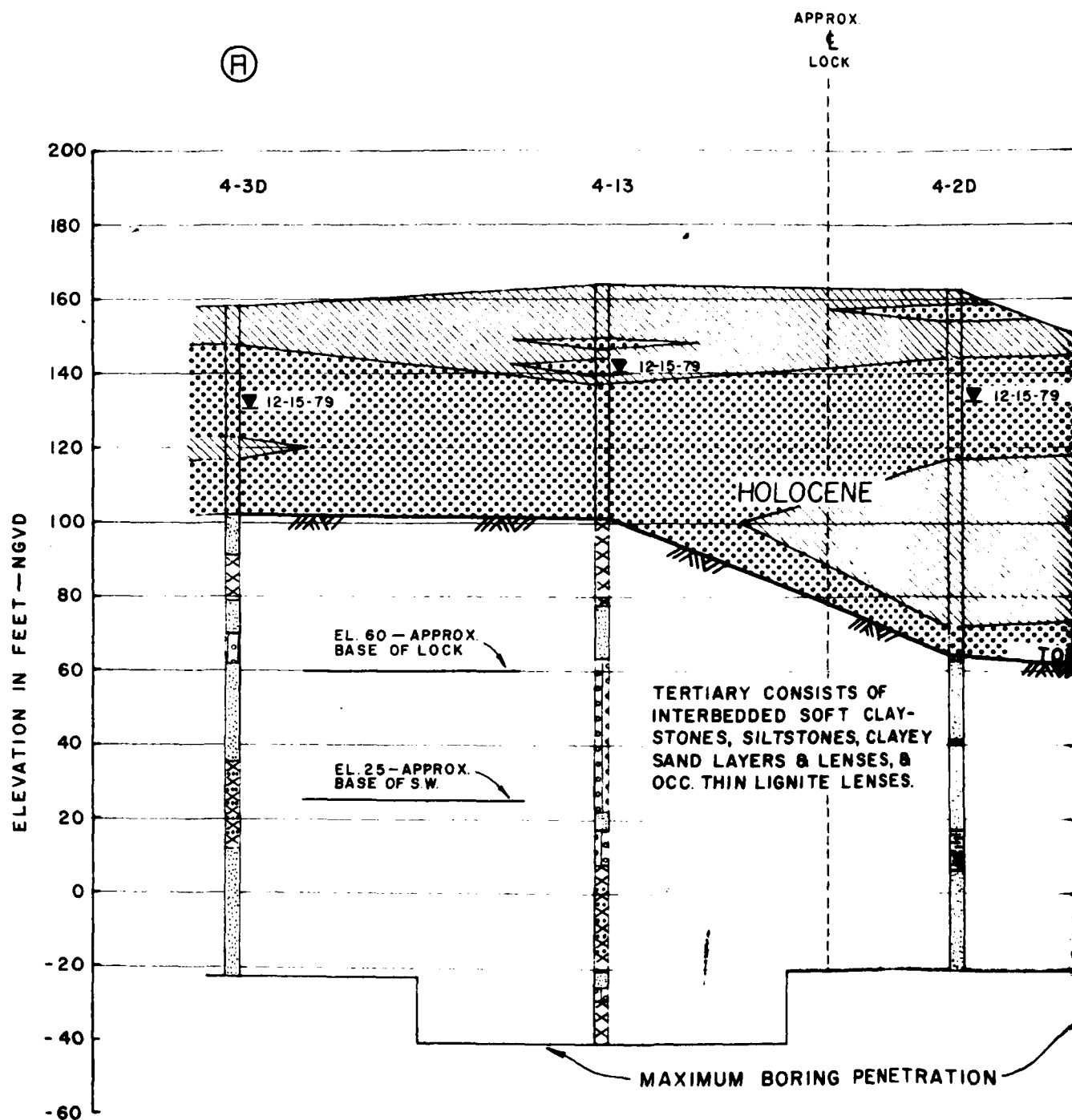
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

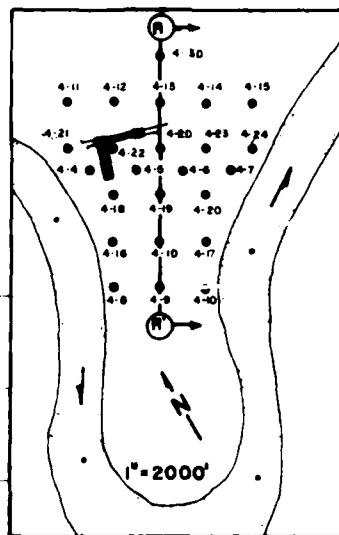
PLAN 2-1 BORING LAYOUT B,
TOP OF TERTIARY CONTIGUOUS, L&D 4

JANUARY 1960

FILE NO. H-2-29839

PLATE 1





LOCATION MAP

(R)

4-20

4-19

4-10

4-9

RED RIVER

12-15-79

UPPER POOL EL. 120

12-15-79

LOWER POOL EL. 98

12-15-79

12-15

TOP OF TERTIARY

OF
CLAY-
CLAYEY
ES, &
NSES.

TERTIARY

BORINGS SPACED ON 1000' INTERVALS

ENETRATION

200' 100' 0 200'
SCALE IN FEET

FOR LEGEND SEE PLATE

(A)

4-9

RED RIVER →

12-15-79

ELEVATION IN FEET - NGVD

200
180
160
140
120
100
80
60
40
20
0
-20
-40

200'

FEET

GATE

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

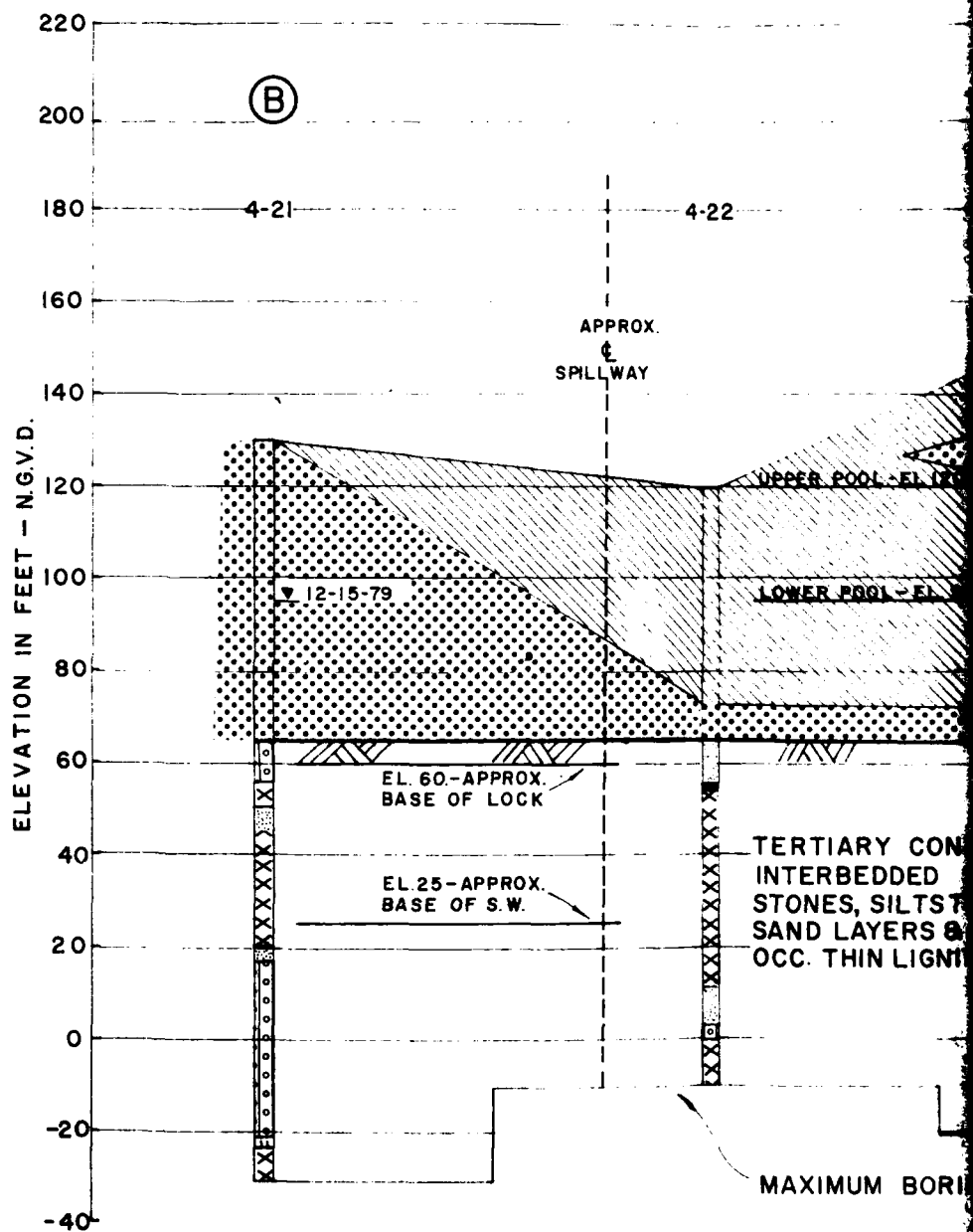
PLAN B-1 GEOLOGIC SEC. A-A', L&D 4

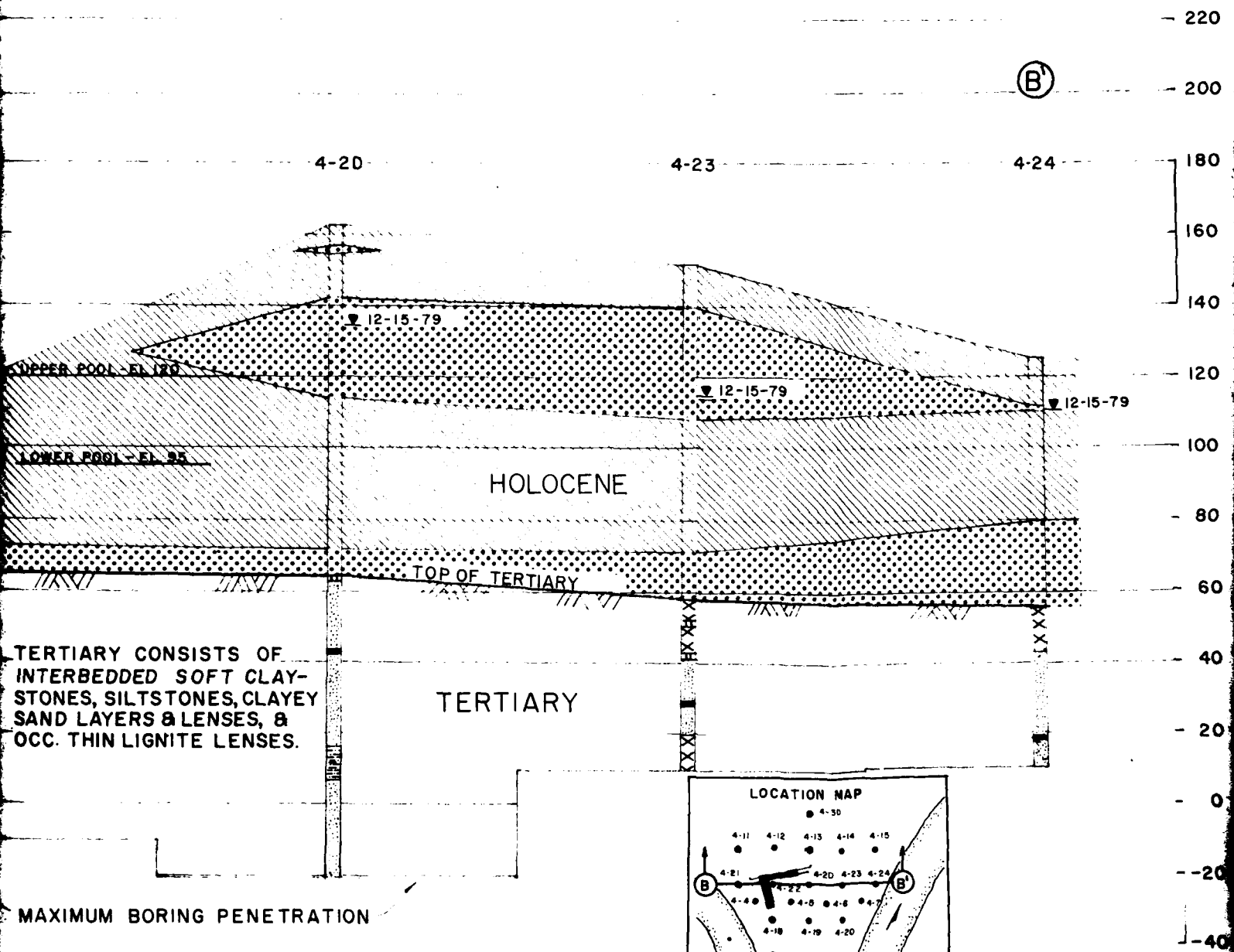
JANUARY 1980

FILE NO. H-2-29230

3

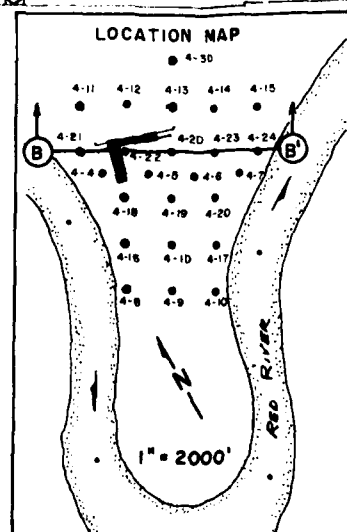
PLATE 8



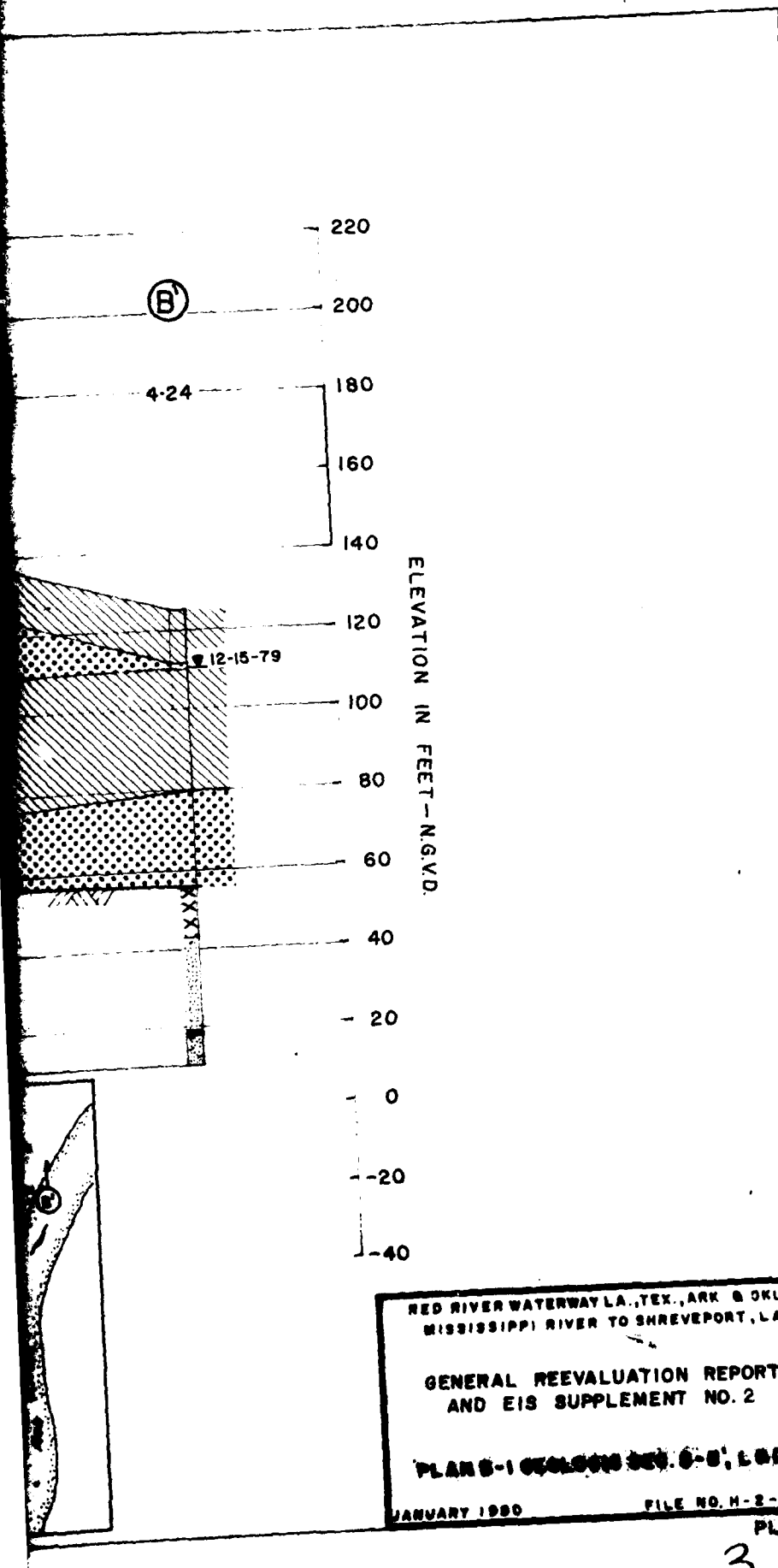


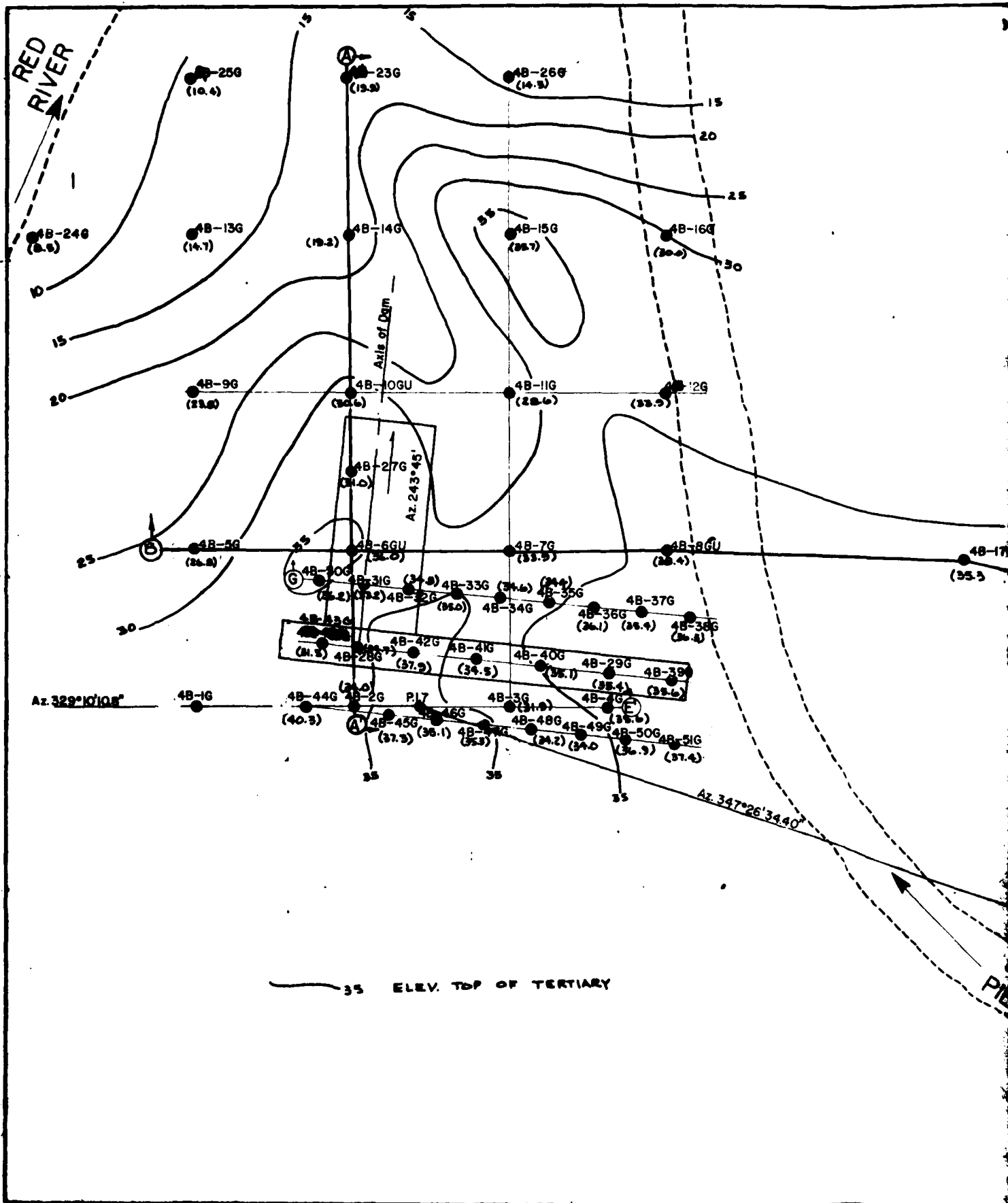
200' 100' 0 200'
SCALE IN FEET

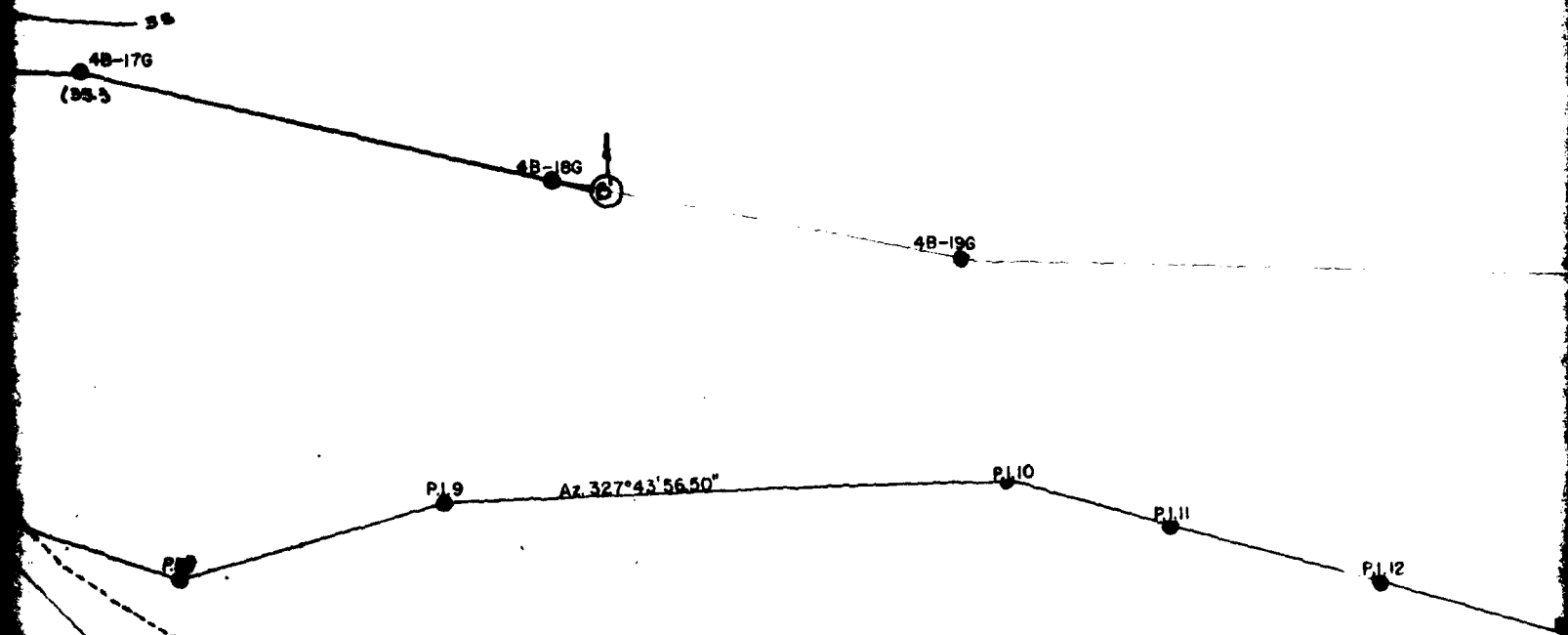
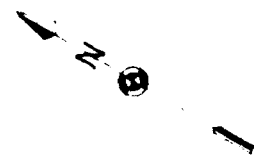
FOR LEGEND SEE PLATE



2







BAYOU
PIERRE



RED R.
MISS.
GE.
TOP
JANUARY



4B-226

Boring is 600'
Due South

4B-216

4B-206

P.I.11

P.I.12

P.I.13

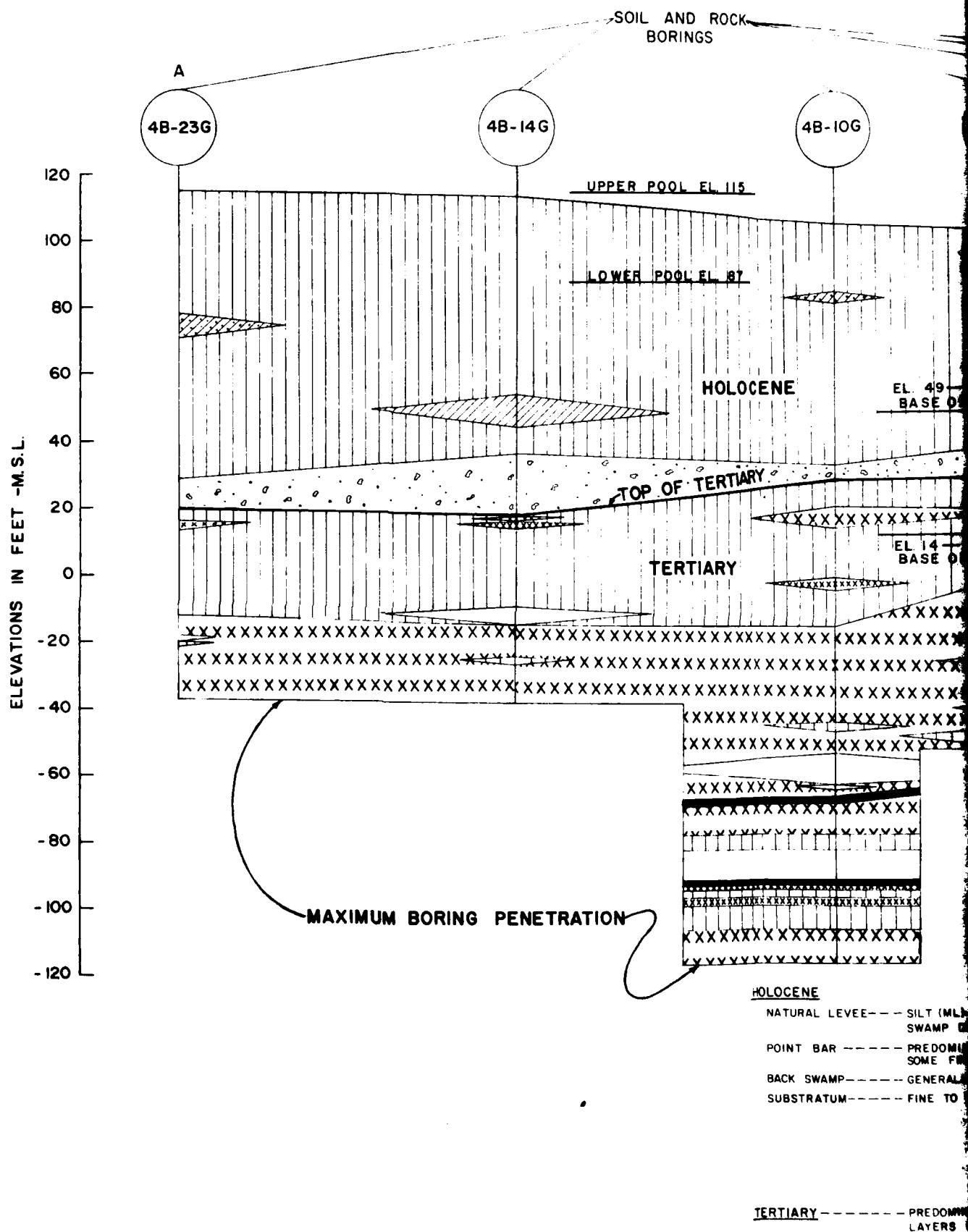
P.I.14

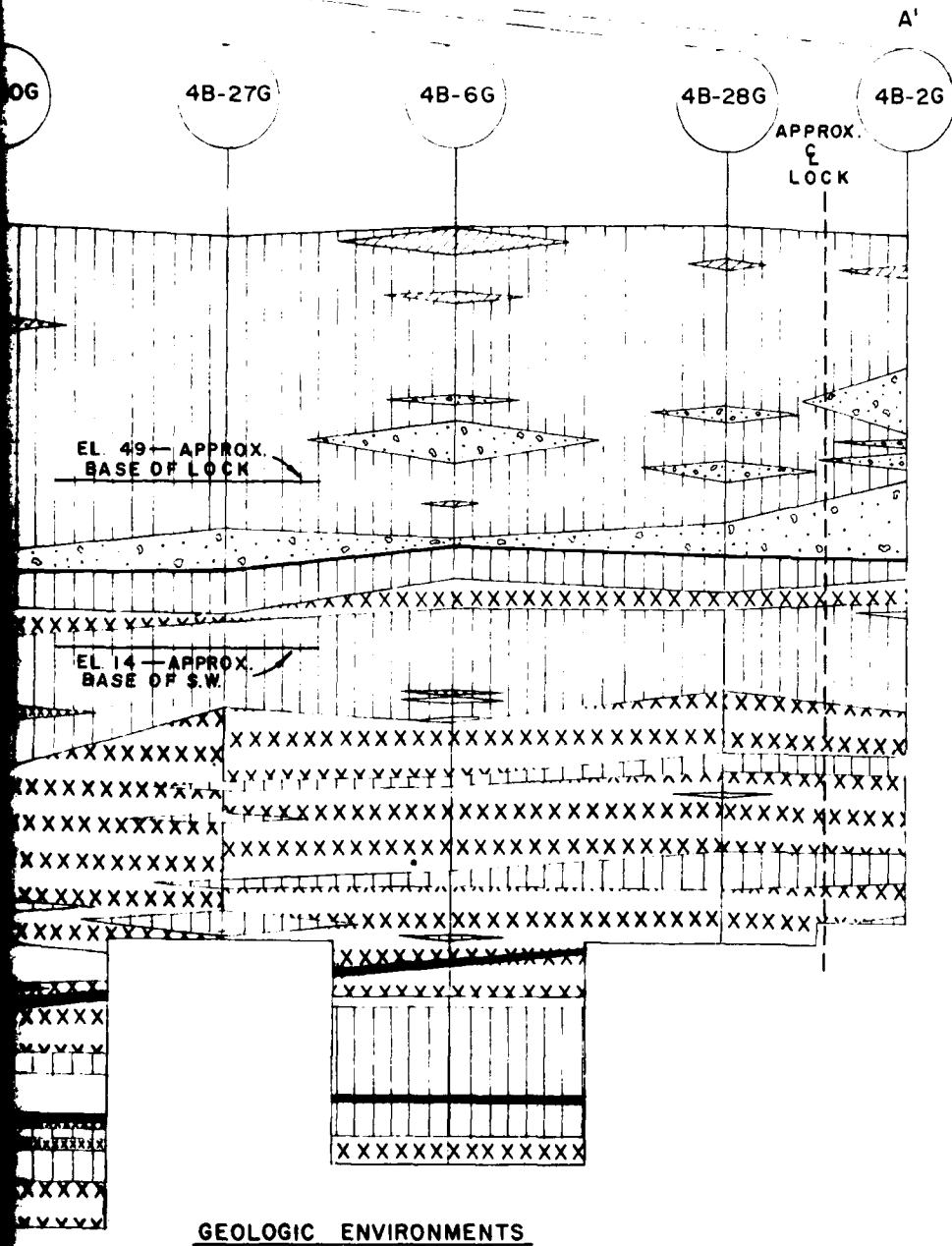
RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B-3 BORING LAYOUT &
TOP OF TERTIARY CONTOURS L.S.D.M.
JANUARY 1980 FILE NO. H-2-222

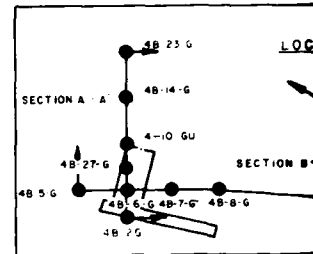
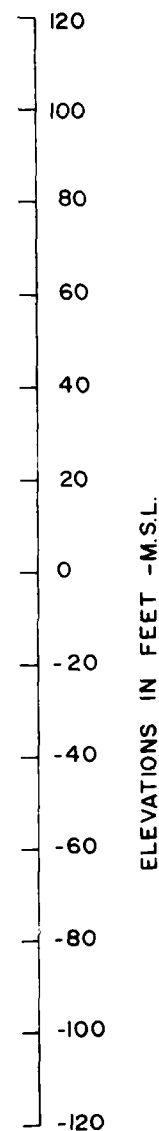
3





GEOLOGIC ENVIRONMENTS

- SILT (ML) AND SOFT TO STIFF CLAY (CH AND CL) OVERLYING POINT BAR AND BACK SWAMP DEPOSITS ADJACENT TO THE RED RIVER
- PREDOMINANTLY SILT (ML) WITH STRATA OF SOFT TO STIFF CLAY (CL AND CH) AND SOME FINE SAND (SP) AND SILTY SAND (SM)
- GENERALLY VERY STIFF TO HARD CLAY (CH) ADJACENT TO THE PLEISTOCENE UPLANDS
- FINE TO OCCASIONALLY MEDIUM SAND (SP) WITH LENSES OF SILTY SAND (SM)
- PREDOMINATELY SOFT SILTY CLAYSTONE WITH LENSES OF SILT AND SAND, OCCASIONAL LAYERS OF MEDIUM TO VERY STIFF CLAY NEAR THE TOP

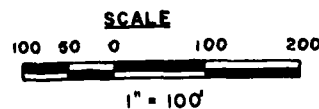


LEGEND

- SILT
- SILTY SAND
- POORLY GRADED SANDSTONE
- POORLY GRADED CLAYSTONE
- SILTY SANDSTONE
- LEAN CLAY
- FAT CLAY
- CLAYSTONE
- SANDSTONE
- LIMESTONE
- SILT, SILTY MIXTURE
- LIGNITE

NOTES:

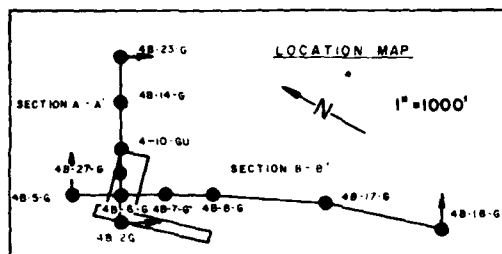
1. For local



RED RIVER
MISSISSIPPI
GENERAL AND
PLAN
JANUARY 1961

ELEVATIONS IN FEET - M.S.L.

120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120



LEGEND

- SILT
- SILTY SAND
- POORLY GRADED SAND
- POORLY GRADED SAND-GRAVEL
- SILTY SAND-GRAVEL
- LEAN CLAY
- FAT CLAY
- CLAYSTONE
- SANDSTONE
- LIMESTONE
- SILT, SILTY SAND, SAND, CLAY, CLAYSTONE MIXTURE
- LIGNITE

NOTES:

1. For location of section, see plate

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

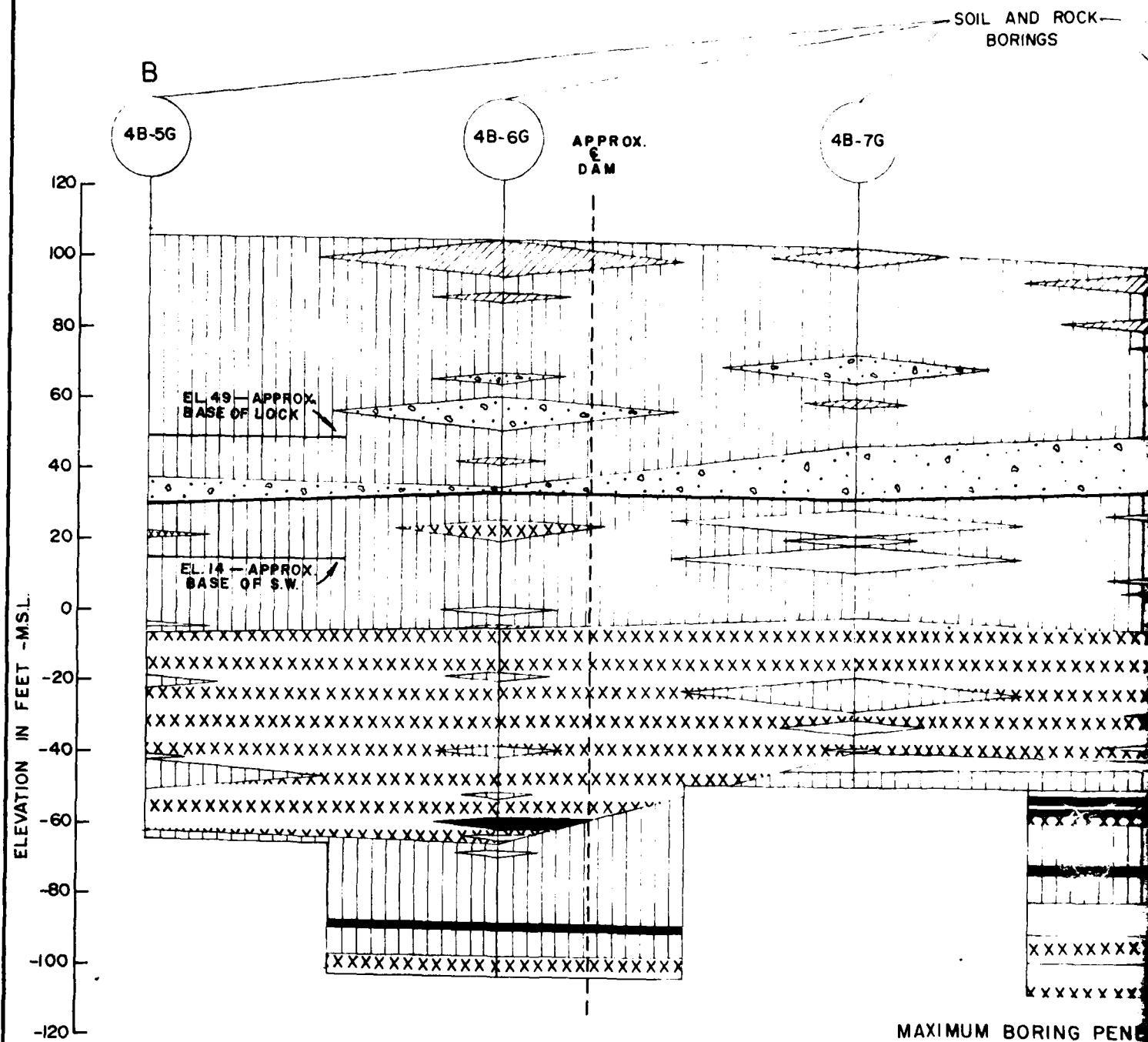
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B-SM GEOLOGIC SEC. A-A', LWB 4

JANUARY 1980

FILE NO. H-2-29230

PLATE II.



NO ROCK
INGS

4B-8G

4B-17G

UPPER POOL EL 115

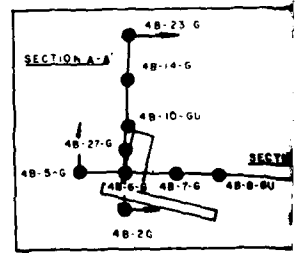
LOWER POOL EL 87

HOLOCENE

TOP OF TERTIARY

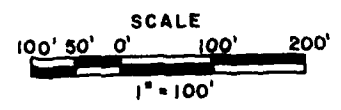
TERTIARY

RING PENETRATION



NOTES:

1. For legend, see plate
2. For location of section, see plate



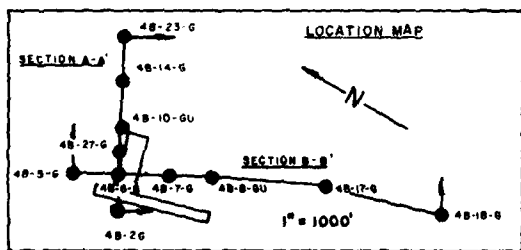
RED RIVER
MISSISSIPPI
GENERAL
ANALYSIS
PLAN
JANUARY 1

2

B'

4B-18G

120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
ELEVATION IN FEET - MSL



RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

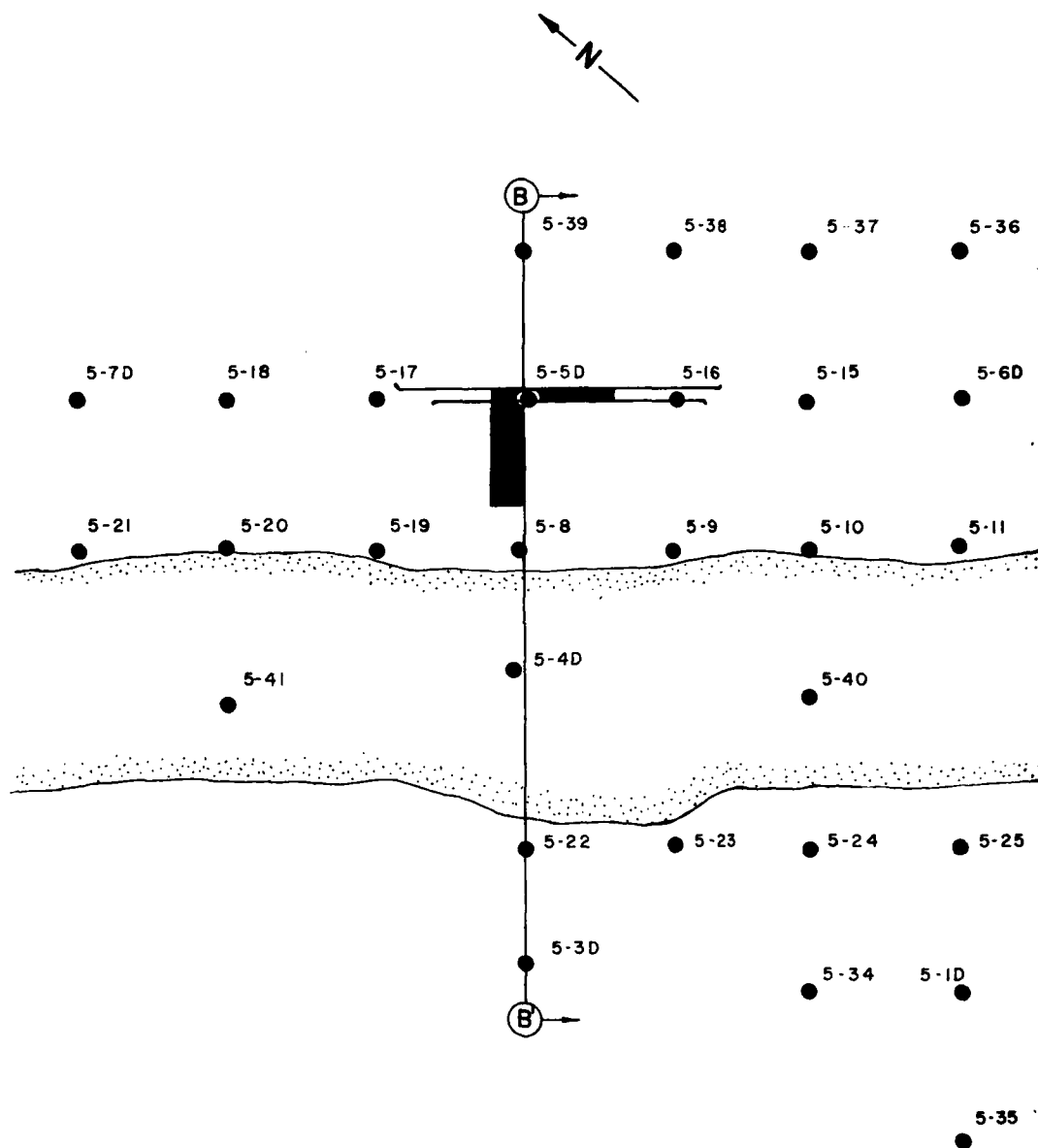
PLAN B-SM GEOLOGIC SEC. B-B' L&D 4

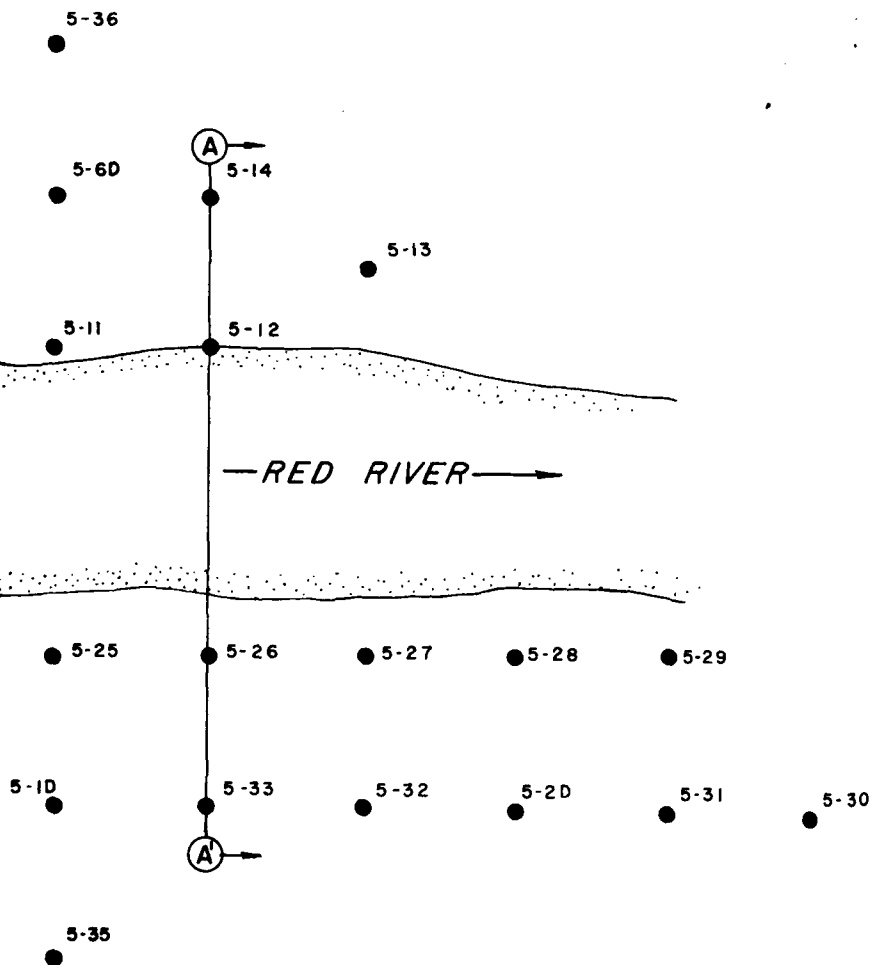
JANUARY 1980

FILE NO. H-2-28230

PLATE 12

3





RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

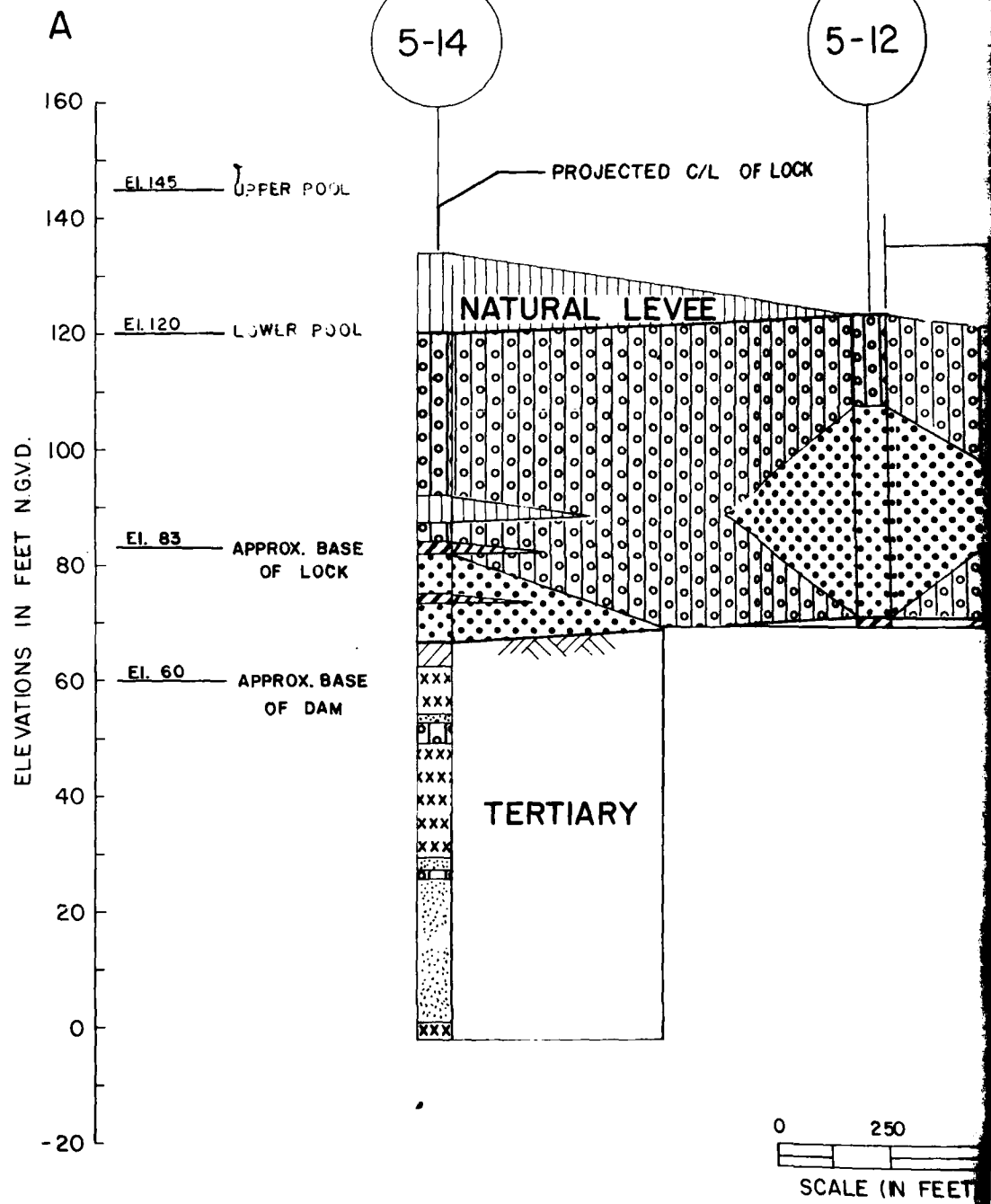
PLAN B-1 BORING LAYOUT, L-8-88

JANUARY 1990

FILE NO. M-2-29230

PLATE 15

3



SOIL AND ROCK
BORINGS

5-26

5-33

RED RIVER

NATURAL LEVEE

POINT BAR (HOLOCENE)

TOP OF TERTIARY

TERTIARY

MAXIMUM BORING PENETRATION

NOTES

1. For boring and section locations see plate
2. For legend see plate

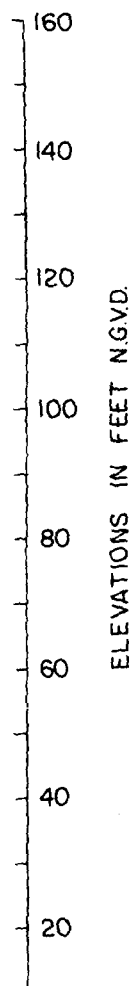
500

(ET)

2

5-33

A'



RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

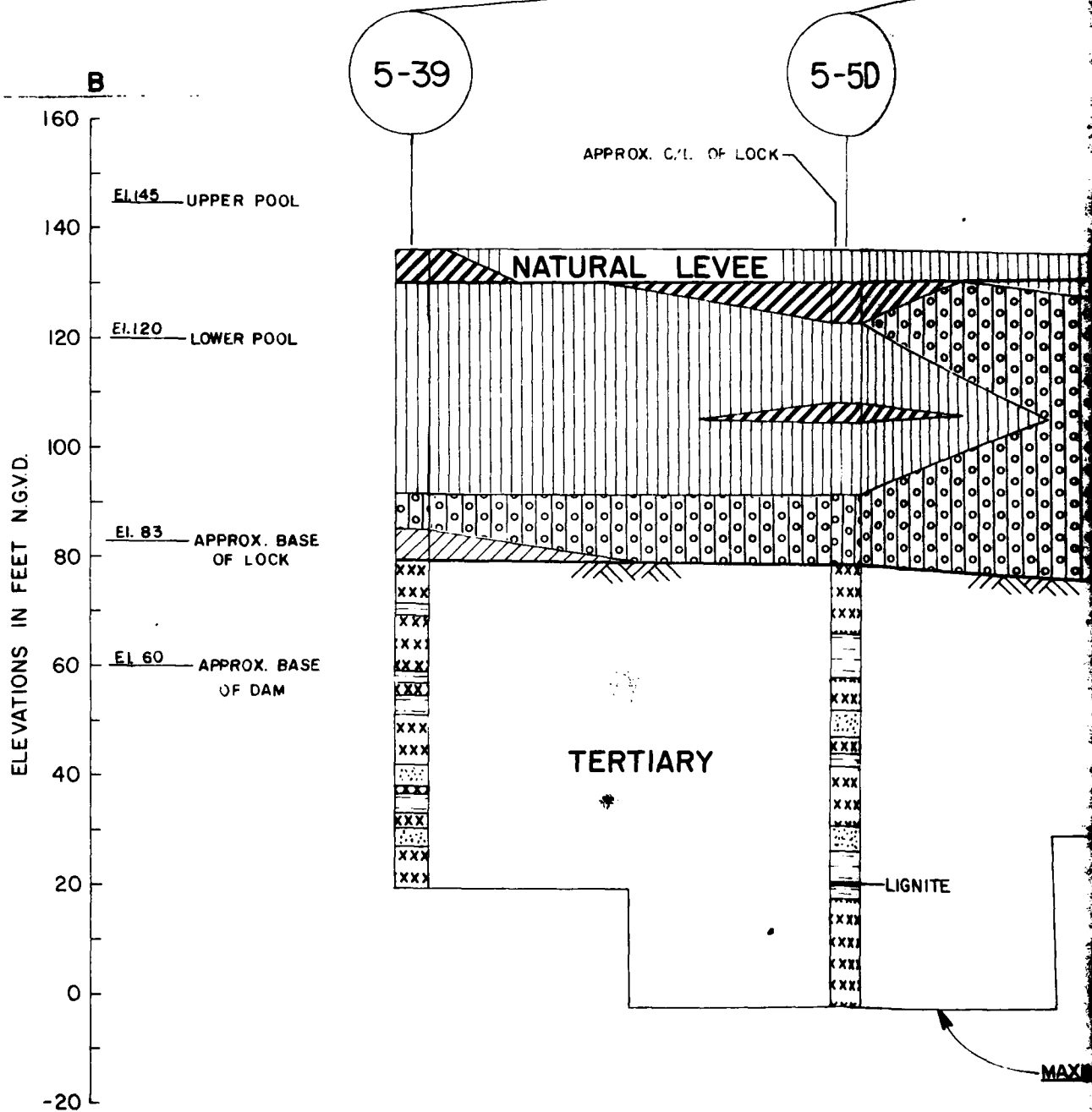
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

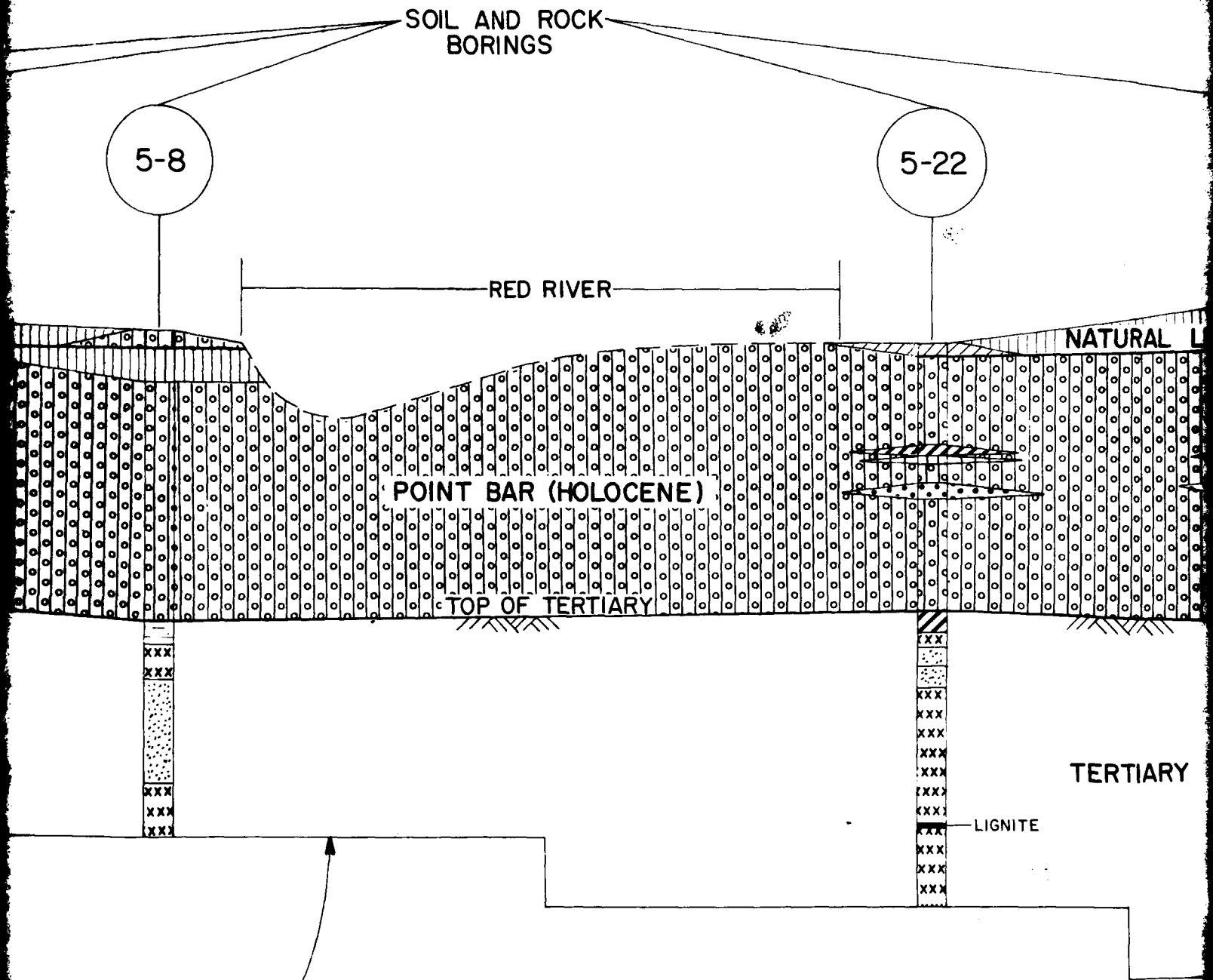
PLAN B-1 GEOLOGIC SEC. A-A', L&OS

JANUARY 1980

FILE NO. H-2-28230

PLATE 14





NOTE

- 1. For boring locations see plate
- 2. For section location see plate
- 3. For legend see plate

22

5-2D

B'

NATURAL LEVEE

TERTIARY

LIGNITE

160

140

120

100

80

60

40

20

0

ELEVATIONS IN FEET NGVD

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN 3-1 GEOLOGIC SEC. B-B', L&D

JANUARY 1980

FILE NO. H-2-29230

PLATE 15

58-266

58-256

58-240

58-236

58-226

58-216

58-206

58-196

58-186

58-176

58-166

58-156

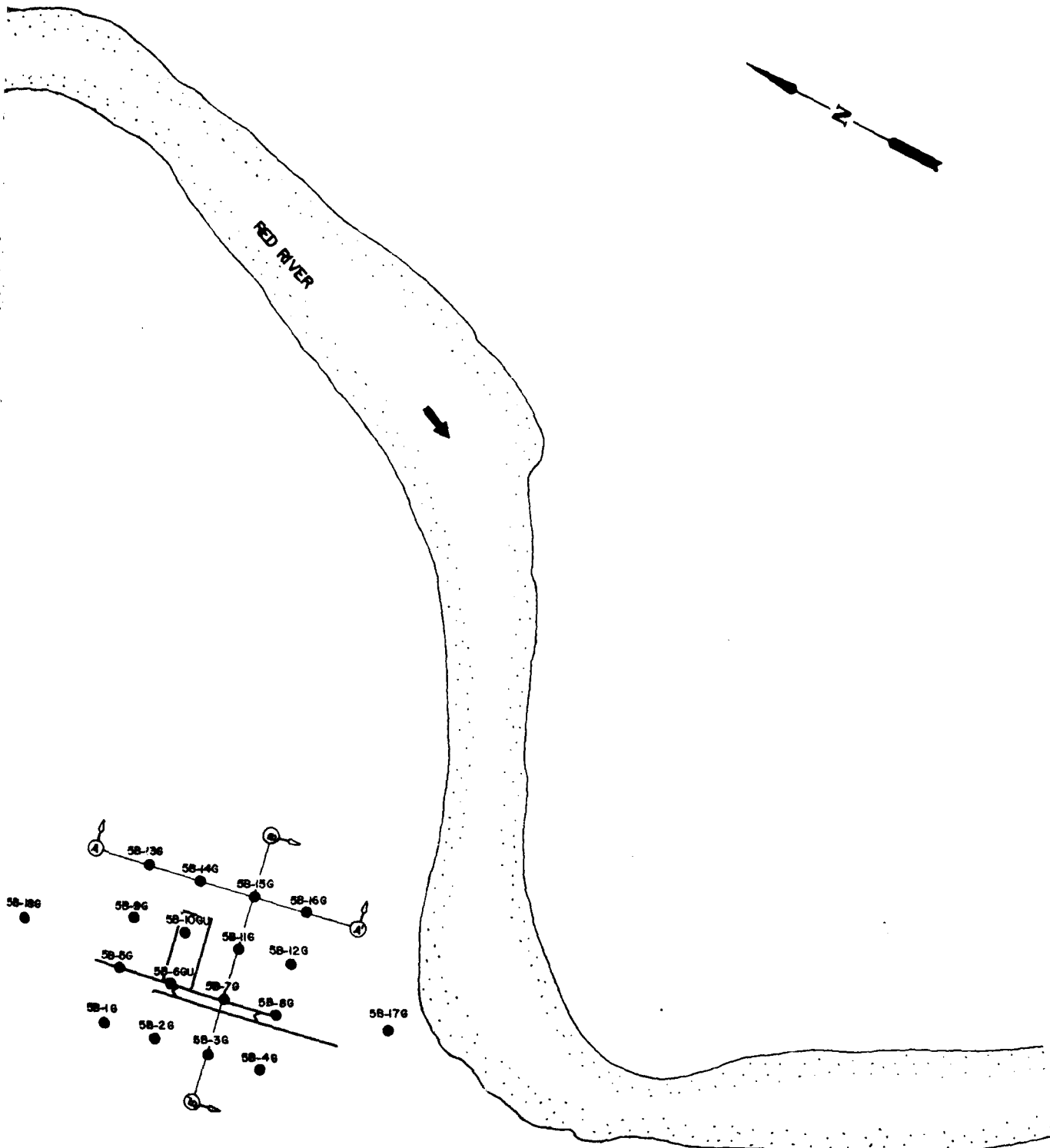
58-146

58-136



SCALE

0 300 600 1200 1800
(In Feet)



RED RIVER WATERWAY I.A., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B - BRIDGES, LAYERS, L.S. 0.6

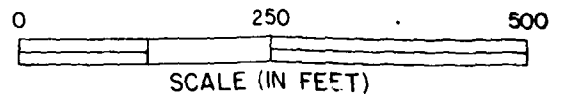
JANUARY 1980

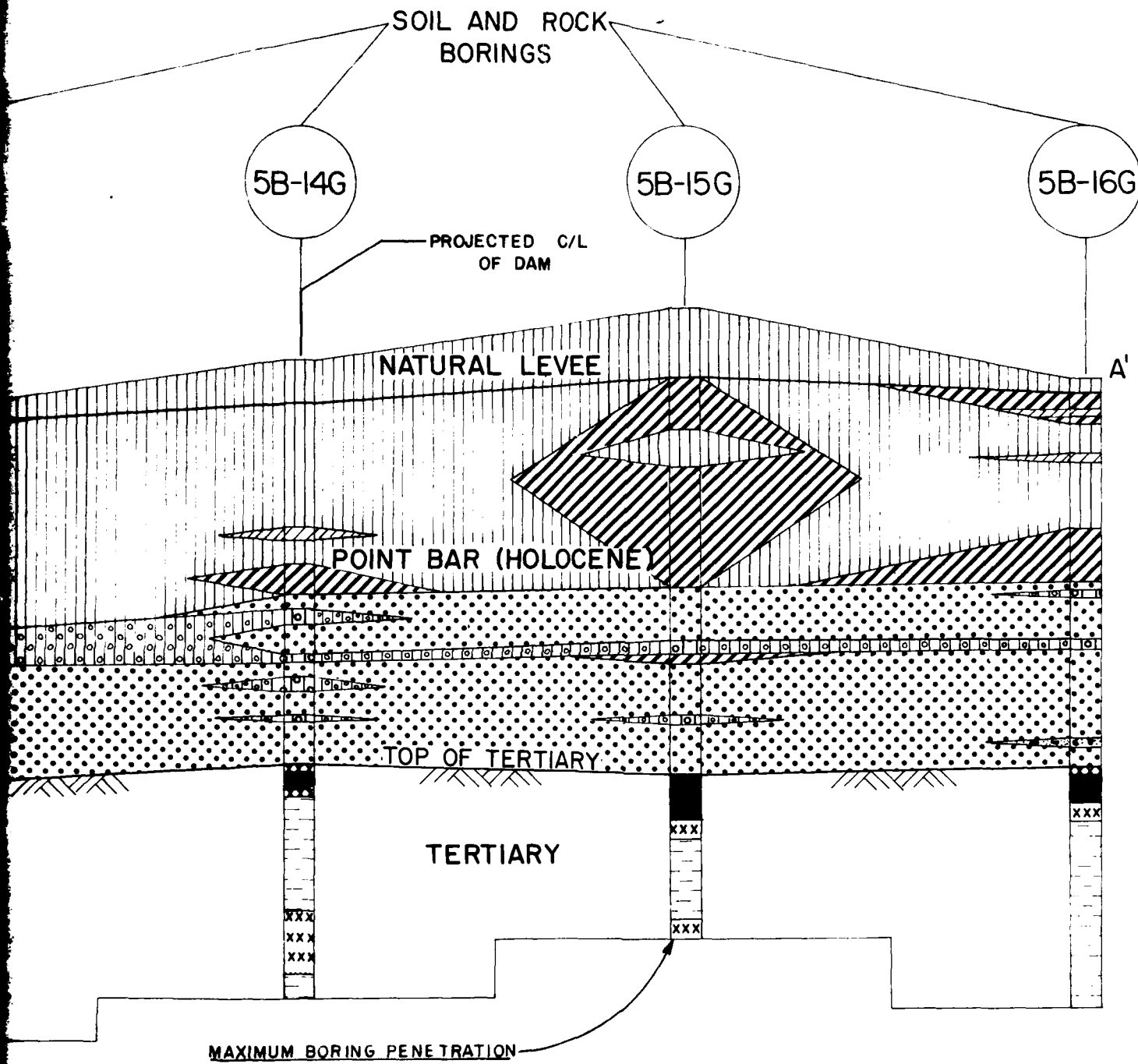
FILE NO. H-2-29230

PLATE IV

2

A





NOTES

1. For boring and section locations see plate
2. For legend see plate

5B-16G

A'

160
140
120
100
80
60
40
20
ELEVATIONS IN FEET NGVD

and section locations see plate
see plate

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

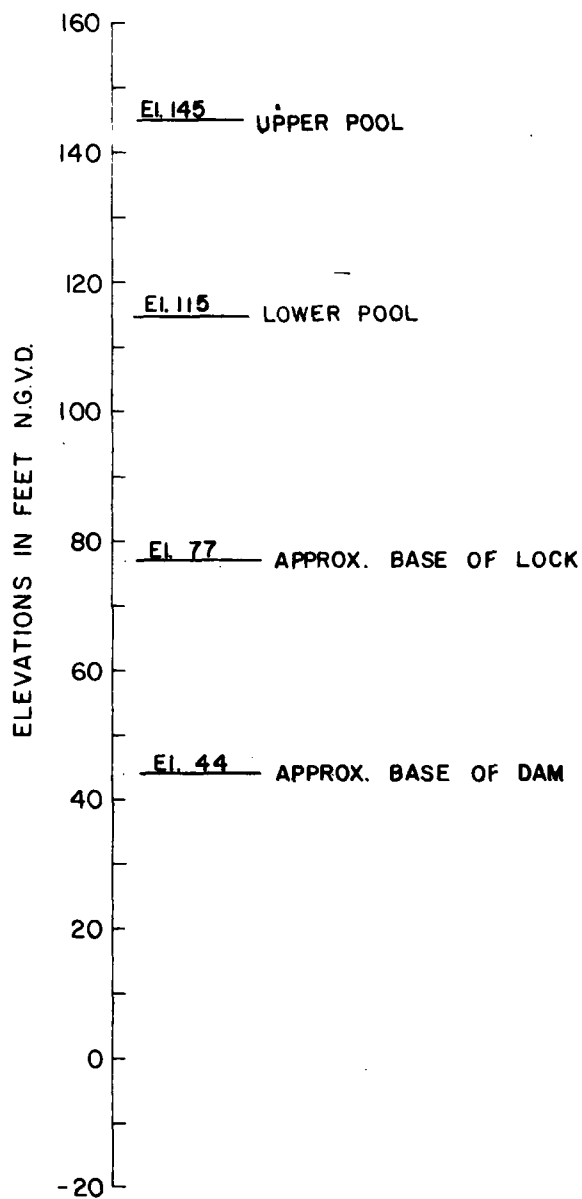
PLAN B-5M GEOLOGIC SEC. A-A', L. 856

JANUARY 1980

FILE NO. H-2-29230

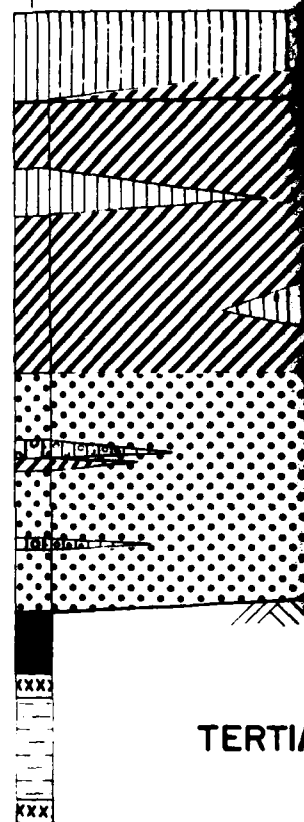
PLATE 17

3

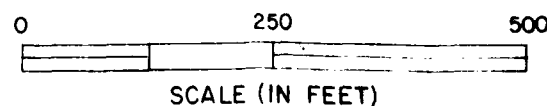


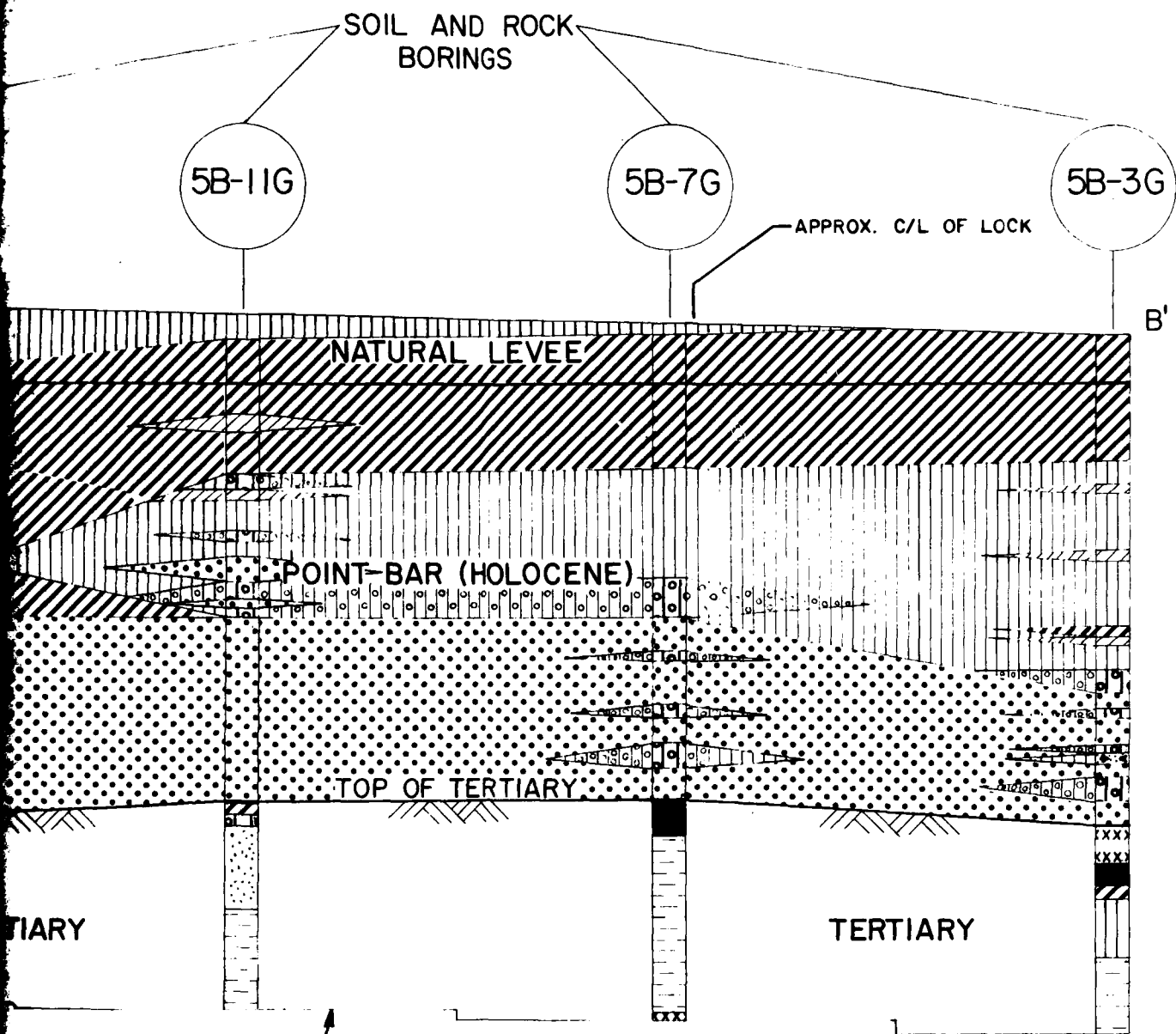
5B-15G

B



MAXIMUM BO





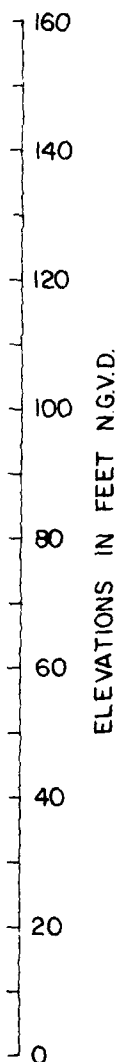
NOTES

1. For boring location see plate
2. For section location see plate
3. For legend see plate

2

3G

B'



1

see plate

see plate

see

RED RIVER WATERWAY LA., TEX., ARK. & OKLA.
MISSISSIPPI RIVER TO SHREVEPORT, LA.

GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

PLAN B-3M GEOLOGIC SEC. B-B', LADS

JANUARY 1980

FILE NO. H-2-29230

PLATE 18

3

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX C
PUBLIC MEETING RESPONSE

C-1

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX C
Public Meeting Response

Table of Contents

<u>Name</u>	<u>Organization Represented</u>	<u>Page</u>
Jeff DeBlieux	Individual	C-1
Kenneth Dutile	Landowner	C-2
Clarence N. Frierson	Frierson Plantation	C-3
J.H. Gardner	Landowner	C-4
Johnny H. Guilliams	Landowner	C-5
Henry W. Hearne	Landowner	C-6
Mrs. Joseph Ned Henry, Sr.	Landowner	C-7
Ned Henry, Jr.	Landowner	C-8
Pat Henry	Landowner	C-9
A. Adler Hirsch	Individual	C-10
Mrs. Marlan Anderson	Landowner	C-12
Ellis S. Martin	Roy O. Martin Lumber Co., Inc	C-13
Clemmons R. Matthews	Individual	C-15
Sonie M. Moore	Individual	C-16
Mrs. Margaret Vandersypen	Landowner	C-17
Mrs. Dell Morgan	Landowner	C-18
Robert R. Morgan	Landowner	C-19
Genevieve Morgan	Landowner	C-20
John C. Moser	Rapides Wildlife Association, Inc.	C-21
Elsie A. Ragan	A. A. Ragan Realty Corp	C-22
W. Herman Ragan	A. A. Ragan Estate	C-23
Lee Grappe	Individual	C-24
Nathan Smith	Landowner	C-25
Arthur R. Theis	DTD, Office of Public Works	C-26
Mrs. D. Crawford Young	Landowner	C-29
Fred Parkey	Red River Authority of Texas	C-30
Vincent W. Foster	Red River Commission	C-35
Ben Munson	Denison Area Chamber of Commerce	C-39
Bob Embry	Hope-Hempstead County Chamber of Commerce	C-40
Wini Bishop	Clarksville Chamber of Commerce	C-42
William E. Butler, Jr.	Mayor, City of Hope, Arkansas	C-44

Table of Contents (cont'd)

<u>Name</u>	<u>Organization Represented</u>	<u>Page</u>
Bill Clinton	Governor, State of Arkansas	C-46
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May 23, 1980
1001 Washington St.
Natchitoches, La. 71457

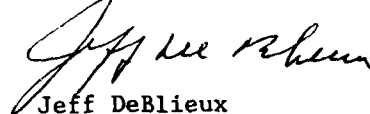
Colonel Sands
Department of the Army
New Orleans District, Corps of Engineers
New Orleans, La. 70160

Dear Colonel Sands:

I am writing to you in regards to the Red River Waterway Project and the alternate dam locations & pool elevations. It is my opinion the the main objectives of this project is to provide water transportation and to stabilize the erosion on Red River. These objectives will never be accomplished unless a final decision is made either on the original or alternate plans. The Red River Project should progress in an orderly and timely sequence to insure a early completion date. Interference to delay the project as Mr. John Chance of Lafayette, La. has done should not effect this decision.

The impact on the Red River Valley, upon completion is immeasurable, water transportation, bank stabilization, recreation, hunting, and fishing will be available to all. I urge you and the Corps of Engineers to reach a decision on the locks and dams locations so construction can begin. Thank you.

Yours, truly,


Jeff DeBlieux

cc: Mr. John Chance

C-1

Rece

Route 4, Box 468
Natchitoches, LA 71457
May 16, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160


Gentlemen:

I am an administrator of a school in Natchitoches and have been actively following the Red River Project since 1973. I am deeply concerned about the Red River Waterways plans and impact on the lands that I own along with that of my neighbors.

My wife and I own in excess of 400 acres of rich farm land along the Red River. I have attended numerous Red River Waterway public meetings to gain a better knowledge of the beneficial aspects of this projects and to learn of the effects of flooding and groundwater damage.

A review of current data indicates that B1 (alternative plant) is far superior to B3M (original plan): requires no maintenance dredging, cheaper to construct, reduces groundwater damage and flooding of prime farmland. For the benefit of our family and that of our neighbors, we ask that you reject the original proposal.

Sincerely,


Kenneth Dutile

KD/bd

Frierson Plantation

ROUTE 1, BOX 236
SHREVEPORT, LA. 71105

May 20, 1980

District Engineer
U S Army Engineer District, New Orleans
Corps of Engineer, New Orleans
P O Box 60267
New Orleans, La. 70160
ATTN: LMNED-MW


Dear Sir,

I would like to speak against the 145'
pool level above Lock #5 of the Red River
Waterway Project, Mississippi to Shreveport,
Reach.

The chief objection to the pool level
of 145' is that it would cover an enormous
area of agricultural land. Red River soil is
some of the finest in the nation and to perman-
ently by design loose this asset is to rob
future generations of a valuable heritage.
Even though the 145' level would cost some
\$ 60 million dollars more than the lower
levels, by far the greatest cost would be the
loss of irreplaceable land.

I urge you in the strongest way that
I can to use level 135 or 137 and conserve
our lands and tax dollars as well. The choice
is a clear one.

Very truly yours,



Clarence N. Frierson

AD-A126 528

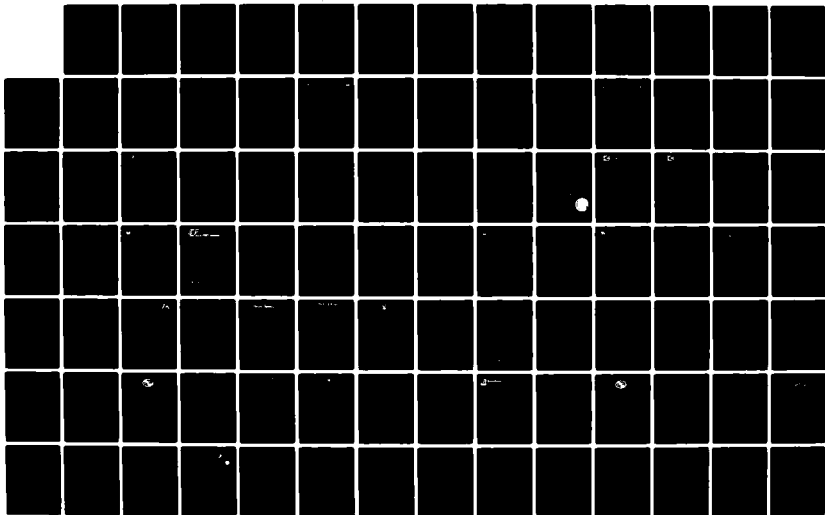
RED RIVER WATERWAY LOUISIANA TEXAS ARKANSAS AND
OKLAHOMA MISSISSIPPI RIVE..(U) ARMY ENGINEER DISTRICT
NEW ORLEANS LA DEC 82

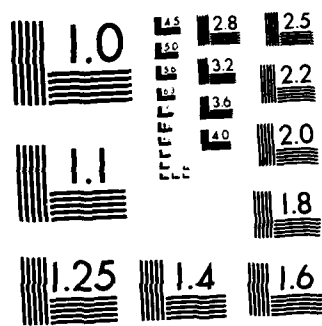
3/8

UNCLASSIFIED

F/G 13/2

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Rt. 1 Box 223-0
Shreveport, La, 71115
May 26, 1980

Dept of The Army
New Orleans Dist. Corps of Engineers
P.O. Box 60267
New Orleans, La. 70160

attention: Colonel Thomas A. Sands
District Engineer

Dear Sir:

I wish to express opposition to the proposed 145 ft. pool level and to favor the 135 ft pool level at lock and dam site # 5 south of Shreveport. I feel that the higher level would inundate large acreages of bature land now in production of farm products as well as pasture land. I did not speak at the Shreveport meeting because I ^{was} not aware of the implications at that time.

I own the land at Wilkesboro Point near the Proposed Port site. Sincerely J. H. Gardner
C-4.

May 7, 1980

District Engineers
U. S. Army Engineers District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

Attention: LMNED-MW

Gentlemen,

I am a resident of Campti, Louisiana and own a small amount of acreage just south of the community. This acreage is pasture land. If the original plan for the Red River water way is put into effect I will lose approximately twenty five (25%) of my land use. This will be about forty to fifty acres.

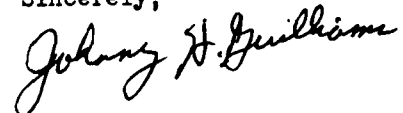
I realize that this is not a great amount; but, considering that even one acre is taken out of use, it is gone forever. I submit that the best plan would be to inundate the smallest amount of acreage possible. Why take thousands of acres of land out of use?

My recommendation to the Commission is to move the lock and dam from Grande Encore to Red Oak, located south of Coushatta, Louisiana. We need to have the lowest possible pool stage at all points on the waterway.

Later, if it is feasible to do so, build another lock and dam just south of Shreveport, Louisiana, to make possible navigation to Dangerfield, Texas.

I submit this recommendation as a land owner and concerned citizen.

Sincerely,



Johnny H. Williams
Campti, Louisiana

HENRY M. HEARNE
P. O. BOX 6057
SHREVEPORT, LOUISIANA 71106

May 19, 1980

District Engineer
U. S. Army Engineer District, New Orleans
Corp of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTN: LMNED-MW

Re: Adoption of alternate
locations and pool
elevations for Locks and
Dams 2, 3, 4 and 5 of the
Red River Waterway Project

Gentlemen:

As the owner of approximately 2,500 acres located on the Left Descending Bank of the Red River between Mile 250 and Mile 243 we would like to comment relative to the comparative data for the B-1 Alternate and the original B-3 Plan for the Red River Waterway Project.

Irrespective of the pool elevation established for Pool No. 5 it appears to us that adoption of the B-1 Alternate Plan should be given serious consideration. Based on the data furnished by the Corp of Engineers, crop losses in excess of one quarter of a million dollars could be expected with the implementation of the B-3 Plan, while a substantial decrease in losses should be realized with the adoption of the B-1 Alternate. It is our opinion that when the detailed ground water impact study is completed an even more favorable balance will recommend the B-1 Alternate. An additional benefit offered by adoption of B-1 is the elimination of the dredging requirement for Pool No. 2.

We believe, based on present data available, that a reduction in direct as well as indirect costs would be effected with the adoption of the B-1 Alternate Plan. We therefore endorse its adoption.

Very truly yours,



Henry M. Hearne
P. O. Box 6057
Shreveport, Louisiana 71106

May 18, 1980

District Engineer,
U. S. Army Engineer District
Camp of Engineers,
P. O. Box 60267,
New Orleans, La.
70160

Attn: LTR E.D.-N.W.

Dear Sirs:

I am a landowner in Natchez Zetelike Parish,
and very much concerned about the flooding of our area,
and the neighbor land which will certainly happen if
you use the B3M plan in making Red River Tongue.

We bought this land in 1945. My late husband
these children, and myself worked very hard to make
this bottom land productive, and I strongly urge you
to consider using the Alternative plan, B1, which would
flood less prime farm land.

Thanking you for your kind consideration in accepting
the B1 plan, of which I am very much in favor of.

Sincerely,
Mrs. Joseph Red Henry, Sr.

May 16, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

Attn: LMED-MW

Gentlemen:

As a landowner and operator in northern Natchitoches parish, I am greatly concerned about the fact that most of the land that we own will be completely flooded under the original B3M plan. As I understand it, there is an alternative plan B1 that is cheaper to construct and would not cause as much flooding of valuable land. I am strongly in favor of this plan.

I, as a farmer, am concerned about this waste of valuable river bottomland. I feel that the government should also be. Each year thousands of acres of productive land are taken out of production by highways, shopping centers, airports, and other such projects. I feel that if there is a way to save any of this land for future agricultural use, it should be done. I feel that more people would benefit from this land if left in production rather than flooded by the B3M project.

Many jobs and businesses would be lost if the B3M plan was implemented. I am completely reliant on the land that we own for my livelihood. If this land was flooded, it would put me out of business completely. There are others who would be in the same position as I.

If the B1 plan would serve the same purpose and save this huge amount of land, I cannot see how there could be any question as to which plan to use.

Sincerely,
Ned Henry, Jr.
Ned Henry, Jr.

C-8.

DISTRICT ENGINEER
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DEAR SIR

AS A PROPERTY OWNER OF LAND
THAT LIES ON THE BANKS OF RED RIVER,
I WOULD LIKE TO TAKE THIS OPPORTUNITY TO
EXPRESS MY OPPOSITION TO THE ORIGINAL PLAN,
THE B3M PLAN.

THIS LAND WAS RECENTLY INHERITED FROM
MY FATHER. IT HAS, FOR THE LAST 36 YEARS
BEEN A PART OF OUR FAMILY. I CAN'T HELP
BUT FEEL THAT THE ORIGINAL PLAN WOULD BE
A TOTAL WASTE OF GOOD PASTURE LAND, THAT
HAS BEEN A GREAT PART OF MY LIFE FOR SO MANY
YEARS. THEREFORE, I HAVE TO HOPE, THE CORPS
OF ENGINEERS, WILL SEE THE LANDOWNERS SIDE
OF THIS PROJECT AND USE THE ALTERNATE PLAN

SINCERELY

Pet Henry

4

A. Adler Hirsch

141 Norwood Street

Shreveport, Louisiana 71105

June 7, 1980

District Engineer
U. S. Army Engineer District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTN: LMNED-MW

RECOMMENDED PRIORITY FOR SHREVEPORT
LOCK AND DAM ON RED RIVER

Pursuant to your Public Meeting in Shreveport, La., on 20 May 1980 for discussions of alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 of the Red River Waterway Project: This letter supplements and crystallizes the oral statement I advanced from the floor.

My concern is not related to the precise locations and pool elevations of the various locks and dams, particularly that at Shreveport, but focuses on another aspect which, although not considered heretofore, is even more important in the light of past and presently possible experiences. This facet involves the sequence in time for the construction of the remaining locks and dams.

Several years ago the Red River Waterway Project was included in President Carter's hit list when he hoped, during his early years in office, to conserve Federal funds by curtailing civil improvements. Only by mustering all the private and political strength at their disposal were affected interests able to rescue the Red River Waterway Project from oblivion, literally by the skin of its teeth. The question now arises whether this project could ever be spared again in second and later hit lists. These are certain to reappear in view of the ever-worsening economy. National defense and social welfare cause such continually heavier strains on Government funds that appropriations for civil projects will shrink further.

In its original conception the waterway concept relied heavily on other benefits than those directly related to navigation to reinforce its Benefit/Cost ratio to a tolerable figure. Hence the next round of an economy binge will find this waterway in a precarious position.

This spectre leads to the stark question: What is the functional value of the completed Red River Waterway structures? Should the project be terminated tomorrow, next year, or some year after. With only the Marksville Lock and Dam to show, the B/C ratio to that point would be sadly below unity.

Realizing such a possibility, prudence dictates that further investments should be targeted at areas where benefits would be maximized. The best insurance for a positive early benefit is to select a dam site above which the pool offers the most advantages for non-navigational purposes. The Shreveport location best meets this requirement. Its auxiliary benefits, immediately attainable before any other stretch of the river is made navigable, include a future water source for Shreveport, the largest city on its banks, and Barksdale Air Force Base, extended availability of water supply for Bossier City, higher surface levels that facilitate pumping from Twelve Mile Bayou Station for Shreveport and from the Bossier City intake. better quality of raw water through impoundment in the pool thereby reducing turbidities, and lessening the hardness and salt concentration by longer residence time of better quality winter and spring high water flows, and improved recreational potentials for boating and fishing upstream. Navigation will not be delayed by this next choice of siting at Shreveport, since this purpose must await completion of all dams and locks regardless of order in which they are built.

Were the Red River Waterway Project to be aborted at any step with only one or all locks and dams below that at Shreveport completed the result would resemble the spectacle of the dry land placement of the draw span in the Red River Bridge at Index, Arkansas. This incongruity was an act of Nature caused by channel instability, but for the waterway case there will be nothing to excuse lack of foresight. It would provide meat for critics of the Corps forever afterward.

SUMMARIZING : Because the sequence in building locks and dams 2, 3, 4, and 5 is not ironclad, the Shreveport Lock and Dam should be built next to provide maximum positive collateral benefits in view of the ever-present threat of truncating the Red River Waterway Project.

Sincerely yours,

A. Adler Hirsch

A. Adler Hirsch

May 15, 1980

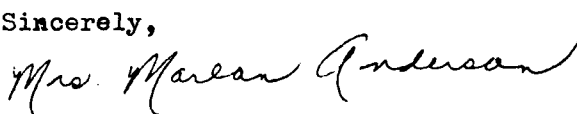
District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160
Attn: LMNED-MW

Dear Sir:

My family owns land on the banks of Red River in northern Natchitoches parish. I am very much opposed to the fact that this valuable land might be flooded and destroyed forever. Landowners have worked too hard and long for their property to be lost by this plan you have submitted.

The original plan would allow this to possibly be done to our and others land. My family is of the farming profession, and I think it is totally uncalled for that this land be wasted. It is in my opinion that an alternative plan, such as B1, be considered rather than the original plan. Thank you for your time and assistance in giving this matter your highest recognition.

Sincerely,



Mrs. Marlan Anderson

C-12.

ROY O. MARTIN LUMBER COMPANY, INC.

P.O. BOX 1110

ALEXANDRIA, LA. 71301

May 26, 1980

District Engineer
U. S. Army Engineer District, New Orleans
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Attn: LMNED-NW

Gentlemen:

In regard to the locations and pool elevations for Locks and Dams 2, 3, 4 and 5 of the Red River Waterway Project, Mississippi to Shreveport Reach, please be advised that Roy O. Martin Lumber Company, Inc. is in favor of the Alternate Location Plan of these Locks and Dams as presented in your "Announcement of Public Meeting" dated April 18, 1980.

Our company feels, after examination of the proposed locations of both the original location plan and the alternate location plan, and listening to testimony given at the public hearing in Alexandria, La. on May 20, 1980, that the alternate location affords the least interruption of the current land-use activities in the areas of each location.

In particular, the alternate plan provides for the least amount of timberland being removed from production. In view of the fact that hundreds of acres of timberland in Louisiana alone are being taken for highway, pipeline, electric utility lines and various other rights-of-way, it is imperative that every effort is made to maintain existing timberlands that are economically and biologically feasible for use as timberlands.

Also be advised that Roy O. Martin Lumber Company, Inc. is opposed to Pool 5 elevation being set at 145. We feel that Pool 5 elevation should be lowered to 137 or 135. The reasoning for our stand concerning this situation is simply the fact that savings in land and structure costs of approximately \$60 million could be realized if the pool elevation is lowered. In relation to the same item, we do not feel that navigation is feasible to Daingerfield, Texas, since alternate and comparable means of freight transportation are already available to the Daingerfield, Texas area.

PHONE: ADMINISTRATIVE & EXECUTIVE OFFICES 318/448-0405
LAND & TIMBER 318/448-0493

C-13.

In regard to the possible relocation of the Kansas City Southern Railroad bridge between Alexandria and Pineville, our company is opposed to such a relocation on the grounds that the expense of obtaining new rights-of-way for such a relocation would far outweigh any gain realized through this action. Our company favors construction of a new railroad bridge at the existing KCS bridge location.

Your attention to and consideration of our recommendations and comments concerning this matter are appreciated.

Yours truly,

Roy O. Martin Lumber Company, Inc.

By: 
Ellis S. Martin, President

ESM/kr

CLEMMONS R. MATHEWS
RT. 1, BOX 139
CHESTNUT, LA. 71017

May 12, 1980.

District Engineer,
U. S. Army Engineer District,
Corps of Engineers,
P. O. Box 60267,
New Orleans, La. 70160

Gentlemen:

Att: IMMED-MW

Although I do not own any land personally which will be affected by the Red River Valley Waterway, I am vitally concerned with possible flooding which would occur if one of the plans being considered were used.

I am an employee of the Young Estate of Campti, La. and to a great extent dependent on their welfare. Should the plan be used which would place the locks just north of Grand Ecore be used it would mean that our pasture land would be flooded right in the middle splitting it in half which would result not only in losing a good deal of acreage but would make it impossible to use as one large pasture but would reduce the value of the land. The B3M plan would also affect a number of others by flooding and possibly putting them completely out of business.

I am in favor of B1 plan on this Waterway Plan for Red River for several reasons. By using the B1 plan it would be cheaper than the B3M and would place the lock in a place which will cause less flooding, leaving the Campti area with minimum damage.

It is my urgent plea that you go ahead with the B1 plan which in my opinion is the best submitted at present.

Thanks.

Sincerely,

Clemmons R. Mathews

C-15,

District Engineer
U.S. Army Engineer District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160
ATTN: LMNED-MW

MAY 20, 1980

The proposed change in elevation for lock and dam #2 will cause significant changes in groundwater effects near this structure. Studies your agency have made have never analyzed in detail, adverse effects from raised pool elevations. Studies of a broad nature have shown that an increase in the pool elevation at lock and dam 2 will cause more adverse effects. It is recognized that realignment of locks and dams #4 and 5 were necessary to prevent "so-called" inundation of several thousand acres of land adjacent to the river. Why haven't similar detailed topographic surveys been made in pool 2? The people who reside in the affected area of pool 2 from Poland to Boyce, are due the same consideration as those in lock and dam no. 4 and 5. If the objective of this project is to provide navigation above Shreveport, six lock and dam structures would seem appropriate. It is generally accepted by your agency that the project is not cost effective anyway. As indicated when the President asked for re-evaluation of water-resource projects, evaluation of this project at any percent above 4 would prove out this non-acceptable benefit-cost ratio. Therefore, reverting back to the plan that called for a sixth lock and dam would be the most sensible approach. This would allow lock and dams 2 through 5 to be installed at more reasonable pool elevations.

The requirement for maintenance dredging is not a valid reason for raising pool 2 (two) some six feet. Studies show that maintenance dredging will be required for a considerable period each year in each lock and dam, regardless of pool elevation.

As representative of 25 families near the site for Lock and Dam No. 2, we strongly oppose raising the pool elevation from 58 to 64 feet. The needed adjustments in Lock and Dam No. 3-5 should not be a reason for additional adverse impacts near Dam No. 2.

C-16.

Sonie M. Moore
RT. 2 Box 337
ALEXANDRIA, LA. 71301

May 20, 1988

My views concerning the two plans:

According to the plans my sons property will definitely be effected. This property was purchased as a mental therapy.

My husband suffers from nerve problems and exercise is very important. So he walks a great deal. And of course neighbors like for people to stay on their own property. Especially in a case such as ours.

We are not against this river project, but you may as well know we will definitely have to move.

This place will be too small so we will have to be re-located.

Any help you can give us with this problem will be greatly appreciated.

From the looks of your plans there will be a pretty good size island left. Would you be willing to give it to us, tax free, for as long as a Vandeweyer walks on it.

Mrs Margaret Vandeweyer
Rt. 2 Box B, Boyce, Va. 22009

C-17.

Route 3, Box 157
Natchitoches, LA 71457
May 20, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Attention: LNMED-MW

Gentlemen:

My husband and I own a piece of property north of Grand Ecore in Natchitoches Parish. This property is bordered by Red River and will be adversely affected by the Navagation Project.

After carefully studying the maps in the Natchitoches Parish Library, it is evident that the original proposal (B3M) for Lock No. 4 would completely destroy our property. The channel would be cut across our land where my home is now located and the remaining land would be covered by dredge surplus.

By using the alternate plan (B1) my home would be saved, even though most of the land would be taken. We have lived in this house for twenty-three years and at this stage of our lives it is incomprehensible to be faced with relocating.

I urge you to adopt the alternate plan for use in the Red River Navagation Project.

Sincerely,

Dell Morgan

Mrs. Dell Morgan

C- 18.

June 2, 1980
304 Watson Drive
Natchitoches, LA 71457

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Attention: LNMED-MW

Gentlemen:

My family owns property north of Grand Ecore in Natchitoches Parish that would be completely taken under the proposed B3M Plan for the Red River Project. I support the B1 Plan and would ask that extreme consideration be given the B1 Plan. Under B1, a portion of the family property would be retained. Of this property, the family home would be saved. My parents are nearing retirement and for them to move to another location would be extremely difficult.

Our property will be affected under either of the two plans, however; B1 Plan would not take all of the family property as would the B3M Plan.

Thanking you in advance for your attention to this matter.

Sincerely yours,



Robert R. Morgan

June 2, 1980
304 Watson Drive
Natchitoches, LA 71457

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Attention: LNMED-MW

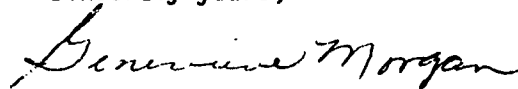
Gentlemen:

In response to your request on the Red River Project, the B3M Plan would be detrimental for my parents. My parents own property north of Grand Ecore in Natchitoches Parish. This property would be completely taken under the B3M Plan. However, under the B1 Plan the family home would not be involved in the Red River Project.

I believe that I am justified in requesting your consideration toward the B1 Plan instead of the B3M Plan.

Thank you.

Sincerely yours,


Genevieve Morgan

C-20.



RAPIDES WILDLIFE ASSOCIATION, Inc.

P. O. Box 431

ALEXANDRIA, LOUISIANA 71301



May 25, 1980

Colonel Thomas A. Sands
District Engineer, USA Corps Engineers
New Orleans District
Box 60267
New Orleans, LA 70160

Dear Col. Sands:

Here are the comments that I read at the Alexandria Corps Meeting, May 20, concerning your proposed alternate plan.

We regard the Red River Waterway as a waste of the Nation's resources, when the nation can ill afford it. Over 100 Million dollars will be spent on the project this year alone -- money that could be better spent reducing the Federal Deficit. The Benefit/Cost Ratio of the original selected plan was a marginal 1.05; now with the increased costs of the alternate plan, the costs must certainly outweigh the benefits.

A great deal has been said about the economic benefits that the barge traffic will bring to Central Louisiana. These benefits are highly speculative, and may at best benefit only a few selected interests. On the other hand, we believe that there is a very good chance that these barges will be hitting bridges that span the river. One has already hit the Boyce Bridge, and it is a matter of time before one or more of the major Alexandria Bridges are knocked into the water, perhaps with a considerable loss of life.

The Corps has had a long history of empty promises as far as wildlife mitigation is concerned. Again, we are "promised" that the Red River Waterway Commission will come up with their 50% of the matching funds for the recreation areas and the oxbow lakes. And as Colonel Sands admitted when I questioned him, if the 50% figure is not completely met by the RRWC, the whole package will go down the drain. And we view the latter as a distinct possibility, based on the Corps previous record.

We strongly suggest that all work on the Red River Waterway come to a halt until the public is assured that the money is in the bank for these Recreational Areas and Oxbow Lakes.

Sincerely,
John C. Moser
JOHN C. MOSER
President

C-21.

A. A. Ragan Realty Corp.
P. O. Box 13
Clarence, La. 71414

May 19, 1980

District Engineer
U.S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160
Attention: LMNED-MW

I am president of the A. A. Ragan Realty Corp., which contains 2,168.9 acres of land, with three locations on Red River at Grappe's Bluff 1100 acres, at Clarence 800 acres and at St. Maurice with 268.9 acres.

I am in favor of the Alternate Plan (B-1). I feel that the lower cost, less flooding and less ground water affects make this plan better for the land owners to get along with, along with a lower pool stage 135 ft. to 137 ft.

Eric A. Ragan President
William H. Ragan. Sec. -

A.A. Ragan Estate
Box 13
Clarence, LA 71414
May 17, 1980

District Engineer
U.S. Army Engineer District, New Orleans
Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160

Attention: SMED-MW

A.A. Ragan Estate requests that the
Corps of Engineers adopt the
Alternative Plan because this
plan will not adversely affect
(flood) agricultural acreage as
significantly as would the
Original Plan.

W. Herman Ragan
William H. Ragan

May 19, 1980 —

C- 23.

Lee Drape
General Delivery
Clarence, La. 71414
May 19, 1980

District Engineer
U.S. Army Engineer District
Corps of Engineers
P.O. Box 60267
New Orleans, La. 70160

Attention: LMNED-MW

Lee Drape request that the Corps of Engineers adopt the Alternate Plan (B.1) as this plan will not affect the flooding of agriculture land as the original Plan would.

Lee Drape

Camp, La.
May 12th 1980

District Engineer
U.S. Army Engineer District
Corps of Engineers
P.O. Box 60267
New Orleans, La. 70160
Attn: LMNED-MW

Dear Sirs:

I just want to say that
as a landowner of a small
part of the Red River bottom
land north of Natchitoches,
I hope you people will choose
the plan that will cause the
least flooding. That plan
seems to be the alternate (B1)
and will cost less money.

Sincerely,
Nathan Smith
Ethel Smith
Nelson L. Smith
Jack W. Smith
Paul R. Smith



PAUL J. HARDY
SECRETARY

Department of Transportation and Development

OFFICE OF PUBLIC WORKS

P.O. BOX 44155 CAPITOL STATION
BATON ROUGE, LA. 70804



DAVID C. TREEN
GOVERNOR

May 19, 1980

Colonel Thomas A. Sands
District Engineer
U.S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

RE: LMNED-MW
April 18, 1980
Red River Waterway Project, Louisiana

Dear Colonel Sands:

I have received your Public Meeting Announcement dated as indicated above concerning a public meeting to be held in Shreveport, Louisiana, on May 19 and in Alexandria, Louisiana, on May 20, 1980. The stated purpose of this meeting is to discuss alternate locations and pool elevations for Lock and Dams 2, 3, 4 and 5 of the Red River Waterway Project, Mississippi to Shreveport Reach. As a part of this meeting notice, Table I, a tabulation of comparative data, was included. This table referred to an alternate and original plans. Other information obtained from your office would indicate that the original plan you refer to is the B-3M Plan and the alternate is the B-1 Plan, both dated April 1980.

The Office of Public Works, Department of Transportation and Development, has in recent years assumed a new role and posture in State Government as well as its relationship to local governments and agencies involved in the Red River Waterway Project. The Office of Public Works has been previously designated by the Governor of Louisiana to represent the State on flood control, navigation and water resource projects and in addition we provide engineering services for the some 24 Levee Districts in Louisiana, 11 of which are affected by this waterway project. In addition to the above responsibilities, the Assistant Secretary, Office of Public Works, also acts as Chairman of the Red River Waterway Commission and provides staff support to that organization, which agency is the project sponsor.

The Office of Public Works has since the inception of this project endeavored to work closely with the New Orleans District Office to discuss the project requirements and needs as well as determine the affects of this project on the areas traversed. Some of these considerations are related to ground water conditions and flood control facilities. There have been, as you well know, numerous changes in the project since the original authorizing documents were prepared. A great many plans with various lock and dam locations and pool stages have been considered. Each of these plans having pronounced effects on local areas and including the

May 19, 1980

flood control project. The Office of Public Works has not always been kept fully advised of the detailed planning for these various locations and pools as the information has been developed in your office. Previous discussions have brought out numerous questions related to the locations of Locks and Dams 3, 4 and 5 as well as the Pools 2, 3, 4 and 5. Since no appreciable amount of detailed mapping was available at that time, we were not able to make reasonable determinations as to the effects of these locations and pool elevations on existing Red River Floodway areas, as well as the impact on existing flood control levees along Red River. In addition, there were wide variances in possible and probable ground water impacts related to the various pool stages to be considered. Since that time we have had no further staff conferences for defining or discussing the unresolved questions.

Table I prepared and made a part of this meeting notice presents new data that has not previously been discussed with this Office. We certainly appreciate the stringent time frames that you are endeavoring to work within but this should not be allowed to prevent coordination with the Office of Public Works and the other agencies involved in this project. In reviewing the Table I there are a number of apparent and serious problem areas. I will briefly state some of these problems at this time; however, there will be a need for a more detailed staff conference in which a thorough and more detailed discussion can be held. For instance, Lock and Dam #2 is located at Mile 87 on both plans; however, the alternate plan has a 6 foot higher pool elevation. In the column indicated as ground water impacts, there is a change from having 28,080 acres beneficially affected under the B-3M Plan to having 30,160 acres adversely affected under the B-1 Plan. In addition, a general comment is made that the pool under the B-3M Plan may be 4 foot lower than needed. This does not appear to be consistent with the 6 foot change proposed in the pools for the two plans enumerated. There must be a common ground where maintenance can be reduced and the acreage affected adversely also reduced. For the other lock and dam locations 3, 4 and 5, significant changes have been made to dam locations as well as the pool elevations. A very preliminary comparison of the two plans does not indicate a reasonable improvement one over the other. In fact as related to impingement on levees, the alternate plan involved 3.9 miles as opposed to 3.5 miles for the original plan. The ground water impact statements for these three areas speaks in general terms of likely decrease or likely changes. These types of statements do not provide us with sufficient data to compare the two plans. It is apparent that Lock and Dam #5, having three different pool elevations, has such complex and numerous impacts as to make a reasonable decision difficult based on the data provided. The Office of Public Works cannot, at this time provide you with any meaningful input for your consideration without more conferences and without being provided with more detailed information. We certainly realize at this point in time that there are a number of questions, both engineering and legal, to be considered in determining the most feasible plan to be adopted. All of these conditions impact heavily on the Red River Waterway Project as well as all of the existing flood control features.

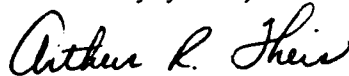
Of necessity flood control is paramount in the Red River Basin, We have fought for many years to establish a flood control system to protect the Red River alluvium.

Colonel Thomas A. Sands
Page 3
May 19, 1980

To date this flood control project is not complete. It is further complicated by the fact that the flood control features in your project, Red River Below Denison Dam, are only about 80% complete and therefore do not provide optimum protection for Louisiana. These aspects must be a part of our consideration in the Red River Waterway Project since the two are inseparable.

I would like to emphasize that the Office of Public Works supports this project and compliments you on your efforts to expedite the planning process. We will continue to cooperate and work closely with you and your staff to promote the progress of the project. We wish also to request that you keep these proceedings open for a sufficient time to allow us to meet with your staff and to formulate meaningful comments and recommendations for a reasonable and viable project.

Sincerely yours,



ARTHUR R. THEIS
CHIEF ENGINEER

ART:s1

xc: Mr. I. F. Hingle
Mr. Gerald Dyson
Mr. Richard Bennett

YOUNG ESTATE

CATTLE - TIMBER

Ph. 318-875-2759
Rt. 1, Box 139
Chestnut, La. 71017

Ph: 318-476-3732
P. O. Box 167
Campti, La. 71411

District Engineer
U.S. Army Engineering District, New Orleans
Corps of Engineers
Dt. Bag 60267
New Orleans, La 70160

Dear Colonel Sands.

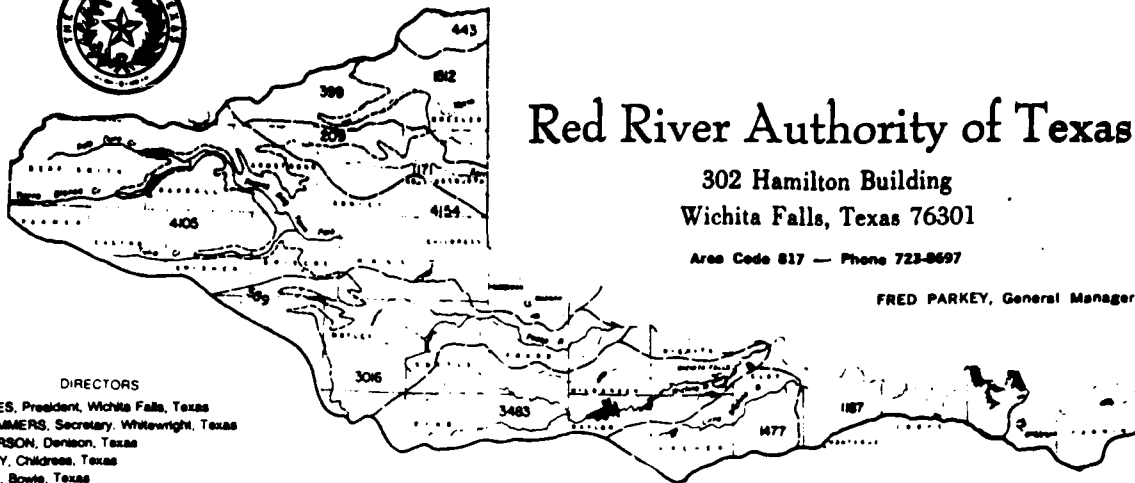
I am a landowner of a part of the Rich land of the Red River North of Campti. 600 acres is the location of my pasture that is one of the most outstanding in Natchitoches Parish. Four employees obtain their livelihood from working this property. If BOM is used this will force flood water through Times Bayou and destroy this land. BT would be very damaging, will you please consider this plan?

This land is my most valuable asset, and very valuable to four other families. Please reject BOM as it is destructive to so many neighbors, friends, as well as personally.

Sincerely

Mr D. Crawford Young -

C-29.



Red River Authority of Texas

302 Hamilton Building
Wichita Falls, Texas 76301

Area Code 817 — Phone 723-8697

FRED PARKEY, General Manager

DIRECTORS

ALVIN L. BARNES, President, Wichita Falls, Texas
WILLIAM H. SUMMERS, Secretary, Watauga, Texas
JOHN H. ANDERSON, Denison, Texas
MORRIS HIGLEY, Childress, Texas
JACK LOVETTE, Bowie, Texas
HARLAN E. HOOD, Vice President, Estelita, Texas
TOMMY D. CARNAHAN, Harford, Texas
BILL HOLMAN, Henrietta, Texas
JIM W. SOWELL, Quanah, Texas

May 29, 1980

Colonel Thomas A. Sands
District Engineer
U. S. Army Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: LMNED-MW

Dear Colonel Sands:

The Red River Authority of Texas created by the Texas Legislature, a legal subdivision of the State of Texas. The territory of the Red River Authority is from the New Mexico line to and include Fannin County Texas. From information provided us by the Red River Valley Association, of the Public Meeting held on April 18, 1980, discussing alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 on the Red River Waterway Project, Mississippi to Shreveport Reach. We offer the following comments on the proposals set forth in the announcement.

From information and technical data available to us, we feel that establishment of a pool elevation of either 135 feet or 137 feet for Lock and Dam No. 5 would be contrary to Congressional intent in its approval of the Red River Waterway Project, and further would adversely affect any additional upstream extension of navigation. We understand that concerned Louisiana citizens representing the Shreveport area sponsors of the Red River Waterway Project voiced their concerns to your staff at a meeting held in Shreveport on May 8, 1980. They feel that lowering of the pool elevation of Lock and Dam No. 5 would seriously hamper operation of the Waterway in the Shreveport area. We fully support these views. Additionally, Texas is concerned that any short-sighted changes to the authorized features of the Project could preclude, or make exceedingly difficult, the logical extension of the Waterway into Arkansas and Texas in the future.

Colonel Thomas A. Sands
Page Two

May 29, 1980

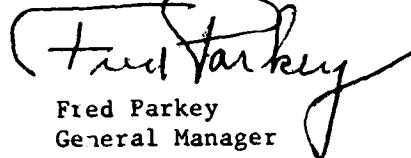
Congress has approved navigation from the Mississippi River to Shreveport, Louisiana and from Shreveport to Daingerfield, Texas as a feature of the Red River Waterway Project. Bank stabilization from Shreveport to Index, Arkansas to Lake Texoma is also authorized. We sincerely feel that navigation to Index, Arkansas and Lake Texoma will be authorized by Congress in the future..

We understand that your restudies have determined that navigation in the Shreveport to Daingerfield reach was not economically feasible at the time of the study, follow-up studies using more recent data are currently in progress. We feel these studies will show a favorable benefit/cost ratio for navigation in the Shreveport to Daingerfield reach. As we understand your alternate proposal for a pool elevation of 135 or 137 feet for Lock and Dam No. 5, adoption of either proposal would require an additional cost of at least \$100 million to previously-computed costs of an extension of navigation through Shreveport and upstream.

The Red River Authority of Texas would like to recommend that the alternative of lowering the pool elevation of Lock and Dam No. 5 to 135 feet or 137 feet not be considered further. We recommend that you consider two alternate proposals, both of which accomplish navigation to Shreveport as presented to and approved by Congress. One proposal would be for a pool elevation of 145 feet; the alternate proposal is to proceed with both Lock and Dam No. 6 at the locations and pool elevations as presented to, and approved by, Congress.

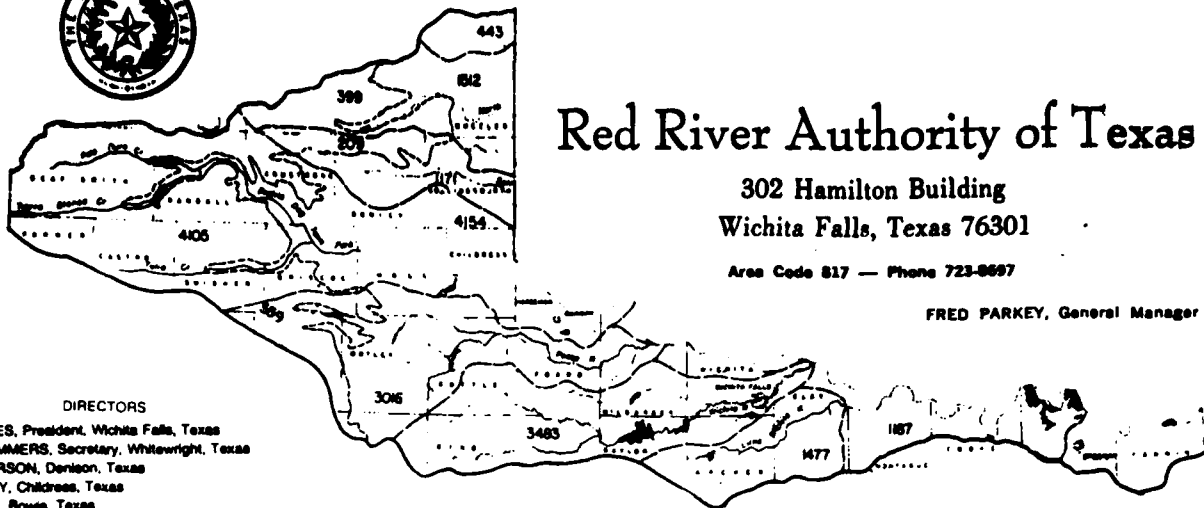
Sincerely yours,

RED RIVER AUTHORITY OF TEXAS


Fred Parkey
General Manager

bc

cc: Homer Tanner, Municipal Water District
Champ Baker, Red River Valley Association



Red River Authority of Texas

302 Hamilton Building
Wichita Falls, Texas 76301

Area Code 817 — Phone 723-8897

FRED PARKEY, General Manager

DIRECTORS

ALVIN L. BARNES, President, Wichita Falls, Texas
WILLIAM H. SUMMERS, Secretary, Whitewright, Texas
JOHN H. ANDERSON, Denison, Texas
MORRIS HIGLEY, Childress, Texas
JACK LOVETTE, Bowie, Texas
HARLAN E. HOOD, Vice President, Estelline, Texas
TOMMY D. CARNAHAN, Hereford, Texas
BILL HOLMAN, Henrietta, Texas
JIM W. SOWELL, Quanah, Texas

June 5, 1980

Colonel Thomas A. Sands
District Engineer
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

Enclosed please find a copy of our proposed Resolution for the Stream Bank Stabilization and Navigation of the Red River from Index Arkansas to Lake Texoma, for your circulation.

Sincerely yours,

RED RIVER AUTHORITY OF TEXAS

Fred Parkey
Fred Parkey
General Manager

bc

Enclosure

C-32.

BE IT RESOLVED:

THAT, at a meeting in Denison Texas, of representatives of the Red River Valley Association of the States of Texas and Oklahoma, cities, and county officials of Grayson, Fannin, Lamar, Red River, and Bowie counties, Soil and Water Conservation district directors of the above counties, North East Texas RC&D Project, Chamber of Commerce and citizens interested in Stream Bank Stabilization and Navigation of the Red River from Index Arkansas to Lake Texoma, were discussed at length, and we would like to submit this Resolution in response to navigation of the Red River.

WHEREAS, the Red River Valley Association have provided us a copy of your April 18, 1980 Announcement of Public Meeting to discuss alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 of the Red River Waterway Project, Mississippi River to Shreveport Reach. We offer the following comments on the proposals set forth in the announcement.

WHEREAS, on the basis of information and technical data available to us, we feel that establishment of a pool elevation of either 135 feet or 137 feet for Lock and Dam No. 5 would be contrary to congressional intent in its approval of the Red River Waterway Project, and further would adversely affect any additional upstream extension of navigation. We understand that concerned Louisiana citizens representing the Shreveport area sponsors of the Red River Waterway Project voiced their concerns to your staff at a meeting held in Shreveport on May 8, 1980. They feel that lowering of the pool elevation of Lock and Dam No. 5 would seriously hamper operation of the Waterway in the Shreveport area. We fully support these views. Additionally, Texas is concerned that any shortsighted changes to the authorized features of the Project could preclude, or make exceedingly difficult the logical extension of the Waterway into Arkansas and Texas in the future.

WHEREAS, Congress has approved navigation from the Mississippi River to Shreveport, Louisiana and from Shreveport to Daingerfield, Texas as a feature to the Red River Waterway Project. Bank Stabilization from Shreveport to Index, Arkansas is also authorized. We sincerely feel that navigation to Index, Arkansas and Lake Texoma will be reality in the future.

WHEREAS, we understand that your restudies have determined that navigation in the Shreveport to Daingerfield reach was not economically feasible at the time of the study, follow-up studies using more recent data are currently in progress. We feel these studies will show a favorable benefit/cost ratio for navigation in the Shreveport to Daingerfield reach. As we understand your alternate proposal for a pool elevation of 135 or 137 feet for Lock and Dam No. 5, adoption of either proposal would require an additional cost of at least \$100 million to previously-computed costs of and extension of navigation through Shreveport and upstream.

Signed this 9th day of June, 1980.

[illegible]

RED RIVER COMMISSION

Suite Six • State Line Plaza • Phone (501) 773-5651
Texarkana, Arkansas 75502

STATEMENT OF RED RIVER COMMISSION OF ARKANSAS BY VINCENT W. FOSTER, CHAIRMAN

As Chairman of the Red River Commission of Arkansas, and with the unanimous approval of the entire Commission, I wish to convey the extreme concern of Arkansas in the possible change of the location and pool elevation for Lock and Dam No. 5 on the Red River as a part of the Red River Waterway Project, Mississippi to Shreveport, Louisiana -- and voice our disapproval of either of the alternate plans.

The original plans for the locks and dams to be constructed included a Lock and Dam No. 6, as well as a Lock and Dam No. 5. Lock and Dam No. 6 has now been eliminated and the pool elevation of Lock and Dam No. 5 lowered from 150 feet to 145 feet at a possible savings of over \$150 million or more. The alternate plans proposed would not only lower the pool elevation to 135 or 137, but also would cause the planned port facilities at Shreveport-Bossier City area to be abandoned and relocated down-river at the disadvantage of all upstream and potential area uses of the port.

Commencing with the authorization of the Millwood Dam in Arkansas in 1946, and until the completion of its construction, many citizens of Arkansas,

including myself, joined in with the Red River Valley Association and made annual trips to Washington, D.C. to encourage our Arkansas Congressional delegation, headed by the late Senator John L. McClellan, to provide funding of our river projects.

The State of Arkansas and its elected officials of the state and in Congress have continuously supported the Mississippi to Shreveport project based on the assumption and assurances from our Louisiana friends and officials that they in turn would provide like support for our Red River Waterway, Shreveport to Index, Arkansas, project and future improvements of the Red River Basin upstream.

This agreement and understanding was struck at a time when the late John L. McClellan was serving as United States Senator from the State of Arkansas, and the people and officials of Arkansas have relied upon this understanding in continually supporting navigation on the Red River as a whole. The people of Arkansas see no cause whatsoever to change or to alter the foundation upon which the navigation project as a whole was based at this late date, and urge the Corps of Engineers and all other responsible public servants to refrain from doing so.

The State of Arkansas and this Commission, after it was appointed by the then Governor of Arkansas, the Honorable Dale Bumpers, for the last eleven consecutive years have sent representatives to Washington, D.D. to testify before both Houses of Congress, with personal appearances by our Congressional delegation,

not only for projects located and situated in Arkansas, but also specifically for the Mississippi River to Shreveport reach of the Waterway. The same support has been evidenced by like representatives from Texas and Oklahoma.

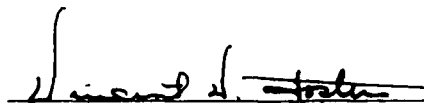
From the very beginning of these representations, it has been the understanding of everyone involved and affected by this navigation project that the pool levels provided for in the series of locks and dams were to be of sufficient height to make further navigation beyond Shreveport both feasible and possible in the future.

It would be absolutely foolish to eliminate the possibility of future navigation to the States of Arkansas, Texas and Oklahoma by the suggested alternate elevations and relocation of Lock and Dam No. 5. To deny these states the benefit of navigation and the tremendous loss it would be to their economy in the future, for the purported savings in the alternate plans, cannot be justified or tolerated.

We sympathize with the Louisiana landowners whose property might be adversely affected by the higher pool level. However, they and the rest of the people downstream on the Red River in Louisiana must remember the many sacrifices in land and timber made by the people of Arkansas, Texas and Oklahoma on such projects as the Millwood Reservoir and Wright Patman Lake which have been instrumental in helping to keep much greater areas of Louisiana lands from being flooded.

The Honorable Bill Clinton, Governor of the State of Arkansas, and the Arkansas Congressmen and Senators have been alerted to these alternate plans and their ultimate effect on Arkansas. It is our sincere belief that they will do everything in their power, working with the Governors and members of the other three states' Congressional delegation, to see that the original plans are carried through.

The Red River Commission of Arkansas pledges an all-out effort, working with our sister states, to the over-all completion of all of our Red River Basin projects, but particularly to the completion of Lock and Dam No. 5 as originally planned and opposed to the penny-wise/pound-foolish solution offered by the alternate plans.



Vincent W. Foster, Chairman
Red River Commission

cc: The Honorable Dale Bumpers
United States Senator

The Honorable David Pryor
United States Senator

The Honorable John Paul Hammerschmidt
Member of Congress

The Honorable Bill Alexander
Member of Congress

The Honorable Ed Bethune
Member of Congress

The Honorable Beryl Anthony, Jr.
Member of Congress

The Honorable Sam B. Hall, Jr.
Member of Congress

The Honorable Bill Clinton
Governor, State of Arkansas

Members of the Red River Commission

A resolution passed by the Denison Area Chamber of Commerce Board of Directors at their regular monthly meeting held 12:00, Noon, Tuesday, June 10, 1980 expressing their strong support of the original Corps of Engineers plan to build the locks and dams just south of Shreveport, Louisiana to a height of 145 feet.


WHEREAS, for the past 50 years the Denison Area Chamber of Commerce have worked diligently to bring navigation up the Red River to Denison; and

WHEREAS, the present world situation and energy considerations are of paramount importance when considering new transportation projects. That water transportation is most economical and energy efficient way to move large masses of materials and goods and we feel that this should be a new impetus to bring water transportation to upper regions of the Red River; and

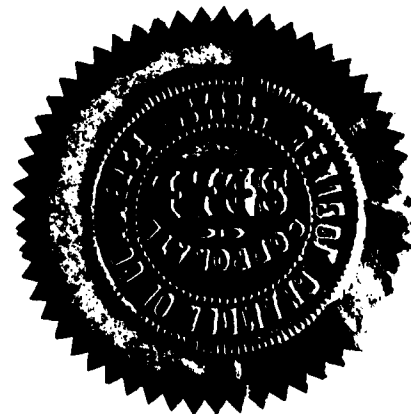
WHEREAS, the Corps of Engineers original study of the locks and dams at 145 feet just below Shreveport to allow transportation to these upper regions the Red River Basin;

NOW THEREFORE LET IT BE RESOLVED that the Denison Area Chamber of Commerce urges the New Orleans District of the Corps of Engineers to stand by their original study and keep the locks and dams below Shreveport at 145 feet in order that another lock and dam system will not be required costing \$120,000,000 to bring navigation to the Denison Dam.

We feel that this project is of the utmost importance not only to our immediate area but of the four states of Oklahoma, Texas, Arkansas and Louisiana.


Ben Munson, IV
President


Bruce Barton
Secretary





**HOPE-HEMPSTEAD COUNTY
CHAMBER OF COMMERCE**

May 29, 1980

Colonel Thomas A. Sands
District Engineer
U.S. Army Engineer District, New Orleans
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

The Hope-Hempstead County Chamber of Commerce expresses its appreciation to the Corps of Engineers for the opportunity to appear before the Corps and relate our views in regard to alternate location and pool elevations for Lock and Dam number 5 on Red River Waterway Project.

As stated at that hearing on May 18, in Shreveport, Louisiana, the Chamber of Commerce of Hope and Hempstead County strongly oppose the alternate plans on Lock and Dam number 5 that would lower the pool level from 145 feet to a possible 137 or 135 feet and virtually eliminate any navigation to the city of Shreveport and beyond.

We believe that the tremendous amount of money and effort that has been expended on channel realignment and bank stabilization from Shreveport north to Fulton and Index, Arkansas will someday be a great asset in the realization of navigation to those points.

It is also our opinion that to lower the pool level at Lock and Dam number 5 and the elimination of future navigation to points in Louisiana, Texas, Arkansas and Oklahoma would be a short sighted action and a great injustice to those states and their people who have worked so hard on the Red River Waterway Project.

A pool level of 145 feet and port facilities in and north of Shreveport would be more serviceable to these states until authorization for navigation past Dangerfield is a reality. A port facility located 10 miles south of Shreveport, as called for by alternate plans, would not be serviceable or practical.



HOPE-HEMPSTEAD COUNTY CHAMBER OF COMMERCE

It is estimated that navigation on the Arkansas River has produced an investment of nearly 4 billion dollars in new and expanding industry. Arkansas's very first major foreign investment in industry was on the Arkansas River. It is also estimated that there are 23 to 25 million visitor days recorded annually at the various recreation areas on the Arkansas River.

The Red River Waterway Project could be an equally successful project and hopefully will be if given the proper consideration. The states of Louisiana, Arkansas, Texas and Oklahoma have long awaited an inland water route that could furnish barge transportation north and south the length of the United States.

We thank you again for your kind consideration and hospitality and hope that you realize the importance of Lock and Dam number 5 and the pool level remaining at 145 minimum to make any future plans of navigation upstream from Shreveport economically feasible.

Sincerely,

A handwritten signature in cursive script that reads 'Bob Embry'.

Bob Embry
Executive Vice-President

BE/bb

cc Senator Dale Bumpers
cc Senator David Pryor
cc Congressman Beryl Anthony

Clarksville Chamber of Commerce

Wini Bishop, President

Clarksville, Texas 75426

101 N. LOCUST ST.

PHONE 427-2845

Directors:

Jerry Ables
Duane Benson
Wini Bishop
Harry Bomar
Bob Bowden
Ida Mae Giles
Dick Goodman
Austin Guest
Larry Hogland
Marion Lowe
Marilyn Morris
Mickey Porterfield
Jimmy L. Smith
Mary Margaret Sturdivant
Sandy Wester
Gary Wilkins
L.D. Williamson
Cab Wolf

June 5, 1980

Secretary:

Mary Whiteman

District Engineer
U. S. Army Engineer District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTENTION: LMNED-MW

Dear Sir:

Enclosed herewith is a copy of the Resolution passed and adopted by the Clarksville Chamber of Commerce at a regular meeting held on June 4, 1980 in regard to the elevation of Lock and Dam No. Five on Red River.

The membership wholeheartedly urges the Corps of Engineers to develop the Red River to its maximum potential for navigational purposes. We urge the Corps of Engineers to design and proceed with the construction whereby all of the River to Denison Dam can be eventually utilized for barge transportation.

Sincerely yours,

Wini Bishop

Wini Bishop
President
Clarksville Chamber of Commerce

RESOLUTION

WHEREAS, the Corps of Engineers is in the process of making a determination as to the elevation at which Lock and Dam No. Five of the Red River Waterway Project will be constructed; and

WHEREAS, by constructing Lock and Dam No. Five at 145 MSL, navigation on Red River can be extended on to Daingerfield and will afford a greater opportunity for navigation to Index, Arkansas and on up the River to Denison Dam; and

WHEREAS, barging is the most economical method of transporting freight; and

WHEREAS, fossil fuel will be in shorter supply in the future and more expensive, it will be wise to utilize water for transportation.

NOW, THEREFORE, the Clarksville Chamber of Commerce wholeheartedly urges the Corps of Engineers to design Lock and Dam No. Five at 145 MSL whereby the Red River can be developed to its maximum potential for navigational purposes.

Passed and adopted at a regular meeting of the Clarksville Chamber of Commerce held on June 4, 1980.

City of Hope

Hope, Arkansas 71801

Office of the Mayor

June 4, 1980

Colonel Thomas A. Sands
District Engineer
U. S. Army Engineering District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

Please enter the following sentiments of the citizens of Hope and Hempstead County, Arkansas, into the records concerning the proposed change in the elevation of the pool below Lock and Dam #5, and the proposed change in the location of Lock and Dam #5.

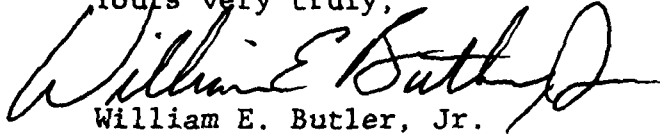
Our engineering firm has indicated that lowering the pool level to any level less than 145 feet would result in a significant impact upon the cost of future development of navigation above Shreveport. According to the Corp's estimates, the proposed changes would result in a savings of \$150,000,000.00. It would seem foolish to us to affect a \$150,000,000.00 savings just to create a much greater expense in future development - unless it is the intention of the Corp of Engineers and U. S. Congress to abandon the possibility of development of future navigation above Shreveport. If this is the case, then the citizens of Arkansas, Texas, and Oklahoma have truly been betrayed. The reality of this project thus far has been due in great part to the efforts of the legislators of these three states and the hard work and support of the citizenry. Although navigation above Shreveport is not approved, the implication has always existed that this would be the ultimate goal.

June 4, 1980
Colonel Thomas A. Sands
- Page Two -

Most every project designed for the public good will inconvenience a few individuals. This is the case with the Red River Valley project. However, the public good must be held in greater value than the inconvenience of a few.

We, therefore, strongly urge that the U. S. Corp of Engineers continue with the project as was originally designed and maintain the river level below Lock and Dam #5 at 145 feet.

Yours very truly,

A handwritten signature in cursive script, reading "William E. Butler, Jr.", written in dark ink.

William E. Butler, Jr.

WEB,Jr:dc



STATE OF ARKANSAS
OFFICE OF THE GOVERNOR
State Capitol
Little Rock 72201

Bill Clinton
Governor

June 18, 1980

Colonel Thomas A. Sands
District Engineer
New Orleans District, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Re: Red River Project Public Meeting
Shreveport, Louisiana, 19 May 1980

Dear Colonel Sands:


I support the Red River navigation project which presently authorizes navigation to Daingerfield, Texas. When this project is completed it will benefit this region of the nation including the counties of southwest Arkansas. The accruing benefits should be in the form of an added mode of transportation increasing the economic development of the basin.

I am advised that by lowering Lock and Dam 5 from an elevation of 145 feet mean sea level (MSL) to either 135 feet or 137 feet MSL would cause navigation on the Red River to terminate just south of Shreveport, Louisiana. I am further advised that such an effort would reduce the project cost by approximately 60 million dollars.

This questionable saving would result in the Corps not providing navigation to Daingerfield, Texas and denying a navigation option to Arkansas, Oklahoma and other parts of Texas. If the lowering of the elevation of Lock and Dam 5 is pursued and in subsequent years a decision is made to have the head of navigation extended to Index, Arkansas, this \$60,000,000 imputed saving would probably cost the nation an additional \$150,000,000 to \$200,000,000.

You are advised that the State of Arkansas wants the Red River made navigable to Daingerfield, Texas and that this basin should be allowed to develop to its fullest potential consistent with the needs of the people and sound environmental and engineering practices.

Sincerely,


BILL CLINTON
Governor

BC/JJ/wggm

C-46.



CADDO/BOSSIER PORT COMMISSION

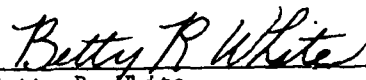
P.O. BOX 1983, SHREVEPORT, LOUISIANA 71166

RESOLUTION FAVORING CONTINUANCE OF 145 FT. POOL ELEVATION FOR RED RIVER LOCK AND DAM 5

- WHEREAS: A pool elevation of 145 feet for Lock and Dam 5 has been an integral part of the design of the Red River Navigation Project since the U. S. Army Corps of Engineers redesigned the project to eliminate the necessity of constructing a sixth Lock and Dam south of Shreveport-Bossier City; and
- WHEREAS: The Red River Navigation Project as authorized by Congress since 1968 calls for navigation on the Red River to be completed through Shreveport and Bossier City; and
- WHEREAS: A pool elevation at Lock and Dam 5 of 137 feet would assure navigation only to the railroad crossing located just north of Jordan Street; and
- WHEREAS: A pool elevation at Lock and Dam 5 of 135 feet would assure navigation only to the Jimmy Davis Bridge, barely within the city limits of the two communities; and
- WHEREAS: Retaining the 145 foot pool elevation would not adversely affect nor cause a dramatic loss of valuable farm land; and
- WHEREAS: A pool elevation of 135 feet or 137 feet would for all intents and purposes jeopardize Red River navigation beyond Shreveport and Bossier City since another dam would have to be constructed to raise the pool level to the required depth, at great cost and even greater liability to the cost/benefit ratio of navigation beyond Shreveport to Dangerfield and other possible locations in Texas and Arkansas.

NOW, THEREFORE, BE IT RESOLVED that the Caddo-Bossier Parishes Port Commission meeting in regular session on May 14, 1980, has voted unanimously to call upon the U. S. Army Corps of Engineers to maintain the pool elevation level at Lock and Dam 5 at 145 feet to ensure the intent of the Congressional authorization for the Red River Navigation project through Shreveport-Bossier City is complied with and to ensure that the future potential for Red River navigation beyond Shreveport-Bossier City is not unnecessarily jeopardized.

Witnessed:


Betty R. White
Secretary


Aaron Selber, Jr.
President

May 14, 1980

MEMBERS: Aaron Selber, Jr., President; John S. Turner,
Vice-President; Betty R. White, Secretary; Claude H. Grace, Treasurer;
Sinclair Kouns, Rogers M. Prestridge, Byrum W. Teekell.

C-47.

CITY of ORE CITY
GATEWAY TO LAKE O' THE PINES
P. O. BOX 327
ORE CITY, TEXAS 75683

Colonel Thomas Sands
U. S. Corps of Engineers
P. O. Box 60267
New Orleans, LA. 70160

Re: LMNED-MW

Dear Sir:

The city of Ore City wishes to respond to the U. S. Corps of Engineers request for public input set forth in your announcement of Public Meeting dated April 18, 1980, in regard the Red River Waterway Project, Mississippi to Shreveport Reach.

This city has a specific interest in the pool elevation of Lock and Dam #5 being retained at the proposed 145 MSL elevation to insure future navigation to Lake O' the Pines. Any lower modification of that pool elevation would be totally unacceptable to us.

We remind you the removal of Lock and Dam #6 (and the savings to the project) was done without benefit of public hearing and that removal endangered the furtherance of the project. We are pleased the proposed changes in location and pool elevations received the benefit of public hearing permitting the inclusion of this statement.

Respectfully,

City of Ore City

J. A. Coffman
Alfred Miller
John W. Ferguson
Stanley R. Ellis
Jack Couch
Glenn Brazzale

C-48.

TEXAS DEPARTMENT OF WATER RESOURCES

1700 N. Congress Avenue
Austin, Texas



Harvey Davis
Executive Director

May 16, 1980

TEXAS WATER DEVELOPMENT BOARD

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John H. Garrett, Vice Chairman
George W. McCleskey
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W. O. Bankston
Lonnie A. "Bo" Pilgrim

TEXAS WATER COMMISSION

Felix McDonald, Chairman
Dorsey B. Hardeman
Joe R. Carroll

Colonel Thomas A. Sands
District Engineer
U.S. Army Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, Louisiana 70160

Attention: LMNED-NW

Dear Colonel Sands:

Representatives of the Red River Valley Association have provided us a copy of your April 18, 1980 Announcement of Public Meeting to discuss alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 of the Red River Waterway Project, Mississippi to Shreveport Reach. We offer the following comments on the proposals set forth in the announcement.

On the basis of information and technical data available to us, we feel that establishment of a pool elevation of either 135 feet or 137 feet for Lock and Dam No. 5 would be contrary to Congressional intent in its approval of the Red River Waterway Project, and further would adversely affect any additional upstream extension of navigation. We understand that concerned Louisiana citizens representing the Shreveport area sponsors of the Red River Waterway Project voiced their concerns to your staff at a meeting held in Shreveport on May 8, 1980. They feel that lowering of the pool elevation of Lock and Dam No. 5 would seriously hamper operation of the Waterway in the Shreveport area. We fully support these views. Additionally, Texas is concerned that any short-sighted changes to the authorized features of the Project could preclude, or make exceedingly difficult, the logical extension of the Waterway into Arkansas and Texas in the future.

As you know, Congress has approved navigation from the Mississippi River to Shreveport, Louisiana and from Shreveport to Daingerfield, Texas as a feature of the Red River Waterway Project. Bank stabilization from Shreveport to Index, Arkansas is also authorized. We sincerely feel that navigation to Index, Arkansas will be authorized by Congress in the future.

Although we understand that your restudies have determined that navigation in the Shreveport to Daingerfield reach was not economically feasible at the time of the study, follow-up studies using more recent data are currently in progress. We feel these studies will show a favorable benefit/cost ratio for

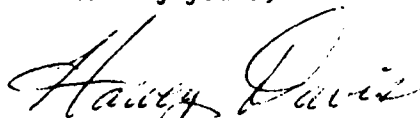
C-49.

Colonel Thomas A. Sands
May 16, 1980
Page Two

navigation in the Shreveport to Daingerfield reach. As we understand your alternate proposal for a pool elevation of 135 or 137 feet for Lock and Dam No. 5, adoption of either proposal would require an additional cost of at least \$100 million to previously-computed costs of an extension of navigation through Shreveport and upstream.

We recommend that the alternative of lowering the pool elevation of Lock and Dam No. 5 to 135 feet or 137 feet not be considered further. We recommend that you consider two alternate proposals, both of which accomplish navigation to Shreveport as presented to and approved by Congress. One proposal would be for a pool elevation of 145 feet; the alternate proposal is to proceed with both Lock and Dam No. 5 and Lock and Dam No. 6 at the locations and pool elevations as presented to, and approved by, Congress.

Sincerely yours,



Harvey Davis
Executive Director

cc: Governor William P. Clements, Jr.
Representative Sam B. Hall, Jr.
Commissioner Kenneth E. Nelson

CITY OF GARLAND

GARLAND, ARKANSAS 71839

June 17, 1980

District Engineer
U. S. Army Engineer District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

I, and many other people in the Garland, Arkansas, community and area, are deeply concerned that the pool level of Lock and Dam No. 5 may be lower than the 145 feet level originally planned. This lower level would completely destroy or considerably diminish the possibility of navigation on the Red River from Shreveport, Louisiana, to Index, Arkansas, through Garland, Arkansas.

I would like to express my continuing support for the navigation project from the Mississippi River to Denison Dam and would ask that the Corps of Engineers use extreme care and caution in revising any plans for the Mississippi River to the Shreveport stretch that might have an adverse affect on the remainder of the project.

Sincerely,



Martha Franklin, Mayor
Garland, Arkansas



James H. Phillips
EXECUTIVE DIRECTOR
(501) 371-1173

ARKANSAS WATERWAYS COMMISSION
Executive Bldg., Suite 506, 2020 W. 3rd St.
LITTLE ROCK, ARKANSAS 72205

June 5, 1980

COMMISSIONERS
H. K. THATCHER
CAMDEN
OUACHITA RIVER BASIN
JAMES WALDEN
HELENA
MISSISSIPPI RIVER BASIN
L. E. GILLILAND
TEXARKANA
RED RIVER BASIN
CHARLES D. MAYNARD Chairman
LITTLE ROCK
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H. CARTER JEFFERY V. Chr.
BATESVILLE
WHITE RIVER BASIN
L. E. THOMPSON
PINE BLUFF
ARKANSAS RIVER BASIN
ROBERT H. PARKER
RUSSELLVILLE
AT LARGE

Colonel Thomas A. Sands
District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

WRITTEN STATEMENT OF L. E. GILLILAND
FOR
DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS

RE: Public Meeting held May 19, 1980, Shreveport, Louisiana

I have followed the development of the Red River Basin with great interest for years. I cheered for the successes of those early Red River men of vision who started things happening in the valley. I have felt the same sharp pangs of despair and regret as these leaders when the purse strings of the nation dictated minimum progress on the development of the river.

The people who have worked for the Red River Project through Congress gave the Corps the job of providing navigation to Daingerfield, Texas. Granted it was funded for now only to Shreveport, Louisiana. Now the nation is faced with an energy shortage and a potentially greater water shortage and we are right back again trying to save dollars in the wrong area. The doors should not be closed to the ultimate total development of the river to Fulton and Index, Arkansas, and Denison, Texas, or for providing navigation for Arkansas, Oklahoma, and Texas.

At the May 19, Public Meeting conducted by the New Orleans District, Corps of Engineers, varying plans for the elevation of Lock and Dam #5 were discussed. The lowering of Lock and Dam #5 would virtually eliminate navigation upstream. It would also endanger, if not totally cancel, the construction of the authorized navigation to Daingerfield, Texas.

The Red River Navigation System has a potential that exceeds any system in the nation other than the Mississippi River. On the banks of Red River there exists a large portion of the agricultural production of the nation. This tonnage and the necessary agricultural supplies are substantial loads that need the most economical mode of transportation. The present modes of transportation are becoming too expensive. This is

G-52.

Colonel Thomas A. Sands
Page 2
June 5, 1980

in an area where 25,000,000 people reside with little other than motor transportation available. The waters of Red River, if cleared of excessive salt, would increase the areas productivity by using the water for irrigation. The economic and population growth of the area would be expedited with the advantage of low cost water transportation and high quality water.

The Commission opposes the lowering of Lock and Dam #5 from its authorized 145' M.S.L. to 135' or 137' M.S.L.



L. E. Gilliland, Manager
The Southwest Arkansas Water District

LEG/eh

cc: Senator David Pryor
Senator Dale Bumpers
Representative Bill Alexander
Representative Ed Bethune
Representative J. P. Hammerschmidt
Representative Beryl Anthony
Senator Russell Long



CITY OF TEXARKANA, ARKANSAS

3RD & WALNUT STREETS - PHONE (501) 774-3161

P. O. BOX 2711 - TEXARKANA, ARKANSAS 75502

June 17, 1980

District Engineer
U.S. Corp of Engineer District, New Orleans
Post Office Box 60267
New Orleans, LA 70160

Attention: LMED-MW

Dear Sir:

On behalf of the City of Texarkana, Arkansas, this statement is submitted as our strong endorsement of the testimony of the Red River Commission of Arkansas through its Chairman, Vincent W. Foster. Either of the alternate plans to change proposed location/pool elevation for Lock & Dam #5 is clearly unacceptable to the proper development of the Red River Waterway project.

The citizens of Southwest Arkansas have labored continuously for over 3½ decades to provide a viable Red River Waterway and attendant economic development and resource conservation programs. The original plans that these many years of work created should not be abandoned or changed at all, especially in the name of "economy" which would be a pro forma case of being penny-wise yet pound-foolish, as Mr. Foster aptly puts it. Count our 21,632 citizens in with him.

Sincerely,

George F. Lease
City Manager

GFL:sak

cc: Jim Nutt

II:F



DAINGERFIELD CHAMBER OF COMMERCE

100 Colley Street • Daingerfield, Texas 75638 • 214 / 645-2446

May 23, 1980

Colonel Thomas A. Sands
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: Red River Navigation Canal to Daingerfield

Dear Colonel Sands:

I am writting you this letter to show our full support to keep the water level at 145 feet for lock and dam # 5 by Shreveport.

Although Lone Star Steel is the largest industry in our area, there have been over 35 new major industrials constructed here within the last five years. These Industrys ship and receive thousands of tons a month of various materials and would greatly benefit by having a navigation canal to Daingerfield.

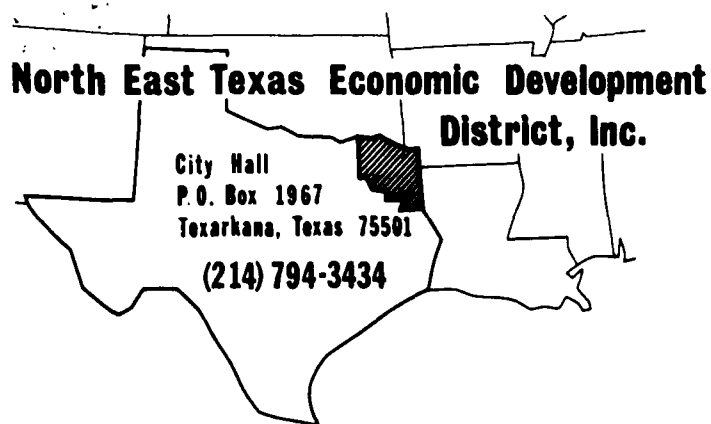
In addition, the vast amount additional water that would be made possible by these locks and dams would insure our water supply and continued growth for many years to come.

Sincerely,

Warren Nilsson
Chairman Industrial Committee

WN/ms

Daingerfield Citizens Care
C-55.



May 21, 1980

LOWELL CABLE
President
Sulphur Springs

JAMES M. STANFILL
Vice President
Marshall

BERNARD A. LEMSER
Secretary-Treasurer
Texarkana

J. SAM SPEARMAN
Executive Director

Colonel Thomas A. Sands
District Engineer
U.S. Army Engineer District, New Orleans
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

ATTN: LMNED-MW

Dear Colonel Sands:

BOWIE

CAMP

CASS

DELTA

FRANKLIN

GREGG

HARRISON

HOPKINS

LAMAR

MARION

MORRIS

NANTALA

RED RIVER

TITUS

UPSHUR

WOOD

The opportunity to express our interest in the pool elevation for Lock and Dam #5 of the Red River Waterway Project is appreciated, and we submit these comments according to the governing policies and procedures to become a part of the proceedings of the public meeting held in Shreveport, Louisiana, on May 19, 1980.

The North East Texas Economic Development District serves sixteen counties and operates under terms and conditions as set forth by the Economic Development Administration, U.S. Department of Commerce. Our planning process is based on input from representatives of business, labor, education, finance, government, agriculture, and ethnic groups. It reflects the needs and goals of the area from a "grassroots level". Each of the counties in the District common to the Red River Basin foresee the need for the full development of the Red River and its resources as being essential to the economic growth and stability of the North-east Texas area. We support a location and pool level of Lock and Dam #5 which will allow navigation through Shreveport up Twelve Mile Bayou to Caddo Lake Dam.

We understand there are three different pool elevations being considered for Pool #5. The 145' MSL pool would provide a navigable depth past Shreveport up Twelve Mile Bayou to Caddo Lake Dam, while the 137' MSL pool would provide navigation barely into Shreveport, and the 135' MSL pool would provide navigation ten miles downstream from Shreveport. The River and Harbor Act of August 1968 authorizes, in addition to the Mississippi to Shreveport Reach, a 9 by 200 foot realigned and stabilized navigation channel extending 75 miles upstream from Shreveport to

Colonel Thomas A. Sands
May 21, 1980
Page 2

Daingerfield, Texas, via Twelve Mile and Cypress Bayous, including 3 locks and dams of which two dams are existing.

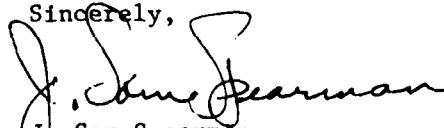
Additionally funds for a transportation economic reanalysis of the Shreveport to Daingerfield Reach were provided by the Appropriation Act of 1973, and that report is scheduled to be completed later this year. We were encouraged to hear you say in Shreveport that the transportation reanalysis was of such magnitude to warrant further economic analysis of the Daingerfield Reach.

It would seem that a decision which would result in a pool level less than 145' MSL would affect the cost-benefit ratio of the Daingerfield Reach, possibly placing it in jeopardy. Such a decision would certainly violate the intent of the River and Harbor Act of August 1968 since there has been no Congressional action to alter this project. Such a decision would limit future development efforts on the Red River to Index, Arkansas, Denison Dam and even beyond.

Peeping into the future we will see the Red River exceeding the potential of any other river system in the nation other than the Mississippi. The Red River penetrates the heartland of agricultural America; and upon the completion of the desalinization project in the Wichita Falls' area, the waters of the Red can be used for irrigation which will substantially increase the area's productivity. A large portion of the nation's grain is produced on the High Plains of Texas which is the origin of this mighty river. Each year this grain production is limited and some wasted because of inadequate transportation facilities, and we expect this situation to become more critical as energy costs increase. We envision a major portion of the Nation's food supply being transported on a navigable Red River to Denison Dam or beyond. The Red River could also be used to facilitate water management and to transfer water to areas where shortages exist.

The development of the Shreveport-Daingerfield Reach, as well as the optimum development of the Red River Basin would be substantially hindered by lowering the level of the pool at Lock and Dam #5. Therefore, the North East Texas Economic Development District, with Daingerfield near its geographic center and the Red River at its northern boundary, requests that Lock and Dam #5 be designed such as not to lower its pool below 145' Mean Sea Level.

Sincerely,



J. Sam Spearman
Executive Director

cc: Hon. John Tower
Hon. Lloyd M. Bentsen
Hon. Sam B. Hall, Jr.
Hon. Ed Howard

C-57

**NORTHEAST TEXAS
RESOURCE CONSERVATION & DEVELOPMENT PROJECT**

"People Involvement For Environmental And Community Improvement"
1745D Ballard Drive
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Phone 214 785-6701

PARIS, TEXAS 75460

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& Bowie County
Box 338, New Boston
214-628-2191

Lamar SWCD
& Lamar County
136 Grand Ave., Paris
214-781-6678

Delta SWCD
& Delta County
Box 30, Cooper
214-395-4517

May 22, 1980

Colonel Thomas A. Sands, District Engineer
U. S. Army Engineering District, New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTN: LMNED - MW

Dear Colonel Sands:

I am attaching a resolution we considered and adopted at our regular meeting on May 22, 1980. We are very concerned that there be no permanent restrictions placed on the further development of the Red River.

It will be of great economic benefit to have the river navigable to Lake Texoma. This is a highly productive agricultural area. Soybeans and grain sorghums are our major crops. These have strong world wide markets and if water transportation were available, it would greatly reduce the transportation costs.

Sincerely,

Dale Stockton

Dale Stockton, President
NETRC&D Executive Committee

WHEREAS: It is a committment of the NorthEast Texas Resource Conservation and Development Area to develop and conserve all the natural resources that are feasible, and

WHEREAS: The Red River and adjoining Valley in Texas form the entire north boundary of the NETRC&D, and

WHEREAS: There is now action underway by the United States Army Corps of Engineers to perform bank stabilization on the Red River that will, in time, permit navigation of the river up to the dam impounding Lake Texoma.

NOW THEREFORE BE IT RESOLVED - That the NETRC&D, after consideration of the effect that proposed alternatives for locating the elevation of Lock and Dam and Pool No. 5 on the Red River below Shreveport Louisiana, officially request the U. S. Army Corps of Engineers to construct said Lock and Dam No. 5 to where it will have an elevation of at least 145' MSL.

This resolution was considered and passed at the official meeting of the NETRC&D Executive Committee on May 22nd, 1980.

Dale Stockton
Signed

TEXARKANA
CHAMBER OF COMMERCE



STATEMENT OF

TEXARKANA CHAMBER OF COMMERCE, ARKANSAS-TEXAS
BEFORE THE
UNITED STATES ARMY CORPS OF ENGINEERS

Shreveport, Louisiana

May 19, 1980

A public meeting has been announced by the United States Army Corps of Engineers in Shreveport, Louisiana, on May 19 to hear testimony on a proposed change in various locks on the reach of the Red River from Old River to Shreveport, including Lock #5. The considerations on the lock include the lowering of the pool behind this lock to either 135' or 137' M.S.L.

The effect of this action would move the potential terminal to the south of the City of Shreveport and necessitate additional facilities to be constructed above the Lock 5 to allow navigation to Daingerfield by Twelve Mile Bayou, and, possibly, for future service on up the main stem of the river.

The River and Harbor Act of August 1968 directed that a navigation channel including 5 locks and dams be built on the Red River, a distance of 236 miles, from the Mississippi River to Shreveport and 75 miles upstream by way of Twelve Mile Bayou to Daingerfield, Texas. There has been no congressional action to alter this project. It should be continued in the manner in which it is authorized and was originally planned.

The Red River Navigation System has a potential of use exceeding any system in the nation other than the Mississippi. This prediction is based on four factors:

- 1) It traverses areas in which 25,000,000 people reside with little other than motor transportation available.
- 2) On its banks and close environs already exist a large portion of the agricultural production of the nation, all of which must use modes of transportation rapidly becoming too expensive. This tonnage and the necessary agricultural supplies are substantial loads that clearly need the most economical mode of transportation.
- 3) The waters of the river, when cleared of the excessive salt, will substantially increase the area's productivity by using the stream for irrigation.
- 4) The combined advantage of low cost water transportation and the availability of controlled water resources of vast extent will materially speed up the economic and population growth of the area.

Page 2

For us to concern ourselves with anything other than the development of the area to its optimum is "penny-wise, but pound foolish". A reduction of the capacity of Lock #5 will cause future problems that are certain to arise. We cannot retard the demands of extension of navigation, but we are certain to substantially hinder it by lowering the level of this lock.

The Texarkana Chamber of Commerce, and its Committee on Navigation and Bank Stabilization, urges that no change in the lock's capacity be made below 145' M.S.L.

C-61.

Hughes Springs

CHAMBER OF COMMERCE

Box 218 Hughes Springs, Texas 75656 Phone (214) 639-2351

June 18, 1980

Colonel Thomas A. Sands
Department of the Army
New Orleans District, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Re: Red River Navigation Canal to Daingerfield

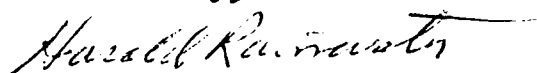
Dear Colonel Sands:

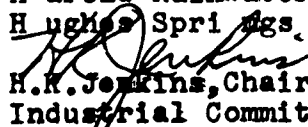
The Hughes Springs Chamber of Commerce gave a unanimous vote for our full support to keep the water level at 145 feet for the lock and dam # 5 by Shreveport.

Although Lone Star Steel is the largest industry in our area, there have been over 35 major industries constructed within the last five years. These industries ship out and receive thousands of tons of various materials each month and would be greatly benefited by having a navigation canal to this area.

In addition, the vast amount of additional water that would be made possible by these locks and dams would insure our water supply and our continued growth for many years.

Sincerely,



Harold Rainwater, President
Hughes Springs Chamber of Commerce

H.R. Jenkins, Chairman
Industrial Committee


G.H. Goolsby, Secretary

C-62.

Where Hospitality Is a Habit!

The City Of Avinger

P. O. Box 334
AVINGER, TEXAS 75630
AC 214-562-3221

MAYOR
W. A. McCain

CITY COMMISSIONERS
Marvin Parvino
Lloyd Shockley

on the

WILD FLOWER TRAILS OF TEXAS

1974 K. A. B. Award Winner

CITY SECRETARY
Johnnie Hill

WATER SUPERINTENDENT
Edwin Downs

June 15, 1980

Colonel Thomas Sands
U. S. Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

RE: LMNED-MW

Dear Sir:

The City of Avinger wishes this statement be placed in the record concerning the proposed alternated locations of Lock and Dams on the Red River Waterway Navigation Project.

The City has specific interest in the elevation of Lock and Dam #5 that would permit navigation through Twelve-mile and Cypress Bayou's to the Lake o' the Pines.

We wish to request your favorable consideration of retaining the 145 pool elevation at Dam #5. Any alternative lower than that will effectively destroy future barge traffic into our area.

We will vigorously epose any other alternatives.

Sincerely,

City of Avinger

Marvin Parvino
Marvin Parvino, Mayor

Lloyd Shockley
Lloyd Shockley, Commissioner

Wilburn Hall
Wilburn Hall, Commissioner

C-63.

ED DRANGUET
COUNCILMAN
District 1

ALVIN J. DEBLIEUX, JR.
COUNCILMAN
District 2



JOHN WINSTON
COUNCILMAN
District 3

JOHN BELOW
COUNCILMAN
District 4

CITY OF NATCHITOCHES

ROBERT B. DEBLIEUX
MAYOR

PAT S. TODD
COUNCILMAN AT LARGE

May 22, 1980

Colonel Thomas A. Sands
District Engineer
U.S. Army District
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

Dear Colonel Sands:

It is my understanding that the Corps of engineers is now re-evaluating the pool levels in the location of several of the locks and dams on the Red River Waterway. It is also my understanding that the Corps is considering three alternative pool stages and I would like to express the feeling of this office as well as many of the Natchitoches towns people that the 145-foot elevation on the last reaches of the river be maintained in order for navigation to reach the City of Shreveport. We feel that it will adversely affect the port facility in the Natchitoches vicinity if the navigation project cannot reach the metropolitan area of Shreveport.

Therefore, I would like to endorse the maintaining of the 145-foot elevation on the upper pool stages of the river.

Yours truly,

Robert B. DeBlieux
Mayor

cc: Mr. Max LeComte
Executive Director



BOSSIER PARISH POLICE JURY

P. O. BOX 68 — 318-965-2329
BENTON, LOUISIANA 71006

May 27, 1980

ZACK J. SANDERS, PRESIDENT
V. B. GLORIOSO, VICE-PRESIDENT

DISTRICT "A"
LARRY TAYLOR
RT. 1,
ELM GROVE, LA. 71051

DISTRICT "B"
TED R. COOK
RT. 1, DOGWOOD DRIVE
HAUGHTON, LA. 71037

DISTRICT "C"
DON M. WHITTINGTON
P. O. BOX 86
BENTON, LA. 71006

DISTRICT "D"
JACKIE MARTIN
RT. 1
PLAIN DEALING, LA. 71064

DISTRICT "E"
SAM GREGORIO
RT. 1, BOX 280
BOSSIER CITY, LA. 71111

DISTRICT "F"
WAYNE KEITH
P. O. BOX 5627
BOSSIER CITY, LA. 71111

DISTRICT "G"
VINCENT B. GLORIOSO
411 WILHELMINA
BOSSIER CITY, LA. 71111

DISTRICT "H"
JAMES D. BROWN
511 YALE PLACE
BOSSIER CITY, LA. 71111

DISTRICT "I"
ZACK J. SANDERS
803 WHITTINGTON PLACE
BOSSIER CITY, LA. 71112

DISTRICT "J"
THOMAS R. MCDANIEL
3216 JANA PLACE
BOSSIER CITY, LA. 71112

DISTRICT "K"

DISTRICT "L"
FRED M. SHEWMAKE, JR.
1906 MILES
BOSSIER CITY, LA. 71112

Department of the Army
New Orleans District, Corps of
Engineers
P. O. Box 60267
New Orleans, LA 70160

Gentlemen:

Enclosed is a certified copy of a resolution adopted by the Bossier Parish Police Jury on May 13, 1980, supporting the original proposal for locations and pool elevations for locks and dams, Red River Waterway Project, Mississippi to Shreveport Reach.

Thank you for your consideration.

Very truly yours,

Cecile K. Boggs
Cecile K. Boggs
Secretary-Treasurer

CKB:cgm

Encl.

JAMES W. RAMSEY, ADMINISTRATOR
HAUGHTON LOUISIANA

MRS. CECILE K. BOGGS, SECRETARY-TREASURER
PLAIN DEALING, LOUISIANA

RONALD G. CARLSON, ENGINEER
2517 ASHDOWN STREET, BOSSIER CITY, LA.

C-65.

RESOLUTION

WHEREAS, the Bossier Parish Police Jury has been advised that the Department of the Army, New Orleans District, Corps of Engineers, is considering alternate locations and pool elevations for Locks and Dams 2, 3, 4 and 5 of the Red River Waterway Project, Mississippi to Shreveport Reach; and

WHEREAS, it is proposed in their alternate plans that pool stage elevations for Pool No. 5 be changed from the 145 foot elevation that was proposed in the original plan, to either 137 foot pool elevations or 135 foot pool elevations; and

WHEREAS, if any elevation other than the original 145 foot pool stage for Pool No. 5 is considered, it will limit navigation to parts of the Shreveport and Bossier area from the St. Louis and Southwestern Railroad bridge south; and

WHEREAS, in the opinion of the Bossier Parish Police Jury, this would prohibit any private development along the northern reaches of the Shreveport-Bossier area, would possibly impair recreation and parks development along these reaches, and could possibly adversely affect future domestic water supplies of the Shreveport-Bossier area.

NOW, THEREFORE, BE IT RESOLVED, after consideration of the above factors, the Bossier Parish Police Jury does encourage the Department of the Army, New Orleans District, Corps of Engineers, to consider the 145 foot pool stage of Pool No. 5 as originally planned, as this would be in the best interests for future development of this portion of the navigation project along the Red River.

BE IT FURTHER RESOLVED that copies of this resolution be forwarded to the Department of the Army, New Orleans District, Corps of Engineers, and to the congressional delegation representing the Shreveport-Bossier area.

The resolution was offered by Mr. Brown, seconded by Mr. Taylor. Upon vote, the motion carried, and the resolution was duly adopted on this 13th day of May, 1980.

CECILE K. BOGGS
SECRETARY-TREASURER

ZACK J. SANDERS, PRESIDENT
BOSSIER PARISH POLICE JURY

True and correct copy of an
order of the Bossier Parish Police Jury
made at a regular meeting in Bossier,
Louisiana, on the 13th day of May, 1980. Given
under my hand and seal of office on the 13th day
of May, 1980.
Cecile K. Boggs
Secretary-Treasurer

THE SEVEN C'S, INC.
LAFAYETTE, LOUISIANA - 70501

P. O. Box 52047

PHONE 232-3813

May 2, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: LMNED-NW

Gentlemen,

I am a Civil Engineer and have been actively involved in the field of engineering and surveying for 31 years. I consider myself qualified to evaluate the engineering aspects of the various Red River Waterway Plans and their impact on the people who live, work and own property in the Red River Valley.

In 1969, my children and I acquired 1700 acres on the Red River approximately 15 miles north of Natchitoches. I have been deeply concerned about the Red River Project since then and began corresponding with the Corps of Engineers and others since 1972. The initial plan submitted to Congress in 1969 appeared to have minimal adverse impact on the Valley. It basically consisted of a 6 Lock and Dam system which minimized flooding and ground-water damage.

In 1972, in reply to my letter, Colonel Hunt, New Orleans District Engineer, stated, "We realize that some prime farm land will be susceptible to flooding and/or groundwater problems and every effort is being made to select the plan that would have the least overall effect on land use." At this time, the 6th Lock and Dam had been dropped from the project to preserve a favorable Benefit/Cost ratio. The Project could not have been justified cost wise with six Locks and Dams. Several alternative Plans with 5 Locks and Dams were developed. B1 and B3 appeared to be the best of the plans. I always felt and continue to feel that the B1 plan was the best primarily because it flooded less land and cost less money while completely fulfilling the objectives of the project. The final selection by the Corps was the B3 Plan which was later refined to B3M. The location of Locks and Dams in B3M was substantially different from B1, a very substantially greater amount of land was flooded and the cost was substantially more than for B1 and in fact, put the pool stage above Lock and Dam 5 at the elevation of the highest flood expected in 100 years. For several years I have been questioning the Plan selection for the reasons cited above and have continually maintained that the B1 plan is by far the better of the two plans. My protests had very little result until 1978 at which time Colonel Thomas Sands, then recently assigned Chief of Engineers of the New Orleans District, began a

C-67.

District Engineer
Page Two

comprehensive re-evaluation of the B3M versus B1 plan. This reanalysis resulted in these public hearings. I wish to restate publicly what I have stated on numerous occasions during the past few years, that the B1 plan is far superior to the B3M plan in many respects including less adverse impact on people and property in the valley and a lesser cost to the taxpayer while fulfilling all Project objectives. The alternative Plan discussed here is the B1 Plan and is very similar to the plan presented to Congress in 1969.

I strongly recommend that the Corps of Engineers and/or the Red River Waterway Commission publish and subsequently continue to keep the public advised of the following information:

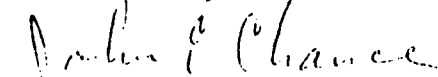
1. A "total cost" comparison of the B1 vs B3M plan.
2. A "local cost" comparison of the B1 vs B3M plan. Local cost is specified as the cost of the project to the Red River Waterway Commission, as agreed to between the state and federal government. These costs are borne by a tax on the people in the affected parishes. Since the Corps has stated publicly that the extent of water damage was not known by 1978, those updated projected costs have not yet been made available to the public.

Although I have been most disappointed with what transpired in the mid 70's, I am most impressed with the attitude and integrity of Col. Sands, Col. Smart, Mr. Shelton, Mr. Broussard, Mr. Rhinehart, and all members of the Corps of Engineers.

I am confident that the Alternate Plan (B1) is the best and that my position is supported on an individual basis by many of the Corps' Engineers associated with the Project.

Yours truly,

THE SEVEN C'S, INC.



John E. Chance

JEC/dh

THE SEVEN C'S, INC.
LAFAYETTE, LOUISIANA - 70501

P. O. Box 52047

PHONE 232-3813

May 12, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: Red River Waterway Section

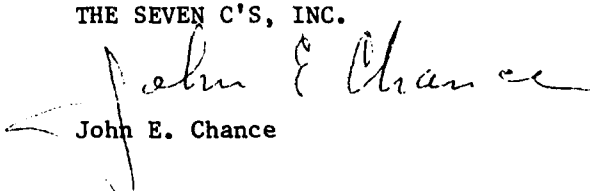
Gentlemen,

I propose to ask two questions at the Public Hearing to be held in Shreveport on 19 May 1980 on the Red River Waterway Project. I am sending them to you at this time so that you might be better prepared to answer them. A copy of this letter is being forwarded to the Red River Waterway Commission in the event that they should be the agency responsible for this data.

1. What is the projected total cost of the B1 Plan vs the B3M Plan?
2. What are the total local costs of the B1 Plan vs the V3M Plan?

Sincerely,

THE SEVEN C'S, INC.


John E. Chance

JEC/dh

cc: Red River Waterway Commission

C-69.

THE SEVEN C'S, INC.
LAFAYETTE, LOUISIANA - 70501

P. O. Box 52047

PHONE 232-3813

April 29, 1980

Dear Gentlemen,

I am a part owner of the Seven C'S Ranch. Our Property is located on the Red River above Natchitoches. I am asking you to do everything possible to keep our land from being destroyed. From the information published, the alternative plan you have submitted will protect our property. I urge you to use the alternative plan in the construction of the Red River Waterway Project.

We also must think in terms of the future as we deal with a project as delicate as this one. We must think of the generations to follow and their need for the land. It is time to stop destroying America to improve it. We must work with Nature and not against it. After all, Nature is a creation of God and I really don't believe God will come down and make us a new Earth after we destroy this one.

Sincerely yours,

Laurie E. Chance

Laurie E. Chance

C-70.

Wednesday
April 30, 1980

Dear Sir:

I am deeply concerned with the flooding of prime Red River bottomland, some of which I am part owner. My family & I have grown to love this land of beauty and wildlife.

It is entirely uncomprehensible why this land should be damaged, or even destroyed, due to the acceptance of the B3W plan. The alternate B1 plan, which exists, could alleviate these dangers and at the same time cost the taxpayer much less money.

For these reasons and others I sincerely urge you to accept the alternate B1 plan.

Sincerely

Jouita A. Chance

C-71

APRIL 28, 1980

DISTRICT ENGINEER

U.S. ARMY ENGINEERING DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

P.O. BOX 60267

NEW ORLEANS, LA 70160

ATTN: LMNED-MW

DEAR COLONEL SANDS:

I AM A LANDOWNER OF PART OF THE RICH
BOTTOMLAND OF THE RED RIVER NORTH OF
NATCHITOCHE. I WOULD LIKE TO EMPHASIZE
THE FACT THAT I AM TOTALLY OPPOSED TO THE
ORIGINAL PLAN WHICH WOULD DESTROY MY PROPERTY.
SINCE I AM 21 YEARS OLD, THIS LAND IS MY
MOST VALUABLE ASSET (AND MORE VALUABLE TO
THOSE WHOSE INCOME IS SOLELY DEPENDENT ON
THEIR PROPERTY.) SEEING THAT ANY FEDERAL
REIMBURSEMENT WOULD BE "TO LITTLE TO LATE"
(AS IN THE ARKANSAS PROJECT) FOR THE SAKE
OF MYSELF, MY NEIGHBORS AND OUR POSTERITY
I ASK THAT YOU PLEASE REJECT THE ORIGINAL
PROPOSAL.

SINCERELY,

Thomas Chance

C-72.

Dear Sir,

I just got your letter asking for my opinion on the Red River Waterway Project.

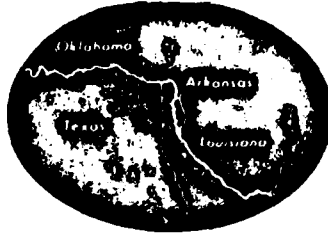
As a future landowner I think the alternative plan is better than the original plan. I feel that ~~the~~ lower cost, less flooding, and lesser ground-water effects make the alternative plan the best plan. The flooding due to the original ~~land~~ plan would destroy most of our best bottom lands. This is why I must support the alternative (B1) plan.

Your friend,
John Chance II

A Four State Association Dedicated to the Development of the Land and Water Resources of the Red River Basin

EXECUTIVE OFFICERS

PRESIDENT
Chester Wells, Alexandria, La.
EXECUTIVE DIRECTOR
Champ L. Baker, Shreveport, La.
SECRETARY-TREASURER
Carlton Murray, Shreveport, La.
PRESIDENT EMERITUS
C. A. Fairbanks, Pineville, La.



EXECUTIVE STATE VICE-PRESIDENTS

Jack Williams, Garland, Arkansas
Troyce McGovern, Durant, Oklahoma
B. A. Rothschild, Jr., Shreveport, Louisiana
Homer Tanner, Dargatzis, Texas

RED RIVER VALLEY ASSOCIATION

629 SPRING STREET
P. O. BOX 709, PHONE 221-5233, 221-5234
SHREVEPORT, LOUISIANA 71162

June 24, 1980

Colonel Thomas A. Sands
District Engineer
Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

In Re: Pool Elevation of Lock & Dam No. 5

As a result of recent public meetings held by your office in Shreveport, Louisiana on May 19 and in Alexandria, Louisiana on May 20, resolutions were adopted by certain industrial and public bodies and copies provided this office.

As I am not sure you may have received the originals, I am enclosing copies of the ones in my files for your information and use. I would appreciate your being certain they are made a part of your official proceedings.

With best regards, I remain

Sincerely,

A handwritten signature in cursive script that reads "Champ".

Champ L. Baker
Executive Director

CLB/df

Enclosures

C-74

RESOLUTION
ADOPTED BY THE
RED RIVER VALLEY ASSOCIATION

QUARTERLY BOARD MEETING
May 19, 1980

Whereas, the 55 year old, Red River Valley Association represents membership in the four state area of Arkansas, Louisiana, Oklahoma and Texas, and has long been dedicated to the development of the land and water resources of the Red River Basin; and

Whereas, navigation in the Basin has long been a main objective of the Association, their ultimate aim being to have water transportation from the mouth of the Mississippi to Shreveport, Louisiana, thence to Daingerfield, Texas, and thence to Index, Arkansas and thence on to Denison Dam at Lake Texoma, Denison, Texas; and

Whereas, aims and objectives cannot be achieved with less than a 145 foot pool elevation at Lock and Dam No. 5 to be located south of Shreveport, Louisiana; and

Whereas, less than a 145 foot pool elevation would require a sixth Lock and Dam below Shreveport to be constructed in the event the navigation project became feasible to Daingerfield, Texas or Index, Arkansas, and thence on to Denison Dam; and

Whereas, certain other benefits to be afforded the citizens of Shreveport-Bossier community would be lost, such as:

1. Planned recreation along the Red in Shreveport-Bossier area would be in great jeopardy.
2. Future plans for the use of water for human consumption, agriculture and industrial use for Shreveport-Bossier would be greatly reduced.
3. There would be no private or public development of port sites north of bridges in downtown Shreveport-Bossier, as the water depth would be insufficient.
4. Prospects for the Caddo-Bossier port becoming a hub of port activities for the Daingerfield stretch on north to Denison Dam would never materialize; and

Whereas, those factors would cause the loss of millions of dollars in economic development in future years for this area, as well as upstream; and

Whereas, the 145 foot pool elevation represents the most efficient development of the total stream potential; and

Whereas, the Red River Valley Association and its membership firmly believe that the intent of Congress was to provide navigation through Shreveport and to Daingerfield, Texas, as was the original intent of Congress, as set forth in Senate Resolution #148 of 1958.

NOW, THEREFORE, BE IT RESOLVED, that the Red River Valley Association, meeting in regular session this 19th day of May, 1980, does hereby urge the U.S. Army Corps of Engineers to maintain a pool elevation of 145 Ft. or more at Lock and Dam No. 5 on the Red River, south of Shreveport, Louisiana.

POLICE JURY

Parish of Red River

CLAUDE E. VEATCH
Rt. 5, Box 127
District 1, Coushatta

MELVIN D. DUPREE
Rt. 2, Box 201
District 2, Coushatta

HERMAN GAY
P. O. Box 127
District 3, Hall Summit

A. P. DILL
President
Rt. 1, Box 112
District 4, Mansfield

P.O. Drawer 709 Phone 318 932-5719
Coushatta, Louisiana

MRS. JOHNNIE L. ROGERS
Secretary-Treasurer

MRS. BRENDA JONES
Asst. Secretary Treas.

ELMER WALKER
Road Superintendent

MRS. PATSY SAMPURG
Clerk Typist

J. T. BIERDEN, JR.
Rt. 4, Box 280
District 5, Coushatta

ALVIN L. PRICE
Rt. 5, Box 36
District 6, Coushatta

LEWIS H. BROWN
Vice President
P. O. Box 572
District 7, Coushatta

GLEN JONES
P. O. Box 528
District 8, Coushatta

May 30, 1980

Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTENTION: LMNED-MW

Dear Sir:

The Red River Parish Police Jury at their regular meeting held Tuesday, May 27, 1980, the following action was taken:

Motion by J. T. Bierden, Jr., seconded by Glen Jones, to support the 145 foot elevation of the upper pool stage, on the Red River Waterway Project, to be maintained to Shreveport. With this elevation navigation will be possible past Shreveport. Roll call vote was unanimous.

Your consideration in this matter of great importance on this project will be greatly appreciated.

Sincerely,

RED RIVER PARISH POLICE JURY



(Mrs.) Brenda W. Jones
ACTING SECRETARY TREASURER

:bwj

← 76.

Regular monthly meetings on second Tuesday
and fourth Tuesday of each month at 7:00 p.m.



OFFICE OF THE MAYOR
SHREVEPORT, LOUISIANA

W. T. HANNA, JR.
MAYOR

May 19, 1980

Colonel Thomas A. Sands, District Engineer
U.S. Army Engineer District
P.O. Box 60267
New Orleans, La. 70160

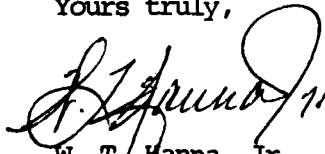
Dear Colonel Sands:

The City of Shreveport is in support of maintaining the minimum elevation of the Red River at Shreveport at 145' as initially considered in the navigation project. We are concerned that a lower level will have an adverse impact on several areas including recreation and water supply.

Mr. Rawlins Collerain, Director of Water & Sewerage, Mr. Steve Pitkin, Director of Planning, and Mr. John deBessonett, Director of Planning for Parks and Recreation, will each present testimony in support of our position.

We strongly urge your consideration of these comments in support of level 145' being maintained in Shreveport.

Yours truly,


W. T. Hanna, Jr.
MAYOR

WTH:kb

Greater Shreveport
Economic Development
Foundation


RESOLUTION

- WHEREAS: The Greater Shreveport Economic Development Foundation is greatly concerned with the continued economic development of the Shreveport area in order to assure decent job opportunities for all Shreveport citizens; and
- WHEREAS: The Red River Navigation Project has been deemed by the Federal Government as a major economic development project with great benefits in numerous areas to be derived for the local economy upon its completion; and
- WHEREAS: The Red River Navigation Project as authorized by Congress in 1968 provides for navigation on the Red River to be completed through Shreveport; and
- WHEREAS: The 145 foot pool elevation for Lock and Dam #5 included in the current U. S. Army Corps of Engineers plan for Red River Navigation assures that navigation will be possible through Shreveport; and
- WHEREAS: Decreasing the pool elevation of Lock and Dam #5 to 137 feet or 135 feet would preclude the navigability of the Red River through the city of Shreveport; and
- WHEREAS: Retaining the 145 foot pool elevation would not adversely affect either developed property or valuable farm land within or without the city limits of Shreveport.

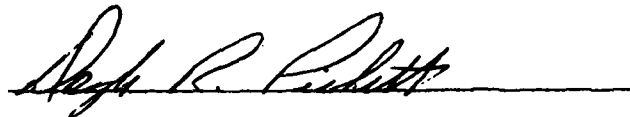
NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Greater Shreveport Economic Development Foundation, a division of the Shreveport Chamber of Commerce, does hereby urge the U. S. Army Corps of Engineers and the Federal Government to maintain the pool elevation at Lock and Dam #5 at 145 feet to insure that the maximum benefits of the Red River Navigation Project to future economic development activities may be realized by the city of Shreveport and its citizens; and

BE IT FURTHER RESOLVED that the Board of Directors of the Shreveport Chamber of Commerce does hereby ratify the position of its division, the Greater Shreveport Economic Development Foundation, and also urges the continuance of the 145 foot pool elevation for Lock and Dam #5 to ensure the original intention of the Congressional authorization as set forth in the 1968 Red River Navigation Act is complied with for the future benefit of all citizens of the city of Shreveport.

DONE AND SIGNED THIS 14th day of May 1980 by the Board of Directors of the Greater Shreveport Economic Development Foundation, and ratified this 15th day of May 1980 by the Board of Directors of the Shreveport Chamber of Commerce.

A handwritten signature in dark ink, appearing to read "W. Clinton Raspberry, Jr.", written over a horizontal line.

W. Clinton Raspberry, Jr.,
Chairman
Greater Shreveport Economic Development Foundation

A handwritten signature in dark ink, appearing to read "Doyle R. Pickett", written over a horizontal line.

Doyle R. Pickett,
President
Shreveport Chamber of Commerce



Greater Bossier
Economic Development Foundation
710 Benton Rd., Bossier City, LA 71111
(318) 746-0252

Joe D. Waggoner Jr.
Chairman

May 28, 1980

As the Chief Economic Development agent for all of Bossier Parish, we are taking this opportunity to express our viewpoint on reduction of the water level along the Red River.

On September 20, 1979, the Greater Bossier Economic Development Foundation unanimously approved the development of navigation along the Red River as purported at that time by the U. S. Corps of Engineers.

Pertaining to this matter of the water level at Locks and Dam No. 5 which is currently being restudied, we are fully aware that no decision as to water level has been made.

Our Foundation is totally opposed to reducing the pool level of Locks and Dam No. 5 below 145 feet for many reasons. Among these are:

- 1- A lower pool level would not provide sufficient water for additional port or other induced developments beyond the presently planned port.
- 2- It would be disastrous for Bossier Parish and Shreveport not to have access to this additional pooled water in the years which are ahead.
- 3- Recreational opportunities would be eliminated, not allowing for multi-purpose uses.
- 4- Production of hydro-electric energy would be jeopardized.
- 5- The potential for adding to the construction cost of Locks and Dam No. 5 to maintain the proposed pool level of 145 feet is without foundation because a reduction of \$150 million or more has been accomplished by reducing from six to five locks and dams, this constitutes a savings from the original.

There are many other arguments but it is our contention that for the reasons previously enumerated as well as the fact that we would break faith with not only the entire Bossier-Caddo area, but it would be breaking faith with all of those who live upstream who have done so much in support of this project looking forward to the navigation of the Red River.

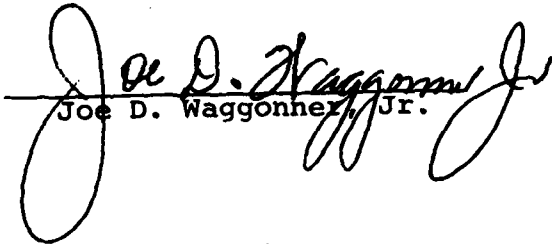
C-80.

A Division of the Bossier Chamber of Commerce

Board of Directors:

Percy V. Hubbard
John D. Caruthers, Jr.
E. H. Lyons
Gilbert Sibley
A. Hartie Spence
Loy Beene Moore
Jerry Harris
Claud Grace
Coy Cooper
Charles Coyle
Wayne Davis

Douglas O. Durham
J. A. Dunnam, Jr.
Roy Hurley
Dr. Bruce Brian
Harold E. Roberts, Jr.
Kennon Harvill
Graham Rogers
Jim Honeycutt
James Ramsey
Reginald K. Adams
Darnell Sibley


Joe D. Waggonner, Jr.

A Four State Association Dedicated to the Development of the Land and Water Resources of the Red River Basin

EXECUTIVE OFFICERS

PRESIDENT:
Chester Wells, Alexandria, La.
EXECUTIVE DIRECTOR:
Champ L. Baker, Shreveport, La.
SECRETARY-TREASURER:
Carlton Murray, Shreveport, La.
PRESIDENT EMERITUS:
C. A. Fairbanks, Pineville, La.



EXECUTIVE STATE VICE-PRESIDENTS

Jack Williams, Garland, Arkansas
Troyce McGovern, Durant, Oklahoma
B. A. Rothschild, Jr., Shreveport, Louisiana
Homer Tanner, Dingerfield, Texas

RED RIVER VALLEY ASSOCIATION

629 SPRING STREET
P. O. BOX 709, PHONE 221-5233, 221-5234
SHREVEPORT, LOUISIANA 71162

July 2, 1980

Col. Thomas A. Sands
District Engineer
Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel,

I attach another resolution regarding the pool elevation to be maintained at Lock and Dam No. 5, south of Shreveport, Louisiana. This resolution is from concerned citizens in Texas and Oklahoma. I would appreciate your making this resolution part of your files.

With best regards, I remain

Sincerely,

A handwritten signature in cursive script that reads "Champ".

Champ L. Baker
Executive Director

CLB/df

BE IT RESOLVED:

THAT, at a meeting in Denison Texas, of representatives of the Red River Valley Association of the States of Texas and Oklahoma, cities, and county officials of Grayson, Fannin, Lamar, Red River, and Bowie counties, Soil and Water Conservation district directors of the above counties, North East Texas RC&D Project, Chamber of Commerce and citizens interested in Stream Bank Stabilization and Navigation of the Red River from Index Arkansas to Lake Texoma, were discussed at length, and we would like to submit this Resolution in response to navigation of the Red River.

WHEREAS, the Red River Valley Association have provided us a copy of your April 18, 1980 Announcement of Public Meeting to discuss alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 of the Red River Waterway Project, Mississippi River to Shreveport Reach. We offer the following comments on the proposals set forth in the announcement.

WHEREAS, on the basis of information and technical data available to us, we feel that establishment of a pool elevation of either 135 feet or 137 feet for Lock and Dam No. 5 would be contrary to congressional intent in its approval of the Red River Waterway Project, and further would adversely affect any additional upstream extension of navigation. We understand that concerned Louisiana citizens representing the Shreveport area sponsors of the Red River Waterway Project voiced their concerns to your staff at a meeting held in Shreveport on May 8, 1980. They feel that lowering of the pool elevation of Lock and Dam No. 5 would seriously hamper operation of the Waterway in the Shreveport area. We fully support these views. Additionally, Texas is concerned that any shortsighted changes to the authorized features of the Project could preclude, or make exceedingly difficult the logical extension of the Waterway into Arkansas and Texas in the future.

WHEREAS, Congress has approved navigation from the Mississippi River to Shreveport, Louisiana and from Shreveport to Daingerfield, Texas as a feature to the Red River Waterway Project. Bank Stabilization from Shreveport to Index, Arkansas is also authorized. We sincerely feel that navigation to Index, Arkansas and Lake Texoma will be reality in the future.

WHEREAS, we understand that your restudies have determined that navigation in the Shreveport to Daingerfield reach was not economically feasible at the time of the study, follow-up studies using more recent data are currently in progress. We feel these studies will show a favorable benefit/cost ratio for navigation in the Shreveport to Daingerfield reach. As we understand your alternate proposal for a pool elevation of 135 or 137 feet for Lock and Dam No. 5, adoption of either proposal would require an additional cost of at least \$100 million to previously-computed costs of and extension of navigation through Shreveport and upstream.

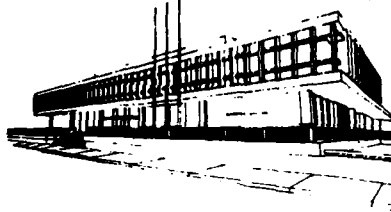
WHEREAS, that the alternative of lowering the pool elevation of Lock and Dam No. 5 to 135 feet or 137 feet not be considered further. We recommend that you consider two alternate proposals, both of which accomplish navigation to Shreveport as presented to and approved by Congress. One proposal would be for a pool elevation of 145 feet; the alternate proposal is to proceed with both Lock and Dam No. 5 and Lock and Dam No. 6 at the locations and pool elevations as presented to, and approved by, Congress.

Signed this 9th day of June, 1980.

By

NAME	TITLE	ORGANIZATION
Fred Tarkey	General mgr.	Red River Authority of Texas
Tracy McHallen	Mayor	Durant, Okla.
Allen Bates	City Mgr	Durant, Okla
Bill Somers	Member of Commerce	Arkansas Tex
Frank A. Bach	City Manager	Texasarkana, Tex
Ray C. Ford	Water Util. Dir.	Texasarkana, Ark-Tex.
John H. Underman	Director	Red River Authority, Texas
John B. Brooks	Reid Coordinator	NETX Reid Area
Jim Evans	Staff	Chamber of Com in Texasarkana

Office of the Mayor



City of Alexandria, Louisiana

Carroll E. Lanier
Mayor

June 2, 1980

Phone (518) 473-1101

Colonel Thomas A. Sands
Department of the Army
New Orleans District, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Re: May 20th Public Hearing in Alexandria

Dear Colonel Sands:

The City of Alexandria is vitally interested in the proposed new 64 foot pool stage on navigation pool #2 on the Red River because of the following reasons.

We have been working with the Louisiana Department of Transportation and Development to work out a feasible solution to the Murray Street bridge replacement with all designs being based on the 58 foot pool stage. I do not believe that the replacement bridge design we have in hand will be acceptable to the Alexandria City Council with the proposed 64 foot pool level.

There was not enough information furnished at the May 20th meeting as to backwater and ground water levels as to how they would effect out existing and proposed sewer lines and drainage systems.

This office needs immediate data on changes in bridge openings, ground water and back water levels in order to inform the Alexandria City Council and to make a recommendation to the council as to an official course of action on this matter.

My personal position as Mayor of Alexandria is in opposition to the 64 foot pool stage based on present information and knowledge.

C-85.

Colonel Thomas A. Sands
June 2, 1980
Page two

I would appreciate your earliest possible answer.

Sincerely yours,

CITY OF ALEXANDRIA


Carroll E. Lanier
M A Y O R

CEL/gar

cc: Alexandria City Council
Paul J. Hardy, Secretary, Department of Transportation & Development
Jiff Hingle, Ass't Secretary, Office of Public Works

Law Offices of
BETHARD & DAVIS
Bethard Building
Coushatta, Louisiana 71019

Henry W. Bethard, Jr. 1922-1961
Henry W. Bethard, III
J. O. Davis
James G. Bethard
Walter E. Dorroh, Jr.

June 16, 1980

Post Office Drawer C
Area Code 518
Telephone 982-4071

Our File No. _____

Army Corp of Engineers
P. O. Box 6267
New Orleans, Louisiana 70160

Attention: Colonel Thomas A. Sands

In Re: Red River Water Way
Lock and Dam No. 4; Mile 206

Dear Colonel Sands:

Please be advised that we represent the heirs of C. A. Detrow, being Mattie Sue Detrow, Clarence Earl Detrow and Randall Augustas Detrow and this letter is being written at their request.

The subject of this letter is Lock and Dam Number 4, which, if built at Mile 206 in Red River Parish, Louisiana, will take up much, if not all, of their land on the East bank of the river. A meeting was held in Alexandria, Louisiana on this topic on May 20, 1980, and input from interested persons was requested. The following reflects the opinions of our clients with regard to this Lock and Dam.

To begin with, they wish to express that they are in favor of the river project as a whole and believe it will benefit the parish and state once completed. However, they are not at all interested in parting with this land. They wish they could continue to hold the land as an investment because as everyone knows, land is about the best long-term investment and it would be hard to replace this particular piece of land due to its high value, good location, development potential and sentimental appeal. Nevertheless, they realize that if the Dam and Lock is to be located on their land, there is nothing they can do about it and they will be forced to relinquish it.

In the event the Lock and Dam is to be located on or near our client's land they wish to express that they are in favor of whichever option will take up the least amount of their land. Land like this cannot be replaced and as much of it as possible should be left in the private sector so it can best reach its full potential.

C-87

BETHARD & DAVIS
COUSHATTA, LOUISIANA

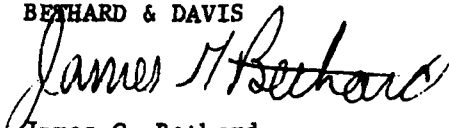
To Army Corp of Engineers
June 16, 1980

SHEET No. 2

Please see that this letter is filed with the other opinions expressed after the meeting referred to above and please see that our clients are kept apprised of all developments with regard to this situation.

Yours very truly,

BETHARD & DAVIS


James G. Bethard

JGB:lg

xc: Mr. Gleen Rhinehard
Mr. Terrell Broussard
Mrs. Mattie Sue Detro Sherrouse
Mr. Clarence Earl Detro
Mr. Randall Augustas Detro

WESTERN KRAFT PAPER GROUP
WILLAMETTE INDUSTRIES, INC.



Red River Mill Division
Post Office Box 377

Campti, Louisiana 71411

Telephone (318) 476-3392

April 30, 1980



District Engineer
U. S. Army Engineer District,
New Orleans
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: LMNED-MW

Gentlemen:

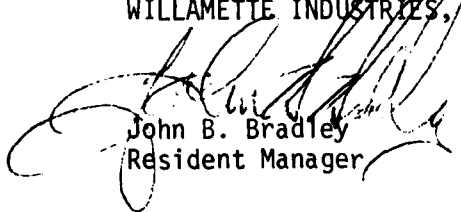
Western Kraft Paper Group, Campti, Louisiana, has been advised that a re-study of the Red River Lock and Dam Project is now completed. Western Kraft would like to offer information relating to this project:

- 1) At pool elevation 115', the Western Kraft effluent discharge parshall flume structure leading to the Red River would be flooded. In fact, the water level would be against the levee of our aeration basins, which could produce erosion with the danger of rupture. This can be seen on Western Kraft Drawing No. D13C-1023, attached.
- 2) At pool elevation 115', all land holdings surrounding the present aeration basins would be flooded. Flooded land holdings would amount to approximately one hundred acres. This can also be seen on the attached drawing.

Western Kraft supports a pool elevation of 95' and respectfully requests that favorable consideration be given to the alternate plan.

Sincerely yours,

WESTERN KRAFT PAPER GROUP
WILLAMETTE INDUSTRIES, INC.


John B. Bradley
Resident Manager

JBB/da
Attachment

C-89.

May 13-80

District Engineer
U. S. Army Engineers District
Corps of Engineers
P. O. Box 60267
New Orleans, La
Attn. LMED-MW

Dear Sir,

We like the B1 plan better than the B3M plan because it floods less land and has less adverse effects from groundwater.

We are opposed to any thing that destroys good farm land, not only for us but for future generations.

Plan B1 would save us over 300 to 400 acres of good pasture land.

Mr. & Mrs. J B Bearden

Box 644

Greensboro, La

Ph. 352-4203 C-90.

71066

HENRY M. HEARNE
P. O. BOX 6057
SHREVEPORT, LOUISIANA 71106

May 14, 1980

District Engineer
U. S. Army Engineer District, New Orleans
Corp of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTN: LMNED-NW

Re: Red River Waterway

Gentlemen:

As the owner of 2,500 acres encompassing Grand Bend and Ninock Plantations as well as Ninock Lake located at the confluence of Caddo, Bossier and Red River Parishes we wish to comment on the proposed Red River Navigation Plan.

With respect to discussions relating to alternate locations and pools for Lock and Dam No. 5 it appears to us, based on an examination of maps in the Caddo Parish Library, that irrespective of the pool stage established to Shreveport, relocation of Lock and Dam No. 5 to Site A, Mile 250, Right Descending Bank, B-1 Alternate Plan is desirable for a number of reasons:

Site A, B-1 would utilize waste sand bar land which is unsuitable for agricultural use and is presently subject to periodic inundation.

Site A does not require the use of high bank land as does B-3. This site also apparently eliminates the necessity for at least 2 dams (1 closure, 1 spillway) and considerable levee which appear to be required by B-3 to prevent flooding of Ninock Lake. The existing drainage from this lake is necessary as it provides drainage for a portion of South Bossier Parish.

Sites B and C, B-1 also appear to present problems as both sites lie on the Left Descending Bank which causes them to interfere with the existing drainage from Ninock Lake. As no provision for drainage is apparent we presume that it is yet to be designed.

C-91.

HENRY M. HEARNE
P. O. BOX 6057
SHREVEPORT, LOUISIANA 71106

Page 2

As the elevation of Pool No. 4 to 120 Ft. is apparently required for the B-1 Plan we have examined your maps in an effort to determine the impact that the additional 5 Ft. would have. It appears to us that the affected areas would be sand bar land which is presently subject to periodic inundation. An additional benefit would seem to be the creation of wetlands attractive to waterfowl which heretofore have been of little benefit to wildlife.

As the relocation of Lock and Dam No. 5 to Site A, B-1 Alternate Plan seems to offer a much less complicated structure and therefore we would hope, could be built at a lower cost and leave undisturbed an area of critical drainage, we believe that serious consideration should be given to adopting this location.

Very truly yours,



Henry M. Hearne
P. O. Box 6057
Shreveport, Louisiana 71106

Rt. 3, Box 156-C
Natchitoches, LA 71457
May 14, 1980

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: LNMED-MW

Dear Colonel Sands:

I own valuable rich bottomlands along Red River at Grand Ecore and am totally opposed to the original plan which would destroy my property. The income from this property I had planned to use for my retirement years as I have reached my 66th birthday.

My neighbors and I all agree that the B1 plan is far superior to the B3M plan in many respects, including less adverse impact on people and property in the valley and a lesser cost to the taxpayer while fulfilling all Project objectives.

I strongly urge that consideration be given to plan B1.

Sincerely,



Mrs. Ellen Rae Aaron

Campti, La

May 13, 1980

District Engineer:

U. S. Army Engineer District
Corps of Engineers

Box 60267

New Orleans, La. 70160

Dear Gentlemen:

I ask of you to please use
your ability and influence in the Red
River Water Project, by selecting
the BI Plan, now called the
Alternative Plan.

The assured and consideration
rendered in this regard, will be
most highly appreciated by
my family and me.

Yours truly,

Mrs. Gabriel S. Brown

Box 395

Campti, La. 71411

C-94.

HENRY M. JACKSON, WASH., CHAIRMAN
 FRANK CHURCH, IDAHO
 J. BERRYETT JOHNSON, LA.
 DALE BUMPERS, ARK.
 WENDELL H. FORD, KY.
 JOHN A. BURKIN, N.J.
 HOWARD M. METZENBAUM, OHIO
 SPARK M. MATSUMAGA, HAWAII
 JOHN MELCHER, MONT.
 PAUL E. TONIAS, MASS.
 BILL BRADLEY, N.J.

MARK O. MATFIELD, OREG.
 JAMES A. MC CLURE, IDAHO
 LEWELL P. WEICKER, JR., CONN.
 PETE V. DOMENICI, N. MEX.
 TED STEVENS, ALASKA
 HENRY BELLMON, OKLA.
 MALCOLM WALLOP, WYO.

DANIEL A. BREYFUS, STAFF DIRECTOR
 D. MICHAEL HARVEY, CHIEF COUNSEL
 STEVEN G. HICKOK, STAFF DIRECTOR FOR THE MINORITY

United States Senate

COMMITTEE ON
 ENERGY AND NATURAL RESOURCES
 WASHINGTON, D.C. 20510

May 15, 1980

Colonel Thomas A. Sands
 District Engineer
 Corps of Engineers
 Post Office Box 60267
 New Orleans, Louisiana 70160

Dear Colonel Sands:

I have recently received notice of a public meeting scheduled May 19 to discuss alternative locations and pool elevations for four locks and dams of the Red River Waterway Project. Frankly, I am very concerned about the proposed revised pool level at Lock and Dam #5. Based on the information included in the Public Notice, if the 145 foot pool level is not maintained, navigation on the river would end at Shreveport. As you know, there is a great deal of support for making the Red River navigable to Denison Dam. Unless a 145 foot pool level is maintained, all chances for that are lost.

I have always opposed projects which are not economically feasible and will continue to do so. However, the Corps of Engineers formulated plans for construction of this project in the 1970's. In the Public Notice you state that extensive plan formulation studies were made in the early 1970's, and based on these studies, the New Orleans District recommended a plan for detailed design and construction. You go on to say that in 1978 NOD obtained information that the originally recommended levels for Pools 4 and 5 would flood several thousand acres of land. The most disturbing thing about all this is the statement that "This flooding was not known nor considered in the earlier plan selection process." What I would like to know is: 1) Was the flooding known or not known in the original study; 2) If it were not known, then why, since "extensive plan formulation studies were made"; and 3) If it was known, why was it not considered?

There may be some valid reasons that this was not considered in the original plans, but there is nothing in the notice

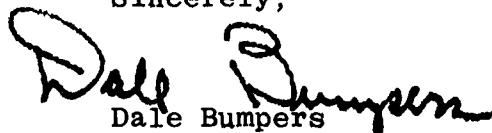
Colonel Thomas A. Sands
May 15, 1980
Page Two

to indicate that. I cannot understand why the Corps of Engineers would not consider the possibility of flooding when it originally studied pool levels and dam sites.

Residents along the Red River have worked very hard to assure continuation of this project to Denison Dam. For several years, they have done everything they could to support the project, and to my knowledge, the Corps of Engineers has never discouraged such support or activity. It would be most upsetting if, at this point, the Corps developed a plan which would in effect kill all chances of continuation of the project above Shreveport.

I cannot overemphasize my concerns about the possible change in the pool level at Lock and Dam #5 and its impact on the rest of the project. Therefore, I would appreciate it if you would respond to my questions and the other issues raised in this letter at your earliest convenience.

Sincerely,


Dale Bumpers

DB:mdl

cc: Mr. Vincent Foster

G-96.

STATEMENT
of the
Northeast Texas Municipal Water District
Presented to
U. S. Army Corps of Engineers
at
Shreveport, La., 7:00 P.M., May 19, 1980

My name is Homer Tanner, I am the manager of the Northeast Texas Municipal Water District, a body politic of the State of Texas created for the purpose of developing the waters of Cypress Creek Basin, tributary to the Red River, to its highest and best use.

The District since its inception in 1957 has had an abiding interest in the development of the navigation feature of the Red River Project to the end that navigation become a reality to the proposed "head of navigation" at mile 294 (re-aligned channel.)

We appear here to express our sincere desire that the alternate proposals of lower lock elevations specifically lock and dam #5 set forth in your "Announcement of Public Meeting" are eliminated and wish to strongly state a pool elevation at Lock & Dam #5 of 145 m. s. l. is the only acceptable proposal.

Senate Joint Resolution 148 adopted by the 85th Congress January 1958 and signed into law by the President called for studies to include a navigation feature via Twelve Mile Bayou thence thru Cypress Bayou to Daingerfield.

Resultant from those studies the USCE Interim Report dated March 1966 determined the project feasible. I draw your attention to Paragraph 5 of the Syllabus of the report, the lead sentence states "navigation was found to be economically feasible as far north as Shreveport, Louisiana, on the main stem, and along the Twelve Mile - Cypress Bayou tributary to Daingerfield, Texas."

We all know subsequent studies have determined a gray area in the B/C ratio's that have stemmed from changes in the project structurally and in re-assignment of project costs. While this District believe these changes have unfairly created problems we have continued to work within the system toward the end a B/C ratio of a more favorable nature will be forthcoming.

The latest major announcement in the series of events subsequent to 1958 was the announcement by top representatives of President Carter here in Shreveport March 3, 1980, that adequate funding for the Red River Project was assured by the administration

under guidelines set forth in the White House Rural Development Initiatives, Area Development from Large-Scale Construction.

Navigation to mile 294 should most clearly demonstrate the ideals set forth in the Presidents Initiatives to open up Rural America. There is but one small city in the entire effected area with a population that exceeds 10,000 and only one other of 5,000 inhabitants, the rest are rural America.

The proposal under discussion here to revise the pool elevation of 145 thus destroying future navigation above Shreveport, Louisiana, flies in the face of the Congressional intent established in 1958 and we respectfully request your withdrawing from consideration any modification of Lock & Dam below the 145 m. s. l. pool level.

Homer Tanner, Manager
Northeast Texas Municipal Water Dist.
1002 Linda Drive
P. O. Box 680
Daingerfield, Texas 75638
Tel. (214) 645-2241

AD-A126 528

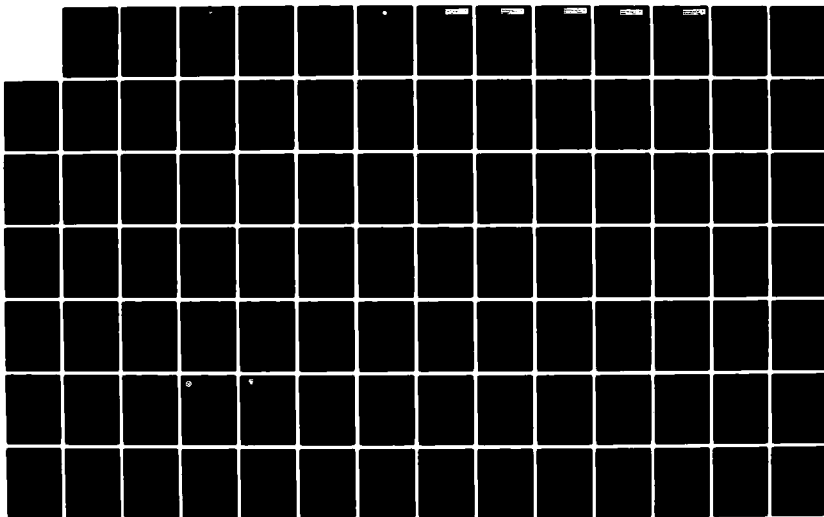
RED RIVER WATERWAY LOUISIANA TEXAS ARKANSAS AND
OKLAHOMA MISSISSIPPI RIVE..(U) ARMY ENGINEER DISTRICT
NEW ORLEANS LA DEC. 82

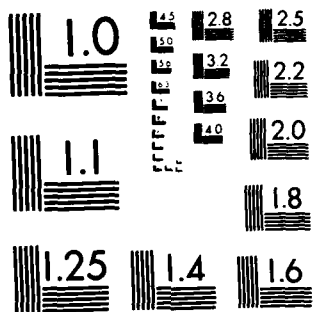
4/8

UNCLASSIFIED

F/G 13/2

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

RUSSELL B. LONG, LA., CHAIRMAN

HERMAN E. TALMADGE, GA.
ABRAHAM RIBICOFF, CONN.
HARRY P. BYRD, JR., VA.
GAYLORD NELSON, WIS.
MIKE GRAVEL, ALASKA
LLOYD BENTSEN, TEX.
SPARK M. MATSUNAGA, HAWAII
DANIEL PATRICK MOYNIHAN, N.Y.
MAX BAUCUS, MONT.
DAVID L. BOREN, OKLA.
BILL BRADLEY, N.J.

ROBERT J. DOLE, KANS.
BOB PACKWOOD, OREG.
WILLIAM V. Roth, JR., DEL.
JOHN C. DANFORTH, MO.
JOHN H. CHAFER, R.I.
JOHN NEUNE, PA.
MALCOLM WALLOP, WYO.
DAVID BURENBERGER, MINN.

United States Senate

COMMITTEE ON FINANCE

WASHINGTON, D.C. 20510

MICHAEL STERN, STAFF DIRECTOR
ROBERT E. LIGNITZER, CHIEF OF STAFF COUNSEL

August 22, 1980

Col. Thomas A. Sands
District Engineer
Corps of Engineers
P. O. Box 60270
New Orleans, LA 70160

Dear Col. Sands:

I understand that the Corps of Engineers is currently considering three different alternatives for the pool elevation level at Lock and Dam No. 5 of the Red River Waterway.

The public meeting you held last May gave many organizations and individuals the opportunity to express their views on this issue. I join the Red River Valley Association, the City of Shreveport, the Caddo-Bossier Port Commission, and many others in supporting the 145 foot pool elevation.

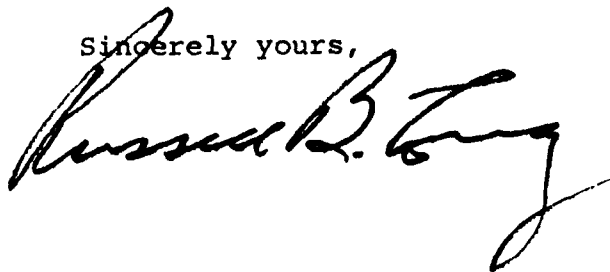
As you know, I have long been a strong supporter and advocate of the Red River Navigation project. This deeper pool depth will be necessary to insure economic development in the upper reaches of the Red River Basin from Shreveport, Louisiana, to Dangerfield, Texas.

I hope that your study on the costs and benefits of the three alternatives will include the economic benefits of the 145 foot pool and that you will agree that this elevation will be the most suitable to meet the goals of the Red River project.

I look forward to your report on this matter.

With best regards, I am

Sincerely yours,



C-100.



**OFFICE OF THE MAYOR
CITY OF BOSSIER CITY, LOUISIANA**

**MARVIN E. ANDING
MAYOR**

July 15, 1980

Lt. Colonel Bruce Miller
U.S. Corps of Engineers
New Orleans Area Office
Post Office Box 60267
New Orleans, Louisiana 70160

SUBJECT: Red River Navigation Project;
Locks and Dam No. 5 (Pool Level)

Dear Colonel Miller:

Recently members of my staff and myself discussed the above subject project with Mr. Champ Baker, Executive Director, Red River Valley Association. As a result of the conversation I felt I should contact you and make you aware of several related actions and community and economic development projects in Bossier City which would be adversely affected by a pool level below 145 feet at Locks and Dam No. 5. I am also attaching a copy of the Resolution supporting the original proposed pool level of 145 feet which was adopted by the Bossier City Council on June 12, 1980.

The City of Bossier City is strongly opposed to the reduction of the pool level of Locks and Dam No. 5 below 145 feet for many reasons.

1. It is felt that a lower pool level would not provide adequate water supplies for Bossier City or proposed port facilities.
2. A lower pool level would constrict the continuation of Navigation and Economic Development on the Red River North of Bossier City.
3. The City of Bossier City is presently involved in the planning of several projects which would be adversely affected by the lower pool level. These include the following:
 - a. The proposed Red River Waterway Recreation Project has been submitted for funding approval. This recreation project would involve park facilities (Cane's Landing, Bennett's Bluff, etc.) along the Red River.

C-101.

Lt. Colonel Bruce Miller
July 15, 1980

page two

b. The Downtown Redevelopment Project would involve the community and economic redevelopment of the Old Downtown Area located close to the Red River.


4. A lower pool level would also adversely affect the proposed construction of the New Municipal Complex and a new 100 plus store shopping mall and hotel complex which will provide new employment opportunities.

It is also my understanding that the reduction in pool level below 145 feet would adversely affect the benefits which could be attained from the creation of hydro-power. If the pool level is reduced significantly below 145 feet the result would be a loss of at least eight (8) feet of "head"; since this generates electricity there would be a loss of benefits from the power that could not be generated. This would affect community as well as economic development in the area.

There are many other projects within the City which would be affected by the reduced pool level. I would be glad, at any time, to discuss the situation in detail with you should you need additional information or clarification.

Your consideration and assistance in this matter is greatly appreciated.

Sincerely,


Marvin E. Anding
Mayor

Enclosure

cc: Senator Russell B. Long
Senator Bennett Johnston
Congressman Claude Leach
Champ L. Baker (RR Valley Assoc.)
Joe D. Waggoner (Greater Bossier Economic
Development Foundation)
Carolyn N. Weisz (CDC)
Bill Taylor (Engineer)
File

MEA/tlh

C-102.

The following Resolution offered and adopted:

RESOLUTION NO. 13 OF 1980

A RESOLUTION SUPPORTING THE ORIGINAL PLANS OF THE PROPOSED 145 FOOT POOL LEVEL IN RED RIVER AT BOSSIER CITY-SHREVEPORT AND THAT ANY CHANGES WOULD SERIOUSLY IMPAIR PROVISION OF ADEQUATE WATER SUPPLIES TO BOSSIER CITY, CAUSING MUCH CONCERN FOR PUBLIC HEALTH AND WELFARE, AND UNNECESSARILY INDUCE COSTS AS WELL AS OTHERWISE INHIBIT THE CONTINUATION OF NAVIGATION ON THE RED RIVER NORTH OF BOSSIER CITY.

WHEREAS, the City of Bossier City is located on the East bank of the Red River in Bossier Parish, Louisiana; and

WHEREAS, the City of Bossier City's source of water supply is solely the Red River; and

WHEREAS, we must insure adequate year-round pumping capacity and a constant water level to provide this pumping capacity; and

WHEREAS, the City of Bossier City's growth factor is estimated to have the population of 100,000 by the year 2000, requiring an increased source of potable water; and

WHEREAS, increased land areas along the river will be used for Recreation, and a potential source of hydroelectric power; and

WHEREAS, the River and Harbor Act of 1968 provided navigation from the Mississippi River THROUGH the Shreveport-Bossier area not TO the Shreveport-Bossier area.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Bossier City, Louisiana, continues to support the original plans of the proposed 145 foot pool level in Red River at Bossier City-Shreveport and that any changes would seriously impair provision of adequate water supplies to Bossier City, causing much concern for public health and welfare, and unnecessarily induce costs as well as otherwise inhibit the continuation of navigation on the Red River North of Bossier City.

The above and foregoing Resolution was read in full at open and legal session convened, was on motion of Mr. Mercer, seconded by Mrs. Bennett, and adopted this 17th day of June, 1980, by the following vote:

AYES: Mr. Wojcecki, Mr. Mercer, Mr. Maddox, Mr. Provenza, Mr. Blackburn, Mrs. Bennett, Mrs. Miller

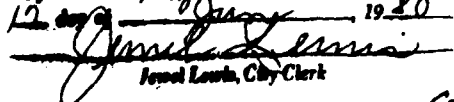
NAYS: None

ABSENT: None

ABSTAIN: None


MARVIN E. ANDING, MAYOR


Jewel Lewis, City Clerk

I, Jewel Lewis, City Clerk of the City Council of the City of Bossier City, Louisiana, do hereby certify that the above is a true and correct copy of Resolution # 13 of 1980 as adopted at the City Council Regular meeting held on the 17 day of June, 1980

Jewel Lewis, City Clerk



WILLIAM P. CLEMENTS, JR.
GOVERNOR

OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

August 18, 1980

Colonel Thomas A. Sands, District Engineer
New Orleans District, U. S. Corps of Engineers
P. O. Box 60267 New Orleans, Louisiana 70160

Dear Colonel Sands:

This is in response to your notice of a public meeting to discuss alternative locations and pool levels for Locks and Dams 2, 3, 4, and 5 of the Red River Waterway Project, Mississippi to Shreveport Reach. As you know, the navigability of the Red River is of great concern to Texas and Texans.

On the basis of information available to me, I believe that it was the intent of the Congress to provide for navigation of the Red River into Arkansas and Texas. I support the contention that a pool elevation for Lock and Dam 5 below 145 feet would be in contravention of that intent and very poor economics. I support that alternative for Lock and Dam 5 which provides for a pool elevation of 145 feet.

Sincerely,

A handwritten signature in black ink that reads "Bill Clements".

William P. Clements, Jr.
Governor of Texas

ep

cc Mr. Chester D. Wells
Mr. Harvey Davis

C-104

AGURS PUMP AND SUPPLY CO. WGA
BOX 7126
SHREVEPORT LA 71107



Mailgram



4-0387638169 06/17/80 ICS IPMBNGZ CSP NLNB
3182226348 MGM TDBN SHREVEPORT LA 79 06-17 0112P EST

UNITED STATES CORPS OF ENGINEERS
ATTN. WILLIE SHELTON
PO BOX 60267
NEW ORLEANS LA 70160

AUTHORIZED 145 FOOT POOL LEVEL AT SHREVEPORT NECESSARY TO INSURE
BARGE TRANSPORTATION TO PRIVATE TERMINALS IN NORTH SHREVEPORT WE PLAN
TO BARGE OIL COUNTRY PIPE TO STORAGE IN THIS AREA EXTRA COST OF LAND
TRANSPORTATION FROM HEAD OF NAVIGATION AT 135 OR 137 FOOT POOL
ELEVATION WILL PRECLUDE BARGE SAVINGS

W. G. AKERS, MANAGER
AGURS PUMP AND SUPPLY COMPANY
BOX 7126
SHREVEPORT LA 71107

13112 EST

MGMCOMP MGM

5241 (R1/78)

G-105
TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

MINUTE MAN INC WGA
755 BEXTER ST
SHREVEPORT LA 71107



Mailgram



4-0112268170 06/18/80 ICS,IPMBNGZ CSP NLND
3182226348 MGM TDBN SHREVEPORT LA 72 06-18 0925A EST

U.S. ARMY CORP OF ENGINEERS
PO BOX 60267
NEW ORLEANS LA 70160

OVER MANY YEARS WE HAVE INVESTED HEAVILY IN LAND FOR AN EXTENSIVE
PORT FACILITY IN NORTH SHREVEPORT. 145 FOOT POOL ELEVATION THROUGH
SHREVEPORT MUST BE MAINTAINED OR ADVANTAGE OF RED RIVER NAVIGATION
MAY BE DENIED HEAVY INDUSTRIAL AREA OF NORTH SHREVEPORT, STRONGLY
URGE 145 FOOT POOL LEVEL.

A W SOUR JR PRESIDENT LANDMAKER INC 1710 NORTH HEARNE SHREVEPORT LA
71107

09125 EST

MGMCOMP MGM

C-106

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

MIKE ROE
5044 GREENWOOD RD
SHREVEPORT LA 71109



Mailgram



4-0176158170 06/18/80 ICS IPMBNGZ CSP NLNB
3186363695 MGM TDBN SHREVEPORT LA 63 06-18 1022A EST

U S CORPS OF ENGINEERS
P O BOX 00267
NEW ORLEANS LA 70160

HORNS SHIPYARD ON CROSS BAYOU DESPERATELY NEEDS 145' POOL LEVEL AT
SHREVEPORT TO EXPAND TONBOAT AND BARGE CONSTRUCTION BUSINESS TO
MULTI-MILLION DOLLAR OPERATION, VIGOROUSLY REQUEST THAT CORPS OF
ENGINEERS RECOMMEND TO THE ADMINISTRATION THAT 145' POOL LEVEL BE
MAINTAINED.

FLOYD B HORN
HORNS SHIPYARD
702 BRINGHURST ST
SHREVEPORT LA 71106

10:22 EST

MGMCOMP MGM

5241 (01/78)

G-107

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA, 22645



Mailgram



4-0381258169 06/17/80 188 IPMBNGZ GBR NLND..
3182226348 MGM TDBN SHREVEPORT LA 71 06-17 0107Z EST

UNITED STATES CORPS OF ENGINEERS
PO BOX 60267
NEW ORLEANS LA 70160

AS OIL PRODUCERS WE PLAN TO SHIP CRUDE OIL FROM PRIVATE TERMINAL IN
NORTH SHREVEPORT WE CALL UPON THE US ARMY CORPS OF ENGINEERS TO
MAINTAIN A POOL ELEVATION LEVEL OF 145 FEET PER INTENT OF
CONGRESSIONAL AUTHORIZATION OF RED RIVER NAVIGATION PROJECT
R J MOSS MANAGER A W SOUR JR AND SONS
1920 CAPTAIN SHREVE DR
SHREVEPORT LA

13107 EST

MGMCOMP MGM

C-108.
TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

R B BARNHOUSE MANAGER PRODUCERS
755 BESTER ST
SHREVEPORT LA 71107



Mailgram



4-0438198169 06/17/80 ICS IPMBNGZ CSP NLND
3182226348 MGM TDBN SHREVEPORT LA 81 06-17 0153P EST

UNITED STATES CORP OF ENGINEERS
PO BOX 60267
NEW ORLEANS LA 70160

STRONGLY RECOMMEND THAT U S ARMY CORP OF ENGINEERS MAINTAIN 145 FOOT
POOL ELEVATION ABOVE RED RIVER LOCK AND DAM 5, AS OIL PRODUCTION
COMPANY WE PLAN TO SHIP CRUDE OIL FROM PRIVATE TERMINAL IN NORTH
SHREVEPORT. CHANGING TERMINAL LOCATION TO SOUTH SHREVEPORT WILL
BURDEN SHIPPING COSTS TO EXTENT BARGE TRANSPORTATION MAY NOT BE
FEASIBLE

R B BARNHOUSE MANAGER PRODUCERS SERVICE CO INC
755 BESTER ST
SHREVEPORT LA 71107

13153 EST

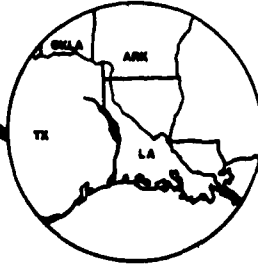
MGMCOMP MGM

5241 (R1/78)

C-109
TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

Mississippi-Red River Transport Co.
2809 North Main Street
Fort Worth, Texas 76106
817/626-1962

For rates & Information:
Ellen M. Holland, Pres.
Lindsay B. Holland, Sec.
Serving Okla., Tx., Ark., La.



June 17, 1980

U.S. Army Corps of Engineers
P.O.Box 60267
New Orleans, Louisiana 70160

Gentlemen:

Mississippi-Red River Transport Co. holds the only ICC permit for carrying regulated commodities on the Red River from Old River Lock & Dam to Denison Dam in Texas. This permit also covers the area from Old River Lock & Dam near Simmesport to New Orleans by way of the Mississippi River and to Morgan City by way of the Atchafalaya River.

This permit was obtained partly through the help and testimony of farmers and other businessmen from Texas, Arkansas and Oklahoma as well as Louisiana.

If the 145' pool level is not maintained through Shreveport it will seriously jeopardize the possibility of those areas above Shreveport ever enjoying the advantages of navigation, river recreation, bank stabilization and flood control which would otherwise be provided.

We have anticipated large and increasing tonnages of grain, crude oil, roofing materials, fabricated steel tanks and vessels, oil country pipe and various other commodities downbound and structural steel, scrap paper, coal and lignite, gravel and other materials upbound. All these large tonnages would be handled at terminals in North Shreveport or above on the Daingerfield reach and the Red River to Denison, Texas.

The cost of extra handling and land transportation between Shreveport and the areas above might cancel any savings in freight costs which would be made possible by direct barge transportation.

We urge the Corps of Engineers to recommend that pool level above Lock & Dam #5 be maintained at 145' above mean sea level.

Sincerely,
W. G. Akers
W. G. Akers
Manager - Shreveport Operation

G 110.

STATEMENT OF JOHN M. MORRIS
VICE PRESIDENT, CORPORATE AFFAIRS - LONE STAR STEEL COMPANY
Concerning Red River Waterway Project
Public Hearing, Shreveport, La., May 19, 1980

My name is John M. Morris. I am Vice President, Corporate Affairs, of Lone Star Steel Company, Dallas, Texas.

Lone Star operates a fully integrated steel mill at Lone Star (Morris County), Texas, with an annual capacity of in excess of 1.5 million ingot tons and with an employment of 5,000. Lone Star began as a merchant pig iron and coke producer in the mid-1940's. In 1953 when the original steel mill expansion program was completed, the company had a capacity of approximately 750,000 ingot tons annually. As you can see, the company's production capabilities have increased approximately 400% in the immediately prior 28 years. *John M. Morris*

This company, in its short history, has grown from a supplier to iron foundries which purchased only pig iron and coke to a major supplier of tubular products to many varied domestic and foreign industries. We are a major supplier of casing and tubing to the oil industry, being the second or third largest producer of such material in the U. S.

The growth of the Lone Star area in the past 30 years has not been limited to Lone Star Steel itself. We estimate that currently, there are 16 companies that have operations, offices, or warehouses in our immediate mill area that are there solely because of Lone Star Steel. These companies employ approximately 800 residents of the area. In addition to these 16 companies, there are many others in the trade area of our mill who look upon Lone Star as a major customer. Further, there are in excess of 30 trucking companies domiciled in the immediate mill area with in excess of 500 employees.

C-111.

May 19, 1980

Water transportation is a vital asset to any major industry using vast quantities of bulk raw materials. With few exceptions, Lone Star being one, most integrated steel producers in the United States have access to water transportation, a very high energy-efficient form of moving bulk raw materials. The availability of water transportation will not only enhance the industrial development of the area, but would also provide water for recreational purposes and human consumption.

Since Lone Star first supplied the Corps of Engineers information concerning its operation in 1966, our company has continued to grow. We would anticipate that such growth would continue in the future and would hope the such continued growth patterns would provide sufficient economic incentive for the Daingerfield reach of the Red River Waterway Project to continue as a vitally needed project for all Northeast Texas and the surrounding four-state area.

DAVID PRYOR
ARKANSAS

604 RUSSELL SENATE OFFICE BUILDING
WASHINGTON, D. C. 20510
(202) 224-3333

ARKANSAS OFFICE:
3036 FEDERAL BUILDING
LITTLE ROCK, ARKANSAS 72201
(501) 378-6336

United States Senate
WASHINGTON, D.C. 20510

COMMITTEES:
AGRICULTURE, NUTRITION, AND
FORESTRY
GOVERNMENTAL AFFAIRS
SPECIAL COMMITTEE ON AGING

July 16, 1980

Major General E. R. Heiberg III
Director of Civil Works
U. S. Army Corps of Engineers
Department of the Army
Washington, D. C. 20314

Dear General Heiberg:

On May 19th and May 20th of this year the New Orleans District of the Army Corps of Engineers conducted public meetings in Shreveport and Alexandria, Louisiana for the expressed purpose of presenting for public comment several alternate locations and pool elevations for Locks and Dams 2, 3, 4, and 5 of the Red River navigation project to Shreveport. As you know, work on this project has been progressing nicely for some time now, and the Congressional Appropriations Committees have been supportive in their recommendations for annual funding levels.

It is my understanding from the brief explanations provided to me by interested parties in Arkansas, and through the Corps' announcement notice for the meetings, that the Corps' intention in examining publicly the alternatives is to determine if any cost savings advantages and downstream flood control benefits might accrue through a reduction in scope of the overall project. Essentially, it appears that if navigation beyond Shreveport was dropped as a future consideration for authorization, or determined infeasible, the federal investment in the project could be reduced and the potential for flooding substantially eliminated by some alterations in project design.

I am confident that the objections of the Red River Valley Association and the Red River Commission of Arkansas, along with several other groups representing waterway interests in Texas and Louisiana, have been brought to your attention in the past few weeks. The purpose of my letter is to advise you of my position in this matter prior to the announcement of any irrevocable decisions which Corps officials may make pursuant to their responsibilities.

G/13

Major General E. R. Heiberg III
July 16, 1980
Page Two


Approximately eleven years ago, then-Governor Dale Bumpers of Arkansas established the Red River Commission of Arkansas for the purpose of protecting and overseeing the interests of the state in the development of this valuable resource. Annually, the appointed members of this Commission come to Washington to testify before the Appropriations Committees of the Congress in support of the Corps' projected needs for funding to continue development of the Red River projects, both navigation and emergency bank stabilization. I meet personally with these people each year, and I am quite familiar with their interests and concerns for this waterway.

On January 28th of this year Senator Russell Long, along with myself and others, introduced Senate Bill 2227, a bill to grant the consent of the United States to the Red River Compact among the States of Arkansas, Louisiana, Oklahoma and Texas. This compact is a statement of agreement among the several states, developed over the course of several years of negotiation, and designed to promote cooperation and coordination in the pursuit of common interests in the Red River Basin. Article I, Section 1.01 of this bill outlines the purposes of the compact, and I will take this opportunity to commend it to your attention.

In summary, it is my judgement that the development of the Red River waterway for navigation to Denison, Texas is in the best interests of the Red River Compact states. As you know, on March 3rd of this year President Carter sent his assistant for intergovernmental relations, Mr. Jack Watson, to Shreveport to announce a major development plan for the cities and rural areas along the Red River that would directly impact the economic interests that are served by the Corps' project. I have to believe that such a plan was never intended to be terminated at Shreveport and limited to those who have already been served by the project.

I will use this document to go on public record in opposition to any design changes in this project which may be undertaken by Corps officials, within their statutory authority, which will result in pool elevations or dam locations which may render consideration of additional navigational improvements into Arkansas and Texas impracticable or economically infeasible. I would appreciate an opportunity to have your official and candid response to my comments.

Sincerely,



David Pryor

DP/chj

C-1141

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO.2

APPENDIX D
ENVIRONMENTAL ANALYSIS

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND
EIS SUPPLEMENT NO. 2

APPENDIX D
ENVIRONMENTAL ANALYSIS

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND
EIS SUPPLEMENT NO. 2

APPENDIX D
ENVIRONMENTAL ANALYSIS

I. LAND-USE PROJECTIONS FOR
RRWW PROJECT AREAS
(includes only part of recreation
plan induced changes)

1. Losses of terrestrial habitat vary according to alternative. Obviously, the greater losses would occur by the flooding of more land, so a 145-foot pool elevation for pool 5 would impact more land than the 137-foot pool and the 137-foot elevation more than the 135-foot. The B-3 Modified (B-3M) Plan, considering like pool elevations, causes greater loss than the B-1 Plan primarily because of different lock and dam locations. Land-use trends, such as clearing or habitat succession, are relatively the same for any alternative. Differing acreages are due to different base conditions. Tables D-1 through D-6 show acreages projected over time for a with and without project condition for the B-1 and B-3M Alternatives using the three possible pool elevations for Lock and Dam No. 5. Oxbow and river channel acreage is shown because much of it fills in with silt, becomes terrestrial habitat, and can change in land type over a period of time. Some of the recreational lands are accounted on these tables because they are from dredged-material disposal areas that would have otherwise become agricultural lands. Other recreational lands are discussed separately in this appendix. Several assumptions were made in setting up tables to show projected land use:

(a) The construction period for the project is approximately 15 years (1973 to 1988 or 1989). In order to clearly present the data in table form, 1975 was presented as the beginning of construction and 1990 as the completion. The 50-year project life was shown to run from 1990 to 2040.

(b) During the construction period, it was assumed that 1/3 of the construction would have been accomplished every 5 years - that is 1/3 by 1980, 2/3 by 1985, and all by 1990.

TABLE D-1
LAND USE PROJECTIONS (ACRES)
B-1 ALTERNATIVE, 135' POOL

Habitat Type	1975 Base Condition	1980 (yr 5) W/O Pro- ject	1985 (yr 10) W/O Pro- ject	1990 (yr 15) W/O Pro- ject	2000 (yr 20) W/O Pro- ject	2010 (yr 25) W/O Pro- ject	2020 (yr 30) W/O Pro- ject	2030 (yr 35) W/O Pro- ject	2040 (yr 40) W/O Pro- ject	2050 (yr 45) W/O Pro- ject
Soybean	5193	5672	6688	6151	8334	6151	8185	6151	8185	6151
Pasture	7889	8368	8603	8847	8689	8847	8540	8847	8540	8847
CWS	15562	14784	11017	14006	1927	14006	1927	14006	1927	14006
BLH	2268	2155	1559	2042	141	2042	141	2042	141	2042
WSB	2593	2593	3060	2593	3994	2593	3713	2593	1680	2593
PH	634	602	443	570	61	570	61	570	0	570
CT	700	665	467	630	0	630	0	630	0	630
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	2860	3700	2860	3700	2860	3700
Oxbows (Severed Bendways)	0	0	2629	0	7887	0	7400	0	6426	0
Existing River Channel	11653	11653	7769	11653	0	11653	0	11653	0	11653
Intensive Recreation	0	0	0	0	482	0	535	0	535	0
Low-Use Recreation	0	0	0	0	820	0	912	0	912	0
Natural/Wildlife	0	0	0	0	1386	0	1539	0	1539	0
Total Acres Lost to Revetment, New Channel and Flooding (Navigation Pool)	0	0	4537	0	13611	0	13611	0	13611	0
Column Totals	50192	50192	50192	50192	50192	50192	50192	50192	50192	50192

TABLE D-2
LAND USE PROJECTIONS (ACRES)
B-1 ALTERNATIVE, 137' POOL

Habitat Type	1975 Base Condition	1980 (yr 5)		1985 (yr 10)		1990 (yr 15)		2000 (yr 20)		2010 (yr 30)		2020 (yr 40)		2030 (yr 50)	
		W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-
Soybean	5298	5795	6775	6293	7579	6293	8384	6293	8235	6293	8235	6293	8235	6293	8235
Pasture	8134	8632	8839	9129	8873	9129	8907	9129	8758	9129	8758	9129	8758	9129	8758
CWS	16190	15380	11543	14570	6896	14570	2249	14570	2249	14570	3565	14570	6075	14570	5794
BLH	2352	2234	1639	2116	926	2116	213	2116	213	2116	213	2116	213	2116	1468
WSB	2641	2641	3101	2641	3561	2641	4021	2641	4508	2641	3740	2641	1717	2641	1717
PH	634	602	443	570	252	570	61	570	61	570	0	570	0	570	0
CT	700	665	467	630	234	630	0	630	0	630	0	630	0	630	0
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	3140	3700	2860	3700	2860	3700	2860	3700	2860	3700	2860
Oxbows (Severed)	0	0	2629	0	5258	0	7887	0	7400	0	6426	0	5939	0	5452
Existing River Channel	11653	11653	7769	11653	3885	11653	0	11653	0	11653	0	11653	0	11653	0
Intensive Recreation	0	0	0	0	241	0	482	0	535	0	535	0	535	0	535
Low-Use Recreation	0	0	0	0	410	0	820	0	912	0	912	0	912	0	912
Natural/Wildlife	0	0	0	0	693	0	1386	0	1539	0	1539	0	1539	0	1539
Total Acres Lost to Revetment, New Channel and Flooding (Navi- gation Pool)	0	0	4676	0	9352	0	14028	0	14028	0	14028	0	14028	0	14028
Column Totals	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300	51300

TABLE D-3
LAND USE PROJECTIONS (ACRES)
B-1 ALTERNATIVE, 145' POOL

Habitat Type	1975 Base Condition	1980 (yr 5)	1985 (yr 10)	1990 (yr 15)	2000 (yr 20)	2010 (yr 25)	2020 (yr 30)	2030 (yr 35)	2040 (yr 40)	2050 (yr 50)
		W/O	With	W/O	With	W/O	With	W/O	With	W/O
		Pro-	Pro-	Pro-	Pro-	Pro-	Pro-	Pro-	Pro-	Pro-
		ject	ject	ject	ject	ject	ject	ject	ject	ject
Soybean	5792	6321	7170	6851	8581	6851	8432	6851	8432	6851
Pasture	9963	10493	10290	11022	9601	11022	9452	11022	9452	11022
CWS	17408	16538	12278	15668	7148	15668	2018	15668	3334	15668
BLH	2438	2316	1666	2194	884	2194	122	2194	122	2194
WSB	2734	2734	3136	2734	3538	2734	4427	2734	3639	2734
PH	634	602	443	570	61	570	61	570	0	570
CT	700	665	467	630	234	630	0	630	0	630
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	2860	3700	2860	3700	2860	3700
Oxbows (Severed Bendways)	0	0	2629	0	5258	0	7887	0	6426	0
Existing River Channel	11653	11653	7769	11653	3885	11653	0	11653	0	11653
Intensive Recreation	0	0	0	0	241	0	482	0	535	0
Low-Use Recreation	0	0	0	0	410	0	820	0	912	0
Natural/Wildlife	0	0	0	0	693	0	1386	0	1539	0
Total Acres Lost to Revetment, New Channel and Flooding (Navi- Pool)	0	0	5754	0	11508	0	17262	0	17262	0
Column Totals	55022	55022	55022	55022	55022	55022	55022	55022	55022	55022

TABLE D-4
LAND USE PROJECTIONS (ACRES)
B-3M ALTERNATIVE, 135' POOL

Habitat Type	1975 Base Condition	1980 (yr 5) W/O Pro- ject	1985 (yr 10) W/O Pro- ject	1990 (yr 15) W/O Pro- ject	2000 (yr 20) W/O Pro- ject	2010 (yr 25) W/O Pro- ject	2020 (yr 30) W/O Pro- ject	2030 (yr 35) W/O Pro- ject	2040 (yr 40) W/O Pro- ject	2050 (yr 50) W/O Pro- ject
Soybean	4626	5121	6485	5616	8858	5616	8709	5616	8709	5616
Pasture	9516	10011	9902	10506	9331	10506	9182	10506	9182	10506
CWS	15093	14300	10485	13507	1268	13507	2388	13507	5080	13507
BLH	2009	1909	1414	1809	224	1809	224	1809	224	1809
WSB	2454	2454	2822	3190	2454	4072	2454	1833	2454	1833
PH	1122	1066	758	1010	30	1010	0	1010	0	1010
CT	819	778	549	737	9	737	9	737	9	737
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	2860	3700	2860	3700	2860	3700
Oxbows (Severed Bendways)	0	0	2700	0	8099	0	7071	0	6043	0
Existing River Channel	11365	11365	7576	11365	0	11365	0	11365	0	11365
Intensive Recreation	0	0	0	241	0	535	0	535	0	535
Low-Use Recreation	0	0	0	410	0	912	0	912	0	912
Natural/Wildlife	0	0	0	0	1386	0	1539	0	1539	0
Total Acres Lost to Revetment, New Channel and Flooding (Navi- gation Pool)	0	0	4993	0	13780	0	13780	0	13780	0
Column Totals	50704	50704	50704	50704	50704	50704	50704	50704	50704	50704

TABLE D-5
LAND USE PROJECTIONS (ACRES)
B-3M ALTERNATIVE, 133rd POOL

Habitat Type	1975 Base Condition	1980 (yr 5)		1985 (yr 10)		1990 (yr 15)		2000 (yr 20)		2010 (yr 30)		2020 (yr 40)		2030 (yr 50)	
		W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-	W/O Pro-	With Pro-
Soybean	4689	5200	6539	5710	7716	5710	8894	5710	8745	5710	8745	5710	8745	5710	8745
Pasture	9952	10462	10292	10973	9961	10973	9629	10973	9480	10973	9480	10973	9480	10973	9480
CWS	15628	14809	10895	13990	6162	13990	1429	13990	1429	13990	2548	13990	4726	13990	4665
BLF	2104	1999	1499	1894	884	1894	289	1894	289	1894	289	1894	289	1894	1378
WSB	2502	2502	2863	2502	3224	2502	3385	2502	4099	2502	3524	2502	1860	2502	1860
PH	1122	1066	758	1010	394	1010	30	1010	30	1010	0	1010	0	1010	0
CT	819	778	549	737	279	737	9	737	9	737	9	737	9	737	9
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	3140	3700	2860	3700	2860	3700	2860	3700	2860	3700	2860
Oxbows (Severed Bandways)	0	0	2700	0	5400	0	8099	0	7585	0	7071	0	6557	0	6043
Existing River Channel	11365	11365	7576	11365	3787	11365	0	11365	0	11365	0	11365	0	11365	0
Intensive Recreation	0	0	0	0	241	0	482	0	535	0	535	0	535	0	535
Low-Use Recreation	0	0	0	0	410	0	820	0	912	0	912	0	912	0	912
Natural/Wildlife	0	0	0	0	493	0	1386	0	1539	0	1539	0	1539	0	1539
Total Acres Lost to Revetment, New Channel and Flooding (Navi- gation Pool)	0	0	4790	0	9581	0	14371	0	14371	0	14371	0	14371	0	14371
Column Totals	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881	51881

TABLE D-6
LAND USE PROJECTIONS (ACRES)
B-3M ALTERNATIVE, 145' POOL

Habitat Type	1975 Base Condition	1980 (yr 5) W/O Pro- ject	1985 (yr 10) W/O Pro- ject	1990 (yr 15) W/O Pro- ject	2000 (yr 20) W/O Pro- ject	2010 (yr 20) W/O Pro- ject	2020 (yr 30) W/O Pro- ject	2030 (yr 40) W/O Pro- ject	2040 (yr 50) W/O Pro- ject
Soybean	4975	5530	6757	6085	8827	6085	8827	6085	8827
Pasture	12710	13265	12383	13820	10386	13820	10237	13820	10237
CWS	17326	16422	11947	15518	1189	15518	2308	15518	5000
BLR	2186	2077	1522	1968	858	1968	194	1968	194
WSB	2520	2520	2847	3174	2520	3501	3440	2520	1776
PH	1122	1066	758	1010	30	1010	0	1010	0
CT	825	784	555	743	285	15	743	15	743
Existing Backwaters (Oxbows, sloughs)	3700	3700	3420	3700	2860	3700	2860	3700	2860
Oxbows (Severed Bendways)	0	0	2700	0	5400	0	7071	0	6043
Existing River Channel	11365	11365	7576	11365	0	11365	0	11365	0
Intensive Recreation	0	0	0	0	241	0	535	0	535
Low-Use Recreation	0	0	0	0	410	0	912	0	912
Natural/Wildlife	0	0	0	0	83	0	1539	0	1539
Total Acres Lost to Revetment, New Channel and Flooding (Navi- gation Pool)	0	0	12525	0	18788	0	18788	0	18788
Column Totals	56728	56728	56728	56728	56728	56728	56728	56728	56728

(c) Based on earlier surveys, it was assumed that 6,680 acres of induced clearing would occur by the year 1990. The breakdown of wooded habitat cleared was proportioned according to the percentage of wooded habitat that presently exists.

(d) Ten percent of the remaining woodlands of the project area are expected to be cleared without project implementation. This is expected by 1985 and is broken down by habitat type according to the percentage of wooded habitat that exists. By 1985, all land adjacent to the river that is suitable for agriculture is projected to be cleared.

(e) It was jointly determined by US Army Corps of Engineers, New Orleans District (NOD) and US Fish and Wildlife Service biologists that cleared land would go to pasture and rowcrop in equal amounts. Additionally, experience indicates that dredged-material disposal areas would become agricultural. This, too, was designated to pasture and rowcrop in equal amounts.

(f) Recreational lands (Intensive, Low-Use, and Natural/Wildlife) were taken half and half from dredged-material disposal areas that would have otherwise become pasture and soybean in equal amounts. In the tables, gains to recreational areas are reflected as losses to agricultural lands. The approximate development schedule for recreational lands is 45 percent by 1985, 90 percent development by 1990, and 100 percent complete by year 2000. Recreational lands were given separate categories because they usually would not fit into other land categories. Intensive recreational lands could include ball fields, parks, etc. Low-use recreational areas might include horse riding trails and other low-use areas by people. Natural/wildlife areas could include areas allowed to develop naturally or areas kept at early succession stages for wildlife management purposes.

(g) Severed bendways in the amount of 3,766 acres in the B-1 plan and 3,266 acres of bendways in the B-3M plan would not be preserved during construction. It was assumed that these acreages would fill-in and succeed to willow-sandbar areas in 1/3 increments (1980, 1985, and 1990) during the construction period. The NOD engineers further estimated that preserved oxbows (which are all established by 1990) would partially fill-in and become terrestrial habitat over the 50-year project life. The 2,433 acres filled-in for B-1 and the 2,570 acres for B-3M (in addition to that immediately lost during construction) are projected to accrete in 1/5 increments from 1990 to 2040. These acres are projected to go initially to willow-sandbar and eventually to cottonwood-willow-sycamore. Therefore, by year 2040, only 5,452 acres of severed bendways of 11,653 original acres in the B-1 plan and 5,529 acres of the 11,365 in the B-3M plan would remain as aquatic habitat.

(h) Of the 3,700 acres of project area water bodies (existing oxbow lakes and backwater areas), it is estimated that 840 acres will become terrestrial habitat due to dredged-material disposal. These changes are expected to occur in 1/3 increments every 5 years during the construction period and are allocated evenly between pasture and soybeans.

2. The following is a narrative of land-use projections for the B-1 alternative, 137-foot pool elevation (Table D-2). Trends are the same regardless of the selected alternative.

(a) Year 1975

Acres given for the various habitat types at the beginning of construction are acres that would be impacted to some degree by implementation of the particular alternative. Acreage breakdown for B-1, 137-foot pool elevation for 1975 is as follows:

Soybean	-	5,298
Pasture	-	8,134
Cottonwood-Willow-Sycamore (CWS)	-	16,190
Bottomland Hardwoods (BLH)	-	2,352
Willow-Sandbar (WSB)	-	2,641
Pine Hardwoods (PH)	-	634
Cypress Tupelo (CT)	-	700
River Channel	-	11,653
Backwater Area	-	<u>3,700</u>
Total	-	51,302

(b) Year 1980

(1) Without Project

Soybean gains 497 acres from land clearing and totals 5,795 acres. Pasture has a similar gain from land clearing and totals 8,632 acres. CWS loses 810 acres to clearing and becomes 15,380 acres. BLH loses 118 acres to clearing and becomes 2,234 acres. WSB remains 2,641 acres throughout the project life for the without condition because of the dynamic river environment which continually erodes and rebuilds this habitat type. PH loses 32 acres to clearing and is reduced to 602 acres. CT loses 35 acres to clearing and is reduced to 665 acres. River channel remains 11,653 acres and backwater habitat remains 3,700 acres and neither changes throughout the project life for the without condition. It should be noted that gains to agriculture equal losses to wooded lands.

Soybean	-	5,795
Pasture	-	8,632
CWS	-	15,380
BLH	-	2,234
WSB	-	2,641
PH	-	602
CT	-	665
Natural River Channel	-	11,653
Backwater	-	<u>3,700</u>
Total	-	51,300

(2) With Project

Soybean gains 1,113 acres from induced woodland clearing, 140 acres from dredged-material disposal areas located in backwater habitat, and 224 acres from dredged-material disposal areas used for agriculture for a net gain and an increase in soybean acreage to 6,775 acres. Pasture has a similar gain from induced clearing and disposal areas but loses 547 acres to construction activities, revetments, new channels, and flooding resulting in an overall increase to 8,839 acres. CWS loses 1,804 acres to induced clearing and 2,843 to construction activities, which reduces the amount of habitat to 11,543 acres. BLH loses 245 acres to induced clearing and 468 acres to construction and decreases to 1,639 acres. PH loses 89 acres to induced clearing and 102 acres to construction and decreases to 443 acres. CT loses 89 acres to induced clearing and 144 acres to construction and has a decrease to 467 acres. WSB gains 1,255 acres from accreted river channel, has a loss of 795 from construction impacts, and increases to 3,101 acres. Oxbow lakes, created from preserved river channel increase by 2,629 acres. River channel loses 2,629 acres to severed bendways and 1,255 acres to WSB and is, therefore, reduced to 7,769 acres. Backwater habitat loses 240 acres to disposal areas and is reduced to 3,420 acres. A total of 4,676 acres has been lost as terrestrial habitat, at this point, due to revetments, new channels, and flooding. These terrestrial and aquatic habitat acreages will become the navigation pool upon project completion. However, some gains to terrestrial habitat, as stated above, have occurred.

Soybean	- 6,775
Pasture	- 8,839
CWS	- 11,543
BLH	- 1,639
WSB	- 3,101
PH	- 443
CT	- 467
Natural River Channel	- 7,769
Backwater	- 3,420
Severed Oxbows	- 2,629
Revet, Channel Flooding	- 4,676
Total	- 51,300

(c) Year 1985

(1) Without Project

Soybean gains 498 acres from land clearing and increases to 6,293 acres. Pasture gains similar acreage and increases to 9,129 acres. CWS loses 810 acres to land clearing and drops to 14,570 acres. BLH loses 118 acres to land clearing and becomes 2,116 acres. PH loses 32 acres to land clearing to a reduced total of 570 acres. CT loses 35 acres to land clearing and is reduced to 630 acres.

Soybean	- 6,293
Pasture	- 9,129
CWS	- 14,570
BLH	- 2,116
WSB	- 2,641
PH	- 570

(2) With Project

Soybean gains 1,112 acres from induced clearing, 140 acres from filled backwater habitat, and 224 acres from disposal areas, but loses 672 acres to recreational development and increases overall to 7,579 acres. Actually, the 672 acres lost to recreational development were dredged-material disposal areas that would have gone to soybean production were it not for recreational needs. Pasture gains similar to soybean from induced clearing and backwater habitat but loses 547 acres to construction features and, as soybean, loses 672 potential acres to recreational lands for a reduction to 8,773 acres. CWS loses 1,804 acres to induced clearing and 2,843 acres to construction impacts and is reduced to 6,896 acres. Part of the 2,843 acres lost to CWS is dredged-material disposal area; so rather than being totally lost to terrestrial habitat, it is changed to another habitat type (either agricultural or recreational lands). BLH loses 245 acres to induced clearing and 468 acres to construction features and is reduced to 926 acres. WSB gains 1,255 acres from silted-in river channel and loses 795 acres to construction and increases overall to 3,561 acres. PH loses 89 acres to induced clearing and 102 acres to construction and is reduced to 252 acres. CT loses 89 acres to induced clearing and 144 acres to construction and is reduced to 234 acres. Oxbow lakes gain another 2,629 acres from preserved river channel and increase to 5,258 acres. River channel loses the 2,629 acres to oxbow lakes and accretes 1,255 acres to WSB. A total of 3,885 acres remain as river channel. Backwater habitat loses 240 acres to agricultural lands. By this year, 241 acres have been developed into intensive recreational areas, 410 acres to low-use recreation, and 693 acres to wildlife/natural areas. These recreational lands are from dredged-material disposal areas from all land types that would have otherwise become agricultural lands. At this point, 9,352 acres of terrestrial habitat will have been lost to construction activities such as new channel cuts, revetments, and flooding.

Soybean	- 7,579
Pasture	- 8,873
CWS	- 6,896
BLH	- 926
WSB	- 3,561
PH	- 252
CT	- 234
Natural River Channel	- 3,885
Backwater	- 3,140
Severed Oxbows	- 5,258
Revet, Channel Flooding	- 9,352
Intensive Rec	- 241
Low-Use Rec	- 410
Natural/WL	- 693
Total	51,300

(d) Year 1990

This year, for purposes of this analysis, is viewed as the last year of construction and the beginning of the project life.

(1) Without project

All land clearing was projected to have taken place by 1985. Other factors which may induce land changes for the without project are not within our capabilities to project. Succession of one habitat type to another is not quantifiable because of the dynamic river meandering whereby low quality habitat (WSB) is created and high quality habitat (BLH or CWS) is destroyed. The trade-offs between land succession and land destruction creates equilibrium throughout the project area concerning overall habitat quality. Without project conditions, therefore, do not change for the remainder of the project life.

Soybean	- 6,293
Pasture	- 9,129
CWS	- 14,570
BLH	- 2,116
WSB	- 2,641
PH	- 570
CT	- 630
Natural River Channel	- 11,653
Backwater	- 3,700
Total	- 51,300

(2) With Project

Soybean gains 1,113 acres from induced clearing, gains 224 acres from other habitat types that have received dredged-material disposal, gains 140 acres from filled backwater habitat, and loses 672 acres of land to recreational development. Pasture gains 1,113 acres from induced clearing, 140 acres from backwater habitat, loses 547 acres to construction and 672 acres to recreational development, for an overall lowering to 8,907 acres. CWS loses 1,804 acres to induced clearing, and 2,843 acres to construction features and is reduced to 2,249 acres. This remaining 2,249 acres represents CWS subject to the effects of the freeboard area. BLH loses 245 acres to induced clearing and 468 acres to construction features and is reduced to 213 acres. WSB gains 1,255 acres from accreted river channel, loses 795 acres to construction for an overall increase to 4,021 acres. PH loses 89 acres to induced clearing and 102 acres to construction and is reduced to 61 acres. CT loses 90 acres to induced clearing and 144 acres to construction features and is reduced to zero. CT is, obviously, zero for the remainder of the project life. The remaining 2,629 acres of oxbow lakes have been created and oxbows now total 7,887 acres. River channel has lost 2,629 acres to oxbow lakes and 1,255 acres to WSB and now remains at zero. Natural river channel has now become fully lost for the remainder of the project life. Actually, it has been changed to oxbow lakes or navigation pool. Although much of the navigation pool retains many of its river qualities, for purposes of this analysis, the "natural"

river is considered lost. Backwater habitat loses 240 acres to agricultural lands for a total loss of 840 acres. It remains at 2,860 acres for the remainder of the project life. Intensive recreational areas gain 241 acres from disposal areas that would have become agricultural lands and increases to 482 acres. Low-use recreational land gains likewise an additional 410 acres, and becomes 820 acres. Natural/wildlife areas, likewise, gain 693 acres and increase to 1,386 acres. By this time, all losses to terrestrial habitat have occurred. These losses due to revetments, new channel, and flooded acreage, total 14,028 acres (revetment - 3,465, channel - 4,834, flooding - 5,729).

Soybean	- 8,384
Pasture	- 8,907
CWS	- 2,249
BLH	- 213
WSB	- 4,021
PH	- 61
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 7,887
Revet, Channel Flooding	- 14,028
Intensive Rec	- 482
Low-use Rec	- 820
Natural/WL	- <u>1,386</u>
	51,300

(e) Year 2000

With Project

Soybean loses 149 acres to recreational development. As with previous years, lost soybean acreage is actually disposal areas that would have been used for soybean. Soybean acreage is now reduced to 8,235 acres and is projected to remain at this level for the remainder of the project life. Pasture, likewise, loses 149 acres to recreational lands and is reduced to 8,758 acres. It remains at this level for the remainder of the project life. CWS, BLH, and PH do not change from year 1990 levels. WSB gains 487 acres from accreted oxbow lakes and increases to 4,508 acres. Oxbows lose 487 acres due to accretion and are reduced to 7,400 acres. Intensive recreational areas increase by 53 acres to 535 acres. Low-use recreation increases by 92 acres to 912 acres. Wildlife/natural recreation increases by 153 acres to 1,539 acres. At year 2000, all recreational development is scheduled to be completed.

Soybean	- 8,235
Pasture	- 8,758
CWS	- 2,249
BLH	- 213
WSB	- 4,508
PH	- 61
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 7,400
Revet, Channel Flooding	-14,028
Intensive Rec	- 535
Low-Use Rec	- 912
Natural/WL	- 1,539
Total	-51,300

(f) Year 2010

With Project

CWS gains 1,255 acres from 30-year-old WSB and 61 acres from PH which causes an overall increase to 3,565 acres. WSB gains 487 acres from accreted oxbow lakes but has 1,255 acres succeed to the higher quality CWS. It is, therefore, reduced to 3,740 acres. The remaining PH, because of increased soil saturation, is projected to succeed to CWS. Oxbow lakes lose 487 acres to accretion and become WSB.

Soybean	- 8,235
Pasture	- 8,758
CWS	- 3,565
BLH	- 213
WSB	- 3,740
PH	- 0
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 6,913
Revet, Channel Flooding	-14,028
Intensive Rec	- 535
Low-Use Rec	- 912
Natural/WL	- 1,539
Total	-51,300

(g) Year 2020

With Project

CWS gains 2,510 acres from 30-year-old WSB and increases to 6,075 acres. WSB gains 487 acres from oxbow accretion but loses, by succession, 2,510 acres to CWS and is reduced to 1,717 acres. Oxbows, as previously stated, lose 487 acres to WSB and are reduced to 6,426 acres.

Soybean	- 8,235
Pasture	- 8,758
CWS	- 6,075
BLH	- 213
WSB	- 1,717
PH	- 0
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 6,426
Revet, Channel Flooding	- 14,028
Intensive Rec	- 535
Low-Use Rec	- 912
Natural/WL	- <u>1,539</u>
Total	- 51,300

(h) Year 2030

With Project

CWS gains 487 acres from maturing WSB. Although WSB loses 487 acres to CWS, it has an offsetting 487-acre gain from oxbow accretion and, therefore, remains at 1,717 acres. Oxbow lakes are reduced to 5,939 acres.

Soybean	- 8,235
Pasture	- 8,758
CWS	- 6,562
BLH	- 213
WSB	- 1,717
PH	- 0
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 5,939
Revet, Channel Flooding	- 14,028
Intensive Rec	- 535
Low-Use Rec	- 912
Natural/WL	- <u>1,539</u>
Total	- 51,300

(i) Year 2040

With Project

CWS gains 487 acres from WSB but loses 1,255 acres to BLH and is reduced to 5,794 acres. BLH gains 1,255 acres of 50-year-old CWS and increases to 1,468 acres. WSB has offsetting gains and losses due to succession and accretion and remains at 1,717 acres. Oxbow lakes lose another 487 acres due to accretion and are reduced to 5,452 acres.

Soybean	- 8,235
Pasture	- 8,758
CWS	- 5,794
BLH	- 1,468
WSB	- 1,717
PH	- 0
CT	- 0
Natural River Channel	- 0
Backwater	- 2,860
Severed Oxbows	- 5,452
Revet, Channel Flooding	- 14,028
Intensive Rec	- 535
Low-Use Rec	- 912
Natural/WL	- <u>1,539</u>
Total	- 51,300

II. LAND-USE PROJECTIONS FOR RECREATIONAL LANDS

1. A total of 12,758 acres of land are proposed for recreational development in conjunction with the Red River Waterway Project. The present and future use of these lands for with and without project conditions needs to be discussed for impact assessment purposes and for purposes of determining mitigation needs (discussed in Appendix E, Supplemental Mitigation). Part of the recreational lands (2,986 acres) is already discussed in the land-use projections for the general project area. They are discussed in that section because they involve development on areas already impacted by project activities (dredged material-disposal areas). This section discusses land use trends on lands proposed strictly for recreational development. The following acres would be impacted by recreational development:

Soybean	-	802
Pasture	-	2,488
CWS	-	3,334
BLH	-	600
WSB	-	566
PH	-	1,882
CT	-	100

2. Without project implementation, approximately 5 percent of the wooded habitat would be cleared by 1985. This loss to wooded habitat, 296 acres, would become agricultural lands and, for this analysis, would be distributed evenly between pasture and soybean. After 1985, no further changes would take place for the without project condition. All lands suitable for agriculture are projected to have been cleared by 1985.

3. The New Orleans District planners estimate that the recreational plan will be fully implemented by the year 2000. The schedule would be approximately 45 percent developed by 1985, 90 percent by 1990, and the remaining 10 percent by 2000. Since recreational development would be 90 percent completed by 1990, that is considered the beginning of project life for the recreational plan so it would conform to the total project land-use projections. Recreational land uses have been grouped into three major categories for purposes of this analysis - intensive recreation, low-use recreation, and wildlife/natural areas. Intensive recreational areas are those lands that would normally have high people use such as ball fields, picnic areas, parks, and boat ramps. Low-use recreational areas would encompass such activities as horse riding, nature walks, and primitive camping. Wildlife/natural areas include areas managed for wildlife, buffer or scenic areas, and other areas where the activity should not detract significantly from the habitats' wildlife potential. Table D-7 illustrates land-use trends over time as a result of recreational development. Obviously, the more intense the recreational development, the more likely the lands would be to change from their

TABLE D-7
LAND-USE TRENDS (ACRES)
RESULTING FROM RECREATIONAL DEVELOPMENT

<u>Present Use</u>	<u>Intensive Recreation</u>		
	<u>1985</u>	<u>1990</u>	<u>2000-2040</u>
Row Crop	30	60	66
Pasture	581	1,162	1,291
CWS	574	1,148	1,275
WSB	135	270	300
PH	170	340	378
TOTALS	1,490	2,980	3,310

<u>Present Use</u>	<u>Low-Use Recreation</u>		
	<u>1985</u>	<u>1990</u>	<u>2000-2040</u>
Row Crop	11	22	25
Pasture	42	84	93
CWS	371	742	825
PH	45	90	100
TOTALS	469	938	1,043

<u>Present Use</u>	<u>Wildlife/Natural</u>		
	<u>1985</u>	<u>1990</u>	<u>2000-2040</u>
Row Crop	320	640	711
Pasture	497	994	1,104
CWS	555	1,110	1,234
BLH	270	540	600
WSB	120	240	266
PH	632	1,264	1,404
CT	45	90	100
TOTALS	2,439	4,878	5,419

present land use. Some land clearing would be likely with intensive development. Agricultural lands, in all categories, would be changed to developed fields, early succession fields, or early succession wildlife management. All wooded habitat would remain and mature in wildlife/natural areas. Pine hardwoods would probably remain in intense and low-use areas, but their value to wildlife would be diminished.

III. ANALYSIS OF TERRESTRIAL HABITAT QUALITY CHANGES USING HABITAT EVALUATION SYSTEM

1. In April 1980, field analysis was conducted by an interagency team to determine the quality of various habitat types in the project area. The team consisted of biologists from the US Army Corps of Engineers, US Fish and Wildlife Service (USFWS) and Louisiana Department of Wildlife and Fisheries. Types of analysis used were: Habitat Evaluation Procedure (HEP), a method developed by the USFWS; and Habitat Evaluation System (HES), a method developed by the Corps of Engineers. This section deals with results of HES analysis.

2. With HES, the quality of a habitat type is determined by measuring key habitat variables and deriving a Habitat Quality Index (HQI) for each. An aggregated HQI score for a habitat type is derived by weighted averaging (weighting) of the HQI scores for each key variable. The average of aggregate HQI scores over the various sample plots indicates the overall quality of a habitat type in a particular area. Figure D-1 is a HES data form for bottomland hardwood forest. Key variables and weights would, of course, be different for other habitat types. Figure D-2 is an example of a function curve or model showing how an HQI score for a key variable, in this case species association, would be derived. For example, a hackberry-elm-ash association would have an HQI score of .96. By referring back to the HES data form, it can be seen that the variable "species association" has a weight of 17. Multiplying the weight times the score would yield a weighted score of 16.32. The sum of all the weighted scores would give the aggregate HQI score for that particular plot of bottomland hardwoods (BLH). A complete explanation of HES along with data forms and functional curves is contained in the manual "A Habitat Evaluation System for Water Resources Planning", August 1980, prepared by the US Army Corps of Engineers, Lower Mississippi Valley Division, Vicksburg, Mississippi. A copy of this document is available for review at the New Orleans District library.

3. Table D-8 presents the results of field sampling. As would be expected, BLH showed the highest quality habitat with a value of .71. Much of the project area has small pastures close to woodlands which result in relatively high key variable scores for pasture. Field analysis yielded the following average HQI scores for each habitat type:

Soybean	- .35
Pasture	- .47
CWS	- .42
BLH	- .71
Willow-sandbar (WSB)	- .35
Pine-Hardwoods (PH)	- .51
Cypress-tupelo (CT)	- .61

FIGURE D-1
HES DATA FORM: BOTTOMLAND HARDWOOD FOREST

Project:

Date:

Site No:

Location:

Aggregate HQI Score:

KEY VARIABLE	DATA	HQI SCORE	KEY VARIABLE WEIGHT	WEIGHTED HQI SCORE
1. Species Assoc.			17	
2. Number Mast trees			16	
3. Percent cover- understory			14	
4. Percent cover- groundcover			14	
5. No. 18" trees			14	
6. Tract Size			14	
7. Number Snags			11	

TOTAL

Notes

EVALUATED BY: _____



Table D-8 Summary of Field HES Analysis By Habitat Type

Pasture: Mean HQI Score = .47

Site No.	Land Use	Diversity of Land Use	Key Variables/Weighted Scores					Tract Size	Perimeter Sinuosity	Aggregate HQI Score
			Distance to Cover	Distance to Woods	Frequency of Flooding	Distance to Woods	Frequency of Flooding			
9	.65	.40	.70	.55	.22	.95	.22	.95	.22	52.46
10	.65	.20	.94	0	0	1.00	1.00	1.00	.10	41.25
3	.90	.20	1.00	.93	.55	1.00	1.00	1.00	.20	68.02
16	.90	.20	.10	0	0	.97	0	.97	.08	31.73
25	.90	.20	1.00	.88	0	.98	0	.98	.35	61.46
36	.65	.40	.88	0	0	.30	0	.30	.10	34.25
38	.65	.20	1.00	1.00	0	.77	0	.77	.02	52.04
41	.65	.20	.82	0	0	.50	0	.50	.22	34.63

Soybean: Mean HQI Score = .35

Site No.	Land Use	Diversity of Land Use	Key Variables/Row Scores					Tract Size	Perimeter Sinuosity	Aggregate HQI Score
			Distance to Cover	Distance to Woods	Frequency of Flooding	Distance to Woods	Frequency of Flooding			
7	.40	.20	.20	0	.48	.25	.48	.25	.08	23.09
14	.40	.20	.70	.35	0	.90	0	.90	.05	36.80
19	.40	.20	.95	1.00	0	.78	0	.78	.27	51.17
27	.40	.40	.88	.38	0	.98	0	.98	.12	44.94
29	.40	.20	.70	0	0	.65	0	.65	.02	28.23
33	.40	.20	0	0	0	.65	0	.65	.02	17.73
35	.40	.20	.82	.88	0	.97	0	.97	.18	48.75
43	.40	.20	.58	0	0	.90	0	.90	.02	29.68

Table D-8 (con't). Summary of Field HES By Habitat Type

CWS: Mean HQI Score = .42

Site No.	Species Association	Key Variables/Row Scores					No. Trees 18"	Tract Size	Number of Snags	Aggregate HQI Score
		Number of Mast Trees	Percent Cover Understory	Percent Cover Groundcover	Percent Cover					
12	.62	.52	.90	.56			1.00	.92	.75	61.83
1	.62	0	.94	.90			.90	.80	1.00	71.10
2	.62	0	.42	.70			.90	1.00	.75	61.07
5	.36	0	.84	.56			0	.75	0	36.22
6	.36	0	.70	.12			0	.63	0	26.42
8	.44	0	.60	.40			0	.63	0	30.30
13	.44	0	.70	.84			0	.40	0	34.64
18	.62	0	.35	.70			0	.68	0	34.76
26	.40	0	.20	0			0	.20	1.00	23.40
30	.44	0	.20	.70			0	.80	.90	41.18
34	.45	0	.60	.85			0	.70	0	37.75
37	.62	0	.53	.90			0	.26	1.00	45.20

BLH: Mean HQI Score = .71

Site No.	Species Association	Key Variables/Row Scores					No. Trees 18"	Tract Size	Number of Snags	Aggregate HQI Score
		Number of Mast Trees	Percent Cover Understory	Percent Cover Groundcover	Percent Cover					
4	.96	.85	.80	.60			1.00	.80	1.00	85.72
15	.96	.52	.50	.70			.54	.77	.75	68.03
32	.96	0	.70	.90			.70	.55	.75	64.47
39	.96	.90	.30	.90			0	.50	1.00	65.52

Table D-8 (con't). Summary of Field HES By Habitat Type

WSB: Mean HQI Score = .34*

Site No.	Land Use	Diversity of Land Use	Key Variables/Row Score					Aggregate HQI Score	
			Distance to Cover	Distance to Woods	Frequency of Flooding	Tract Size	Perimeter Sinuosity		
28	.90	.20	.98	0	.55	.80	.18	51.82	
Site No.	Species Association	Number of Mast Trees	Percent Cover-		Percent Cover- Groundcover	No. Trees 18	Tract Size	Number of Snags	Aggregate HQI Score
			Understory	Understory					
11	.36	0	.76		.10	0	.63	0	26.98
40	.62	0	0		.30	0	.70	0	24.54

PH: Mean HQI Score = .51

Site No.	Species Association	Number of Mast Trees	Key Variables/Row Score			No. Trees 18	Tract Size	Number of Snags	Aggregate HQI Score
			Percent Cover- Understory	Percent Cover- Groundcover	Percent Cover- Snags				
20	.61	.90	.18	.65	.90	.48	.90	65.78	
23	.30	0	0	.14	.90	.74	0	29.42	
24	.46	.80	.90	.55	.60	.51	0	56.50	

CT: Mean HQI Score = .61

Site No.	Species Association	Percent Forest Cover	Key Variables/Row Score					Aggregate HQI Score	
			Percent Flooded Annually	Groundcover-Understory	Proximity of Mast	Tree Size	Tract Size		Number of Snags
17	.76	.95	.60	0	0	.90	.40	0	46.39
21	.95	.10	.60	.10	1.00	.90	.10	1.00	58.70
22	.75	.75	.60	.10	.70	.90	.25	.90	61.25
31	.76	.85	.75	.76	.90	.70	.58	1.00	77.60

*This habitat type could be evaluated on two of the data sheets. WSB rated low when measured against key variables of bottomland hardwoods and high when measured against variables associated with open lands.

4. Table D-9 shows HES values projected over time for the with and without project condition. This table does not project HES values for lands proposed exclusively for recreational development. Recreational lands included in this analysis are those developed on dredged-material disposal areas that would, therefore, be impacted whether recreational development was planned or not. These values would apply to those acreages listed in Tables D-1 through D-6. Although the acreages may vary slightly according to alternative, overall habitat quality would be impacted similarly so the HES value for a habitat type at any time would be the same for all alternatives. The values shown for the base condition are as determined by field analysis. Soybean, .35 and pasture, .47 are not projected to change in value over time either with or without the project. CWS is not expected to increase in value over time for the without condition because of the dynamic state of the river. Even though CWS would mature, there would be offsetting losses and gains because river meandering would destroy mature CWS and create, by accretional succession, young CWS stands. The same would be true of WSB. It is a young habitat type that is constantly maturing to CWS, being lost to meandering, and being created. BLH and PH are projected to remain constant in value for the without project condition in that they exist in a state of dynamic equilibrium. The CT of the project area are not expected to change significantly in quality over the life of the project. For the with condition, CWS is expected to increase in value. Bank stabilization would allow for overall maturing of habitat. Values for CWS increase slowly, and in some cases (year 2010) decrease, depending on the acreage of lower quality WSB that succeeds to the CWS type. WSB shows increases in value for the with project condition. It is projected by year 2040 to succeed to its highest potential value of .41. Succession beyond this would indicate a change of habitat type to CWS. A decline in value is projected for BLH. Although there is a maturing of existing BLH acres, several factors tend to lower its overall value. Induced clearing up to year 1990 reduces its value due to decreased tract size. Following 1990, lower grade CWS, which over time succeeds to BLH, has a lowering effect. PH loses value due to induced clearing because of decreased tract size. Values for PH are not shown after year 2000 because they have all been lost or changed to another habitat type. Although some changes might occur in CT as a result of the project, HES values are not expected to change significantly because maturation of habitat would be offset by reduced area. HES values shown for recreational areas are related to type of development and intensity of use. All recreational types in this analysis are from areas that would receive dredged-material disposal, so all habitat would be alike initially. Areas picked for recreational development are described in the section that describes land-use trends. Intensive recreational areas will be designed for high people use, non-wildlife-oriented recreation. They have the lowest HES value, .08 - .10, of all land types. Slight increases are noted in years 2030 and 2040 because of projected maturing of the area's vegetation. Low-use recreational areas are

TABLE D-9

HES VALUES PROJECTED FOR LANDS SUBJECT TO IMPACT BY PROJECT*
FOR WITH AND WITHOUT CONDITION, 1975 - 2040

Habitat/Type	Base Condition 1975	1980		1985		1990		2000		2010		2020		2030		2040	
		W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W
Soybean	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35
Pasture	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47	.47
CWS	.42	.42	.42	.42	.43	.42	.44	.42	.46	.42	.44	.42	.45	.42	.51	.42	.52
BLH	.71	.71	.69	.71	.67	.71	.65	.71	.65	.71	.66	.71	.67	.71	.68	.71	.66
WSB	.34	.34	.34	.34	.34	.34	.34	.34	.37	.34	.37	.34	.38	.34	.40	.34	.41
PH	.51	.51	.49	.51	.47	.51	.45	.51	.45	.51	--	.51	--	.51	--	.51	--
CT	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61
Int Rec				.08		.08		.08		.08		.08		.09		.10	
Low-use Rec				.10		.12		.14		.15		.16		.18		.20	
Wildlife/Natural				.50		.52		.54		.60		.61		.63		.65	

*Exclusive of lands purchased solely for recreation development.

type is projected to have higher values than intensive areas. Approximately half the acres of wildlife/natural areas from dredged-material disposal would be managed at an early succession level for wildlife. This, along with natural succession on remaining acres, gives this land type a high HES value. Increases over time are due primarily to maturing of unmanaged acres. Changes in HES values for any habitat type, as discussed earlier, are based on maturing of habitat, land clearing, succession of one habitat type to another, and other factors that could change key variables. In determining a value for any period of time, acres of habitat going through succession to another habitat type were weighted in order to accurately reflect the new HES value. This is why an understanding of land-use trends as shown in Tables D-1 through D-6 is necessary to understand changes in HES values.

5. HES values for lands designated for recreational development are presented in Table D-10. Lands are separated into three categories for this analysis - intensive, low-use, and wildlife/natural - because the intended development will have a major bearing on the quality of habitat from a wildlife standpoint. Unlike recreational lands discussed earlier which were used for dredged-material disposal, the initial habitat type will have bearing on the HES values. Base condition values were as determined by field survey. Without condition values were as previously discussed for each habitat type. The schedule for recreational development as discussed in the section dealing with land-use trends for recreational land and Table D-7 should be referenced to better understand the projected HES values. All habitat types intended for intensive recreational development show greatly reduced values over time. The fact that pasture has a slightly higher value over the project life than soybean or WSB is based on an analysis of the activities proposed for those lands. The slightly higher values projected for wooded lands of .15 and .20 for CWS and PH, respectively, are based on the idea that the trees will provide some wildlife value in spite of the high people use. Low-use recreational land naturally shows higher HES values than intense areas because of less human disturbance. In wildlife/natural areas management plus natural succession will lead to high values over time. As explained in the land-use section, development for recreational lands is completed over time based on 45 percent by 1985, 90 percent by 1990, and 100 percent by 2000. Therefore, the 1985 value for soybean and pasture of .45 and .52, respectively, is based on weighting acres subject to management and natural succession with acres still retained in those agricultural types. By year 2000, however, acres from soybean and pasture would both be subject to the same management and succession and would, therefore, show the same HES value. Although management for wildlife would be based on maintaining early succession over the project life on those lands subject to management, planting of trees in other areas and maturing of habitat in unmanaged areas account for additional increases in HES value. CWS acres would increase in

TABLE D-10

HES VALUES PROJECTED FOR LANDS PROPOSED FOR RECREATION DEVELOPMENT
FOR WITH AND WITHOUT CONDITION, 1980 - 2040

Habitat/Type	Base Condition 1980	INTENSIVE RECREATION DEVELOPMENT													
		1985		1990		2000		2010		2020		2030		2040	
		W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W
Soybean Pasture CWS WSB PH	.35	.35	.21	.35	.08	.35	.05	.35	.05	.35	.05	.35	.05	.35	.05
	.47	.47	.30	.47	.14	.47	.10	.47	.10	.47	.10	.47	.10	.47	.10
	.42	.42	.30	.42	.18	.42	.15	.42	.15	.42	.15	.42	.15	.42	.15
	.34	.34	.20	.34	.06	.34	.03	.34	.03	.34	.03	.34	.03	.34	.03
	.51	.51	.37	.51	.23	.51	.20	.51	.20	.51	.20	.51	.20	.51	.20
LOW-USE RECREATION DEVELOPMENT															
Soybean Pasture CWS PH		W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W
	.35	.35	.25	.35	.12	.35	.10	.35	.10	.35	.10	.35	.10	.35	.10
	.47	.47	.39	.47	.31	.47	.30	.47	.30	.47	.30	.47	.30	.47	.30
	.42	.42	.34	.42	.27	.42	.25	.42	.25	.42	.25	.42	.25	.42	.25
	.51	.51	.44	.51	.37	.51	.35	.51	.35	.51	.35	.51	.35	.51	.35
WILDLIFE/NATURAL AREA DEVELOPMENT															
Soybean Pasture CWS BLH WSB PH CT		W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W
	.35	.35	.45	.35	.53	.35	.58	.35	.61	.35	.64	.35	.68	.35	.71
	.47	.47	.52	.47	.54	.47	.58	.47	.61	.47	.64	.47	.68	.47	.71
	.42	.42	.43	.42	.47	.42	.50	.42	.53	.42	.57	.42	.60	.42	.63
	.71	.71	.72	.71	.73	.71	.74	.71	.75	.71	.76	.71	.77	.71	.78
	.34	.34	.35	.34	.39	.34	.43	.34	.48	.34	.52	.34	.55	.34	.58
	.51	.51	.53	.51	.56	.51	.58	.51	.60	.51	.62	.51	.64	.51	.68
	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61	.61

value due to maturation as opposed to management. The year 2040 HES value of .63 is higher than that shown for CWS in the impacted project area (.52) because of its proximity to managed areas. WSB increases are due to management and maturing of habitat. BLH and PH in wildlife/natural areas are not designated for management, so their increases are due to maturing of habitat. Acres of different habitat types impacted by recreational development are as follows:

<u>Present Use</u>	<u>Intensive Recreation</u>	<u>Low-Use Recreation</u>	<u>Wildlife/Natural</u>	<u>Total</u>
Row Crop	66	25	711	802
Pasture	1291	93	1104	2488
CWS	1275	825	1234	3334
BLH			600	600
WSB	300		266	566
PH	378	100	1404	1882
CT			100	100
Total	3310	1043	5419	9772

6. Computer analysis was used to determine habitat unit values (HUV's) lost or gained for each project area alternative and for determining losses or gains because of recreational development. Computer input consisted of habitat acreages for each project lifetime interval (Table D-1 through D-6) and the corresponding HES value (Table D-9). The computer output showed the following net HUV losses (for all habitat losses) on a cumulative and annualized basis for each of the alternatives. Total HUV values are shown for illustrative purposes only; HUV's among habitats, e.g., pasture vs. bottomland hardwoods, are not directly comparable.

	<u>Cumulative Losses</u>	<u>Annualized Losses</u>
B-1, 135	261,452	4,022
B-1, 137	271,096	4,171
B-1, 145	353,939	5,445
B-3M, 135	287,310	4,420
B-3M, 137	301,735	4,642
B-3M, 145	416,613	6,409

The higher pool elevation in either alternative showed significantly greater losses than lower pools. B-3M showed significantly greater losses than B-1. Lock and dam site locations, primarily the Lock and Dam 3 site, for the B-3M plan had more adverse impacts on wooded habitat than did B-1 sites. This was the primary reason for greater annualized losses. The B-1 alternative with the 137-foot pool showed fewer habitat units lost than the B-3M alternative with a 135-foot pool. In all analyses, CWS accounted for the greatest loss of habitat units primarily because of the vast acreage impacted. BLH usually accounted for the second highest loss. Although more acreages of other habitats might have been impacted, the HES value of BLH was significantly higher and reflected a greater unit loss. The following

The following is a summary of annualized losses or gains by habitat type for each of the alternatives. Values are also presented for recreational lands that will be developed on dredged material disposal areas.

Habitat Type	B-1			B-3M		
	<u>135</u>	<u>137</u>	<u>145</u>	<u>135</u>	<u>137</u>	<u>145</u>
Soybean	+ 515	+ 486	+ 373	+ 842	+ 824	+ 732
Pasture	- 282	- 309	- 809	- 705	- 776	-1,647
CWS	-3,533	-3,608	-4,109	-3,736	-3,845	-4,512
BLH	-1,209	-1,215	-1,321	-1,013	-1,032	-1,136
WSB	+ 210	+ 198	+ 144	+ 203	+ 198	+ 165
PH	- 289	- 289	- 289	- 524	- 524	- 524
CT	- 338	- 338	- 338	- 391	- 391	- 391
Intensive Rec.	+ 37	+ 37	+ 37	+ 37	+ 37	+ 37
Low Use Rec.	+ 117	+ 117	+ 117	+ 117	+ 117	+ 117
Natural/Wildlife	+ 750	+ 750	+ 750	+ 750	+ 750	+ 750
Totals	-4,022	-4,171	-5,445	-4,420	-4,642	-6,409

7. HES Analysis of recreational land showed the following habitat unit impacts:

	<u>Cumulative</u>	<u>Annualized</u>
Intensive Rec.	-58,544	-976
Low-Use Rec.	-10,072	-168
Wildlife/Natural	+31,356	+487
Net Change	-37,271	-656

Although gains in wildlife habitat quality are substantial on those areas developed to enhance wildlife potential, losses on other recreational lands far outweigh the gains. Wildlife losses were almost total on intensive recreational areas; although impacted acreage was lower (3,310) than on wildlife/natural areas (5,419), its change in habitat value over project life was substantially greater.

8. Total project HUV losses for any alternative can be derived by adding the losses computed for the recreational plan to those computed for an alternative:

	<u>Cumulative</u>	<u>Annualized</u>
B-1, 135	298,723	4,678
B-1, 137	308,367	4,827
B-1, 145	391,210	6,101
B-3M, 135	324,581	5,076
B-3M, 137	339,006	5,298
B-3M, 145	453,883	7,065

IV. ANALYSIS OF MONETARY VALUES FOR HUNTING AND WILDLIFE-ORIENTED RECREATION RRWW, MISSISSIPPI RIVER TO SHREVEPORT

1. Table D-11 shows monetary values for the land-use categories that are part of the project area. Initial monetary values for BLH, PH, and CWS were derived from user-day analysis shown in the original Red River Mitigation Report of December 1978 for small game, big game, and wildlife-oriented recreation. Waterfowl values for bottomland hardwoods were derived from averaging values established by the Louisiana Department of Wildlife and Fisheries for Red River, Three Rivers, Spring Bayou, and Grassy Lake Management Areas, and adjusted according to field evaluation. Values used for CT, WSB, soybean, and pasture were based on a comparison of values established for certain wildlife management areas, the Below Red River Project Area, and other projects in the region. Monetary values were determined by applying user-day analysis to monetary potential as determined in Senate Document 97. Separate values were also provided for dredged-material disposal areas that are planned for recreational use. No wildlife values were given for intensive-use areas. Although no hunting values could be given for low-use areas, it was assumed that other wildlife-oriented activities would be high. Natural/wildlife areas rated high because a high percentage of these areas would be managed primarily for hunter use. Most of the areas would be managed for early succession for small game and produce side benefits for other uses. Table D-12 shows monetary value of habitat types over time for the with and without condition exclusive of those areas purchased solely for recreational development. For most habitat types, monetary values increase or decrease over time in direct correlation to changes in habitat quality. By applying the monetary values of habitats over time to corresponding acreages as presented in Tables D-1 through D-6, changes in the area's value to hunting and wildlife-oriented recreation can be determined. Computer analysis of project alternatives showed the following cumulative and annualized wildlife-related monetary losses:

	<u>Cumulative</u>	<u>Annualized</u>
B-1, 135	- \$1,568,504	- \$24,130
B-1, 137	- \$1,615,651	- \$24,856
B-1, 145	- \$1,961,702	- \$30,180
B-3M, 135	- \$1,595,790	- \$24,550
B-3M, 137	- \$1,695,426	- \$26,083
B-3M, 145	- \$2,119,978	- \$32,615

2. Table D-13 shows wildlife monetary values associated with lands purchased solely for recreational development. As previously stated, no value is given for intensive-use areas and only minimal value to low-use areas. Values given to wildlife/natural areas, however, are very high because of anticipated high hunter and wildlife-oriented uses. Much of

the soybean and pasture areas maximize out in value to small game by year 1990 because of management activities. Old agricultural lands not managed for wildlife would succeed naturally and result in gains for big game and wildlife-oriented recreation. CWS and WSB would also show substantial gains by 1990 because much of their area is subject to management. Although CT, PH and BLH are not planned for wildlife management, they show substantial gains by 1990. This is because of an increase of wildlife-oriented recreation which would occur because of the close proximity of these areas to intensive and low-use recreational areas. After 1990, monetary values of most wildlife/natural areas would increase in accordance with habitat quality. Although there are substantial monetary wildlife losses associated with intensive and low-use recreational areas, there is an over-compensating gain associated with wildlife/natural area development. Computer analysis shows the following losses and gains for recreational development:

	<u>Cumulative</u>	<u>Annualized</u>
Intensive-Use Recreation	- \$372,065	- \$6,201
Low-Use Recreation	- \$105,729	- \$1,762
Natural/Wildlife	+ \$715,060	+ \$11,917
Net gain	+ \$237,266	+ \$ 3,954

3. By subtracting the net monetary gain of recreational development from the losses shown for the various project alternatives, the net monetary losses can be derived:

	<u>Cumulative</u>	<u>Annualized</u>
B-1, 135	- \$1,331,238	- \$20,176
B-1, 137	- \$1,378,385	- \$20,902
B-1, 145	- \$1,724,436	- \$26,226
B-3M, 135	- \$1,358,524	- \$20,596
B-3M, 137	- \$1,458,160	- \$22,129
B-3M, 145	- \$1,882,712	- \$28,661

TABLE 11
USER-DAY DOLLAR VALUES PER ACRE (1980)
BY HABITAT TYPE

For RRRW, Mississippi River to Shreveport

Habitat Type	USE					Total Value
	Small Game	Big Game	Waterfowl	Wildlife-Oriented Recreation		
bottomland hardwoods	.59	4.32	.90	1.13		6.93
pine-hardwoods	.52	2.16	0	1.13		3.80
cottonwood-willow-sycamore	.11	1.08	.45	1.13		2.76
cypress-tupelo	.02	.90	2.70	1.13		4.74
willow-sandbar	.23	.09	1.80	.19		2.31
soybean	.23	.09	.45	.01		.78
pasture	.23	.09	0	.08		.40
From Disposal Areas*						
Intensive Recreation	0	0	0	0		0
Low-Use Recreation	0	0	0	1.69		1.69
Natural/Wildlife	2.00	4.32	.90	1.93		9.15

* These are projected values for dredge-material disposal areas that will be converted to various recreation lands beginning in 1985. Initial values for other recreation lands for the without project condition are the same as those shown for the various habitat types.

TABLE D-12
 USER-DAY DOLLAR VALUES PER ACRE*
 FOR THE WITH AND WITHOUT PROJECT CONDITION, 1980-2040
 RRWW, Mississippi River to Shreveport

Habitat Type or Land Use	Base Year		1980		1985		1990		2000		2010		2020		2030		2040	
	1975		w/o	w	w/o	w	w/o	w	w/o	w	w/o	w	w/o	w	w/o	w	w/o	w
Soybean	.78		.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78
Pasture	.40		.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
CWS	2.76		2.76	2.76	2.76	2.79	2.76	2.82	2.76	2.87	2.76	2.84	2.76	2.87	2.76	3.01	2.76	3.06
BLH	6.93		6.93	6.79	6.93	6.65	6.93	6.51	6.93	6.51	6.93	6.58	6.93	6.65	6.93	6.72	6.93	6.51
WSB	2.31		2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.38	2.31	2.40	2.31	2.40	2.31	2.45	2.31	2.47
PH	3.80		3.80	3.72	3.80	3.65	3.80	3.57	3.80	3.57	3.80	-	3.80	-	3.80	-	3.80	-
CT	4.74		4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74
From Dredge Disposal																		
Intensive Use Recreation	-		-	-	-	0	-	0	-	0	-	0	-	0	-	0	-	0
Low-Use Recreation	-		-	-	-	1.69	-	1.72	-	1.76	-	1.77	-	1.79	-	1.83	-	1.86
Wildlife/ Natural	-		-	-	-	9.15	-	9.33	-	9.52	-	10.07	-	10.16	-	10.34	-	10.52

*These values do not apply to lands bought solely for recreation.

TABLE D-13
USER-DAY DOLLAR VALUE PER ACRE
FOR WITH AND WITHOUT PROJECT CONDITION, 1980-2040
FOR LANDS PURCHASED FOR RECREATION

RRWW, Mississippi River to Shreveport

Habitat Type	1980	1985	1990	2000	2010	2020	2030	2040
	w/o	w	w/o	w	w/o	w	w/o	w
Intensive Recreation Areas								
Soybean	.78	.78	.78	.78	.78	.78	.78	.78
Pasture	.40	.40	.40	.40	.40	.40	.40	.40
CWS	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76
WSB	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
PH	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Low-Use Recreation Areas								
Soybean	.78	.78	.78	.78	.78	.78	.78	.78
Pasture	.40	.40	.40	.40	.40	.40	.40	.40
CWS	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76
PH	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Wildlife/Natural Areas								
Soybean	.78	.78	.78	.78	.78	.78	.78	.78
Pasture	.40	.40	.40	.40	.40	.40	.40	.40
CWS	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76
BLH	6.93	6.93	6.93	6.93	6.93	6.93	6.93	6.93
WSB	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
PH	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
CT	4.74	4.74	4.74	4.74	4.74	4.74	4.74	4.74

V. COMMERCIAL FISH HARVEST
RED RIVER WATERWAY PROJECT

1. Dramatic changes are expected to occur to the commercial fishery as a result of project implementation. Estimates concerning harvest were made by the US Fish and Wildlife Service, National Reservoir Research Team. In order to make these estimates, the following parameters were measured for the B-1 and B-3M alternatives, 135-foot and 145-foot pool elevations: size of drainage area, mean surface elevation, acres of surface area, volume, total annual discharge, storage ratio, mean depth, maximum depth, outlet depth, thermocline depth, mean annual water level fluctuation, shoreline length, shore development, growing season, total dissolved solids, and specific conductance. Tables D-14 through D-17, prepared by the US Fish and Wildlife Service, Lafayette Area Office, present the results of the Research Team's analysis. The following comments should be recognized in order to understand the data presented:

(a) Data for baseline condition (1975), were computed from data supplied by the National Marine Fisheries Service, New Orleans, Louisiana. Values represent 71 percent of the reported commercial finfish landings for the Red River in Louisiana, based on the fact that the project area contains 71 percent of the acreage of the Red River Waterway in Louisiana.

(b) Average price for commercial fish for 1975, 1976, 1977, and 1978 was 0.21 per pound; this figure was multiplied by pounds of commercial finfish landings to obtain commercial fishing value for all target years and annualized values. This seemingly low value includes roughfish harvested for other than human consumption. The National Marine Fisheries Service published prices are substantially lower than current ex-vessel prices. If costs of harvest were subtracted from actual prices, the NMFS prices used would be more realistic.

(c) It was assumed that commercial fish would be harvested in "other water bodies" at the pre-project rate of 13.0 pounds per acre for the life of the project, identical to the calculated per-acre harvest for the Red River project.

(d) It was assumed that commercial fish would be harvested in oxbows without closures at the pre-project rate of 13.0 pounds per acre.

(e) Annualized figures are given for the period 1975 to 2040.

2. Results of analysis indicate that there is not a significant difference in pounds and monetary value of commercial harvest between alternatives when annualized over the project life. The B-1, 135-foot alternative (Table D-14) which shows the least in total pounds annual harvest, 498,277 pounds, compares favorably with the B-3M, 135 foot alternative (Table D-16) which shows the most in total pounds annual harvest, 549,883. There is even less difference between the different alternatives with 145-foot pool elevations, 532,402

versus 531,551 pounds for B-1 and B-3M, respectively. The small difference in total productivity is because the alternatives with the lower pool elevations are more productive on a per-acre basis than corresponding alternatives with higher pool levels. Apparently, those parameters such as shoreline length, volume, surface area, and discharge indicated higher productivity for commercial fishery harvest for the alternatives that more closely resembled the natural river system. Increased area, as with the 145-foot pools, tended to yield less pounds per acre than the lower pools which were better contained within the natural river channel. The tables show trends that often accompany a new reservoir system. Commercial harvest initially decreases from 13 pounds to between 3.5 to 4.1 pounds per acre. Initial impoundment usually stimulates sport fish and, especially, predator fish populations. High predator fish populations and the overall condition of the aquatic ecosystem initially could tend to retard commercial fish populations. By year 2000, or 10 years after total impoundment has occurred, a significant increase in commercial harvest is noted. This increase continues throughout project life so that by year 2040, harvest has increased to between 23 and 24 pounds per acre for the lowest and highest yield alternatives. The annualized commercial harvest would be 42 percent greater for the B-1, 135-foot alternative and 47 percent greater for the B-3M, 135-foot alternative than would be the case without the project. The annualized commercial harvest would be 45 percent greater for the 145-foot plans. Increases are projected because of anticipated changes to the overall aquatic habitat and based on increases observed in other reservoirs. The most significant change to the aquatic habitat that would impact on the commercial fishery would be a tendency toward eutrophication. Besides the changes to the aquatic habitat which would be beneficial to the commercial fish population, other factors such as increases in commercial fishing effort brought about by increased access and other conditions, would bring about higher yields per acre over time.

Table D-14. Commercial Fishery Harvest Expected With the B-1 Plan (135 ft. elevation) for the Red River Waterway Project. The Data are Displayed by Aquatic Habitat Type in Acres, Commercial Harvest in Pounds, and Value in Dollars.

Aquatic Habitat Type	Baseline				Project in Place										Annualized	
	Year 0 1975	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040							
Natural river channel (acres)	22,594	15,063	7,531	0	0	0	0	0	0							0
Commercial harvest (lbs)	290,557	195,819	97,903	n/a	n/a	n/a	n/a	n/a	n/a							n/a
Pounds per acre harvested	13	13	13													
Value in dollars	63,921	41,122	20,560													
Other waterbodies (acres)	3,700	2,876	2,052	1,228	1,228	1,228	1,228	1,228	1,228							1,228
Commercial harvest (lbs)	no data	37,388	26,676	15,964	15,964	15,964	15,964	15,964	15,964							15,964
Pounds per acre harvested	no data	13	13	13	13	13	13	13	13							13
Value in dollars	no data	7,851	5,602	3,352	3,352	3,352	3,352	3,352	3,352							3,352
Oxbows with closures (acres)	0	2,629	5,258	7,887	7,401	6,915	6,429	5,943	5,454							
Commercial harvest (lbs)		10,253	20,506	30,759	87,332	114,098	126,008	134,906	140,713							
Pounds per acre harvested		3.9	3.9	3.9	11.8	16.5	19.6	22.7	25.8							
Value in dollars		2,153	4,306	6,459	18,340	23,960	26,462	28,330	29,550							
Oxbows without closures (acres)	0	3,766	2,510	1,255	0	0	0	0	0							0
Commercial harvest (lbs)		48,958	32,630	16,315	n/a	n/a	n/a	n/a	n/a							n/a
Pounds per acre harvested		13	13	13												
Value in dollars		10,281	6,852	3,426												
Navigation pool (acres)	0	8,597	17,194	25,791	25,791	25,791	25,791	25,791	25,791							25,791
Commercial harvest (lbs)		33,528	67,057	100,585	304,333	425,551	505,504	585,456	665,408							
Pounds per acre harvested		3.9	3.9	3.9	11.8	16.5	19.6	22.7	25.8							
Value in dollars		7,041	14,082	21,123	63,910	89,366	106,156	122,946	139,736							
Total (acres)	22,594	32,931	34,545	36,161	34,420	33,934	33,448	32,962	32,476							498,277
Commercial harvest (lbs)	290,557	325,946	244,772	163,623	407,629	556,613	647,476	736,326	822,085							
Value in dollars	63,921	68,448	51,402	34,360	85,602	116,678	135,970	154,628	172,638							104,638

Table D-15. Commercial Fishery Harvest Expected With the B-3M Plan (135 ft. elevation) for the Red River Waterway Project.
The Data are Displayed by Aquatic Habitat Type in Acres, Commercial Harvest in Pounds, and Value in Dollars.

Aquatic Habitat Type	Project in Place										Annualized		
	Baseline Year 0	1975	1980	1985	1990	2000	2010	2020	2030	2040	2050	2060	2070
Natural river channel (acres)	22,594		15,063	7,531	0	0	0	0	0	0	0	0	0
Commercial harvest (lbs)	290,551		195,819	97,903	n/a								
Pounds per acre harvested	13		13	13	0								
Value in dollars	63,921		41,122	20,560	0								
Other waterbodies (acres)	3,700		2,971	2,242	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513
Commercial harvest (lbs)	no data		38,623	29,146	19,669	19,669	19,669	19,669	19,669	19,669	19,669	19,669	19,669
Pounds per acre harvested	no data		13	13	13	13	13	13	13	13	13	13	13
Value in dollars	no data		8,111	6,121	4,130	4,130	4,130	4,130	4,130	4,130	4,130	4,130	4,130
Oxbows with closures (acres)	0		2,700	5,339	8,099	7,585	7,071	6,557	6,043	5,529	5,015	4,501	4,000
Commercial harvest (lbs)			11,070	22,136	33,206	97,088	125,864	137,008	147,449	153,706	159,963	166,220	172,477
Pounds per acre harvested			3.5	3.5	3.5	10.6	14.8	17.6	20.3	23.1	25.9	28.7	31.5
Value in dollars			2,325	4,649	6,973	20,388	26,431	29,192	30,964	32,778	34,590	36,402	38,214
Oxbows without closures (acres)	0		3,266	2,177	1,088	0	0	0	0	0	0	0	0
Commercial harvest (lbs)			42,458	28,301	14,144								
Pounds per acre harvested			13	13	13								
Value in dollars			8,916	5,943	2,970								
Navigation pool (acres)	0		8,914	17,828	26,742	26,742	26,742	26,742	26,742	26,742	26,742	26,742	26,742
Commercial harvest (lbs)			36,547	73,095	109,642	342,298	476,008	564,256	652,505	743,428	834,351	925,274	1,016,197
Pounds per acre harvested			4.1	4.1	4.1	12.8	17.8	21.1	24.4	27.8	31.1	34.4	37.7
Value in dollars			7,675	15,350	23,025	71,882	99,962	118,494	137,026	156,120	174,642	193,164	211,686
Total (acres)	22,594		32,914	35,177	37,442	35,840	35,326	34,812	34,298	33,784	33,270	32,756	32,242
Commercial harvest (lbs)	290,551		324,517	250,591	176,661	459,055	621,541	722,933	819,623	916,803	1,013,983	1,111,163	1,208,343
Value in dollars	63,921		68,149	52,623	37,098	96,400	130,523	151,816	172,120	192,528	212,930	233,332	253,734

Table D-16. Commercial Fishery Harvest Expected With the B-1 Plan (145 ft. elevation) for the Red River Waterway Project.
The Data are Displayed by Aquatic Habitat Type in Acres, Commercial Harvest in Pounds, and Value in Dollars.

Aquatic Habitat Type	Project in Place										Annualized		
	Baseline Year 0	1975	1980	1985	1990	2000	2010	2020	2030	2040	2050	2060	2070
Natural river channel (acres)	22,594	22,594	15,063	7,531	0	0	0	0	0	0	0	0	0
Commercial harvest (lbs)	290,557	290,557	195,819	97,903	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pounds per acre harvested	13	13	13	13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Value in dollars	63,921	63,921	41,122	20,560	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other waterbodies (acres)	3,700	3,700	2,700	1,700	700	700	700	700	700	700	700	700	700
Commercial harvest (lbs)	no data	no data	35,100	22,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100
Pounds per acre harvested	no data	no data	13	13	13	13	13	13	13	13	13	13	13
Value in dollars	no data	no data	7,371	4,641	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911
Oxbows with closures (acres)	0	0	2,629	5,258	7,887	7,401	6,915	6,429	5,943	5,454	5,454	5,454	5,454
Commercial harvest (lbs)	0	0	9,727	19,455	29,182	82,151	107,183	118,294	126,586	131,441	131,441	131,441	131,441
Pounds per acre harvested	0	0	3.7	3.7	3.7	11.1	15.5	18.4	21.3	24.1	24.1	24.1	24.1
Value in dollars	0	0	2,043	4,085	6,128	17,252	22,508	24,842	26,583	27,603	27,603	27,603	27,603
Oxbows without closures (acres)	0	0	3,766	2,510	1,255	0	0	0	0	0	0	0	0
Commercial harvest (lbs)	0	0	48,958	32,630	16,315	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pounds per acre harvested	0	0	13	13	13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Value in dollars	0	0	10,281	6,852	3,426	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Navigation pool (acres)	0	0	10,345	20,691	31,037	31,037	31,037	31,037	31,037	31,037	31,037	31,037	31,037
Commercial harvest (lbs)	0	0	38,277	76,557	114,837	344,511	481,074	571,081	661,088	747,992	747,992	747,992	747,992
Pounds per acre harvested	0	0	3.7	3.7	3.7	11.1	15.5	18.4	21.3	24.1	24.1	24.1	24.1
Value in dollars	0	0	8,038	16,077	24,116	72,347	101,026	119,927	138,828	157,078	157,078	157,078	157,078
Total (acres)	22,594	22,594	34,503	37,690	40,879	39,138	38,652	38,166	37,680	37,191	37,191	37,191	37,191
Commercial harvest (lbs)	290,551	290,551	327,881	248,645	169,434	435,762	597,357	698,475	796,774	888,533	888,533	888,533	888,533
Value in dollars	63,921	63,921	68,855	52,215	35,581	91,510	125,445	146,680	167,323	186,592	186,592	186,592	186,592

Table D-17. Commercial Fishery Harvest Expected With the B-M Plan (145 ft. elevation) for the Red River Waterway Project. The Data are Displayed by Aquatic Habitat Type in Acres, Commercial Harvest in Pounds, and Value in Dollars.

Aquatic Habitat Type	Project in Place									
	Baseline		5		10		15		25	
	Year 0 1975	1980	1985	1990	2000	2010	2020	2030	2040	Annualized
Natural river channel (acres)	22,594	15,063	7,531	0	0	0	0	0	0	0
Commercial harvest (lbs)	290,551	195,819	97,903	n/a						
Pounds per acre harvested	13	13	13	0						
Value in dollars	63,921	41,122	20,560	0						
Other waterbodies (acres)	3,700	2,854	2,008	1,163	1,163	1,163	1,163	1,163	1,163	1,163
Commercial harvest (lbs)	no data	37,102	26,104	15,119	15,119	15,119	15,119	15,119	15,119	15,119
Pounds per acre harvested	no data	13	13	13	13	13	13	13	13	13
Value in dollars	no data	7,791	5,482	3,175	3,175	3,175	3,175	3,175	3,175	3,175
Oxbows with closures (acres)	0	2,700	5,399	8,099	7,585	7,071	6,557	6,043	5,529	5,529
Commercial harvest (lbs)		9,450	18,897	28,347	80,401	104,651	115,403	122,673	127,720	127,720
Pounds per acre harvested		3.5	3.5	3.5	10.6	14.8	17.6	20.3	23.1	23.1
Value in dollars		1,985	3,968	5,953	16,884	21,977	24,235	25,761	26,821	26,821
Oxbows without closures (acres)	0	3,266	2,177	1,088	0	0	0	0	0	0
Commercial harvest (lbs)		42,458	28,301	14,144						
Pounds per acre harvested		13	13	13						
Value in dollars		8,916	5,943	2,970						
Navigation pool (acres)	0	10,755	21,510	32,265	32,265	32,265	32,265	32,265	32,265	32,265
Commercial harvest (lbs)		37,643	75,285	112,928	342,009	477,522	567,864	654,980	745,322	745,322
Pounds per acre harvested		3.5	3.5	3.5	10.6	14.8	17.6	20.3	23.1	23.1
Value in dollars		7,905	15,810	23,715	71,882	100,280	119,251	137,546	156,518	156,518
Total (acres)	22,594	34,638	38,625	42,615	41,013	40,499	39,985	38,421	38,957	38,957
Commercial harvest (lbs)	290,551	322,472	246,490	170,538	437,529	597,292	698,386	792,772	888,161	888,161
Value in dollars	63,921	67,719	51,763	35,813	91,881	125,431	146,661	166,482	186,513	186,513

VI. SPORT FISHERY RESOURCE
RED RIVER WATERWAY

1. As with the commercial fish harvest, anticipated changes to the sport fishery were estimated by the US Fish and Wildlife Service, Reservoir Research Team. The parameters used in estimating changes were the same as those listed in estimating commercial fish harvest. Tables D-18 through D-21 were prepared by the Lafayette Area Field Office to present the results of the analysis. The following comments should be recognized in order to understand the data presented:

(a) Acres of natural river channel are based on 233 miles of natural river with an average width of 800 feet. This is the number of miles between Lock and Dam No. 1 and Shreveport on which this analysis is based.

(b) Available size sport fish from "other water bodies" is based on fish population sampling that was conducted by an interagency team in July 1979.

(c) Data derived from fish population predictions developed for the navigation pools based on findings of the Reservoir Research Program, Fayetteville, Arkansas.

(d) The assumption was made that the available size sportfish population in oxbows without closures would be the same as for the pre-project river.

(e) Potential sportfishing was calculated by dividing available size sportfish pounds per acre by 3.1 pounds per man-day (average harvest per man-day for Louisiana lakes).

2. Results indicate that, on a per-acre basis, there is very little difference in pounds of fish or potential sportfishing man-days between the B-1 or B-3M alternatives regardless of the selected pool elevation in Pool 5. Although these tables show results of the 135-foot and 145-foot pools, there is no reason to believe that analysis of a 137-foot pool would show otherwise. Since pounds of sport fish of harvestable size are not projected to change over time within any particular aquatic habitat type, then potential user-days of sportfishing in any habitat type is directly proportional to acres of that habitat type that exist. Therefore, the annualized potential user-days of sportfishing for the B-3M alternative with the 145-foot pool of 406,405 user-days is higher than other alternatives because it contains the most acres of aquatic habitat. Total potential user-days of sportfishing is slightly greater for the B-3M alternative when comparing like pool elevations. Analysis of alternatives using the 137-foot pool elevation would probably compare favorably to analysis of the 135-foot pool.

3. The value of 36 pounds per acre of harvestable size sport fish was determined from blocknet sampling in Red River oxbow lakes. Computer analysis made by the Reservoir Research Team for post-project oxbow lakes and navigation pools showed very similar results. Oxbows with closures indicated higher potential than navigation pools, 42 or 43 pounds per acre compared to 32 pounds per acre. Oxbow lakes would be expected to rate higher than navigation pools primarily because of a higher percentage of more productive littoral to open water area. Although the sportfishery would be expected to fluctuate from year to year, the current state-of-the-art for estimating long-term changes based on measurable parameters is inadequate. Applying an age factor to the parameters is beyond our current capability. Therefore, parameters for sportfish estimation were measured and results were applied to all project years.

4. In conclusion, the total sportfishing potential is greatest for the B-3M alternative with the 145-foot pool elevation and least for the B-1 alternative with the 135-foot pool. It should be emphasized, however, that this increase between the lowest and highest potential plan is only 15 percent. The annualized man-day potential for sport fishing would be 66 percent greater for the B-1, 135-foot, 68 percent greater for the B-3M, 135-foot, and 70 and 71 percent greater for the B-1, 145-foot and B-3M, 145-foot alternatives respectively, than would be the case without the project.

Table D-18. Sport Fishery Resources Expected with the B-1 Minimum Plan (135 ft. elevation) for the Red River Waterway Project. The Data are Displayed by Aquatic Habitat Type in Acres, Available Size Sport Fish in pounds Per Acre and Potential Sport Fishing in Man-days

Aquatic Habitat Type	Baseline										Project in Place					Annualized		
	Year 0	1975	1976	1980	1985	1990	2000	2010	2020	2030	2040	15	25	35	45	55	65	
Natural river channel (acres)	22,594	22,594	22,594	15,063	7,531	0	0	0	0	0	0	0	0	0	0	0	0	
Available size sportfish (lbs/acre)	10	10	10	10	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Potential sportfishing (man-days)	72,884	72,884	72,884	48,590	24,294	0	0	0	0	0	0	0	0	0	0	0	0	
Other waterbodies (acres)	3,700	3,700	3,700	2,876	2,052	1,228	1,228	1,228	1,228	1,228	1,228	1,228	1,228	1,228	1,228	1,228	1,228	
Available size sportfish (lbs/acre)	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
Potential sportfishing (man-days)	42,968	42,968	42,968	33,999	23,830	14,261	14,261	14,261	14,261	14,261	14,261	14,261	14,261	14,261	14,261	14,261	14,261	
Oxbows with closures (acres)	0	0	0	2,629	5,258	7,887	7,401	6,915	6,429	5,943	5,454	7,887	7,401	6,915	6,429	5,943	5,454	
Available size sportfish (lbs/acre)	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
Potential sportfishing (man-days)	0	0	0	35,619	71,237	106,856	100,272	93,687	87,103	80,518	73,893	106,856	100,272	93,687	87,103	80,518	73,893	
Oxbows without closures (acres)	0	0	0	3,766	2,510	1,255	0	0	0	0	0	1,255	0	0	0	0	0	
Available size sportfish (lbs/acre)	10	10	10	10	10	10	n/a	n/a	n/a	n/a	n/a	10	n/a	n/a	n/a	n/a	n/a	
Potential sportfishing (man-days)	12,148	8,097	4,048	12,148	8,097	4,048	0	0	0	0	0	4,048	0	0	0	0	0	
Navigation pool (acres)	0	0	0	8,597	17,194	25,791	25,791	25,791	25,791	25,791	25,791	25,791	25,791	25,791	25,791	25,791	25,791	
Available sportfish (lbs/acre)	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	
Potential sportfishing (man-days)	0	0	0	88,743	177,486	266,230	266,230	266,230	266,230	266,230	266,230	266,230	266,230	266,230	266,230	266,230	266,230	
Total potential sportfishing (man-days)	115,852	115,852	115,852	219,099	304,944	391,395	380,763	374,178	367,594	361,009	354,384	391,395	380,763	374,178	367,594	361,009	354,384	344,631

Table D-19. Sport Fishery Resources Expected with the B-3M Minimum Plan (135 ft. elevation) for the Red River Waterway Project. The Data are Displayed by Aquatic Habitat Type in Acres, Available Size Sport Fish in pounds Per Acre and Potential Sport Fishing in Man-days

Aquatic Habitat Type	Project in Place											
	Baseline Year 0 1975	1 1976	5 1980	10 1985	15 1990	20 2000	25 2010	30 2020	35 2030	40 2040	45 2050	Annualized
Natural river channel (acres)	22,594	22,594	15,063	7,531	0	0	0	0	0	0	0	0
Available size sportfish (lbs/acre)	10	10	10	10								
Potential sportfishing (man-days)	72,884	72,884	48,590	24,294								
Other waterbodies (acres)	3,700	3,700	2,971	2,242	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513
Available size sportfish (lbs/acre)	36	36	36	36	36	36	36	36	36	36	36	36
Potential sportfishing (man-days)	42,968	42,968	34,502	26,036	17,570	17,570	17,570	17,570	17,570	17,570	17,570	17,570
Oxbows with closures (acres)	0	0	2,700	5,399	8,099	7,585	7,071	6,557	6,043	5,529	5,015	5,015
Available size sportfish (lbs/acre)			43	43	43	43	43	43	43	43	43	43
Potential sportfishing (man-days)			37,452	74,889	112,341	105,211	98,082	90,952	83,822	76,693	70,563	70,563
Oxbows without closures (acres)	0	0	3,266	2,177	1,088	0	0	0	0	0	0	0
Available size sportfish (lbs/acre)			10	10	10							
Potential sportfishing (man-days)			10,535	7,023	3,510							
Navigation pool (acres)	0	0	8,914	17,828	26,742	26,742	26,742	26,742	26,742	26,742	26,742	26,742
Available sportfish (lbs/acre)			32	32	32	32	32	32	32	32	32	32
Potential sportfishing (man-days)			92,015	184,031	276,046	276,046	276,046	276,046	276,046	276,046	276,046	276,046
Total potential sportfishing (man-days)	115,852	115,852	223,094	316,273	409,467	398,827	391,698	384,568	377,438	370,309	359,703	359,703

Table D-20. Sport Fishery Resources Expected with the B-1 Maximum Plan (145 ft. elevation) for the Red River Waterway Project.
The Data are Displayed by Aquatic Habitat Type in Acres, Available Size Sport Fish in pounds Per Acre and Potential Sport Fishing in Man-days

Aquatic Habitat Type	Baseline				Project in Place						Annualized			
	Year 0 1975	1 1976	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040	Annualized			
Natural river channel (acres)	22,594	22,594	15,063	7,531	0	0	0	0	0	0				
Available size sportfish (lbs/acre)	10	10	10	10										
Potential sportfishing (man-days)	72,884	72,884	48,590	24,294										
Other waterbodies (acres)	0	3,700	2,700	1,700	700	700	700	700	700	700				
Available size sportfish (lbs/acre)	36	36	36	36	36	36	36	36	36	36				
Potential sportfishing (man-days)	42,968	42,968	31,355	19,742	8,129	8,129	8,129	8,129	8,129	8,129				
Oxbows with closures (acres)	0	0	2,620	5,258	7,887	7,401	6,915	6,429	5,943	5,454				
Available size sportfish (lbs/acre)			42	42	42	42	42	42	42	42				
Potential sportfishing (man-days)			35,619	71,237	106,856	100,272	93,687	87,103	80,518	73,893				
Oxbows without closures (acres)	0	0	3,766	2,510	1,255	0	0	0	0	0				
Available size sportfish (lbs/acre)			10	10	10									
Potential sportfishing (man-days)			12,148	8,097	4,048									
Navigation pool (acres)	0	0	10,345	20,691	31,037	31,037	31,037	31,037	31,037	31,037				
Available sportfish (lbs/acre)			32	32	32	32	32	32	32	32				
Potential sportfishing (man-days)			106,787	213,584	320,382	320,382	320,382	320,382	320,382	320,382				
Total potential sportfishing (man-days)	115,851	115,852	234,499	336,954	439,415	428,783	422,198	415,614	409,029	402,404	380,022			

Table D-21. Sport Fishery Resources Expected with the B-3M Maximum Plan (145 ft. elevation) for the Red River Waterway Project.
The Data are Displayed by Aquatic Habitat Type in Acres, Available Size Sport Fish in pounds Per Acre and Potential Sport Fishing in Man-days

Aquatic Habitat Type	Project in Place									
	Baseline									
	Year 0 1975	1 1976	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040
Natural river channel (acres)	22,594	22,594	15,063	7,531	0	0	0	0	0	0
Available size sportfish (lbs/acre)	10	10	10	10						
Potential sportfishing (man-days)	72,884	72,884	48,590	24,294						
Other waterbodies (acres)	3,700	3,700	2,854	2,008	1,163	1,163	1,163	1,163	1,163	1,163
Available size sportfish (lbs/acre)	36	36	36	36	36	36	36	36	36	36
Potential sportfishing (man-days)	42,968	42,968	33,143	23,319	13,506	13,506	13,506	13,506	13,506	13,506
Oxbows with closures (acres)	0	0	2,700	5,399	8,099	7,585	7,071	6,557	6,043	5,529
Available size sportfish (lbs/acre)	43	43	43	43	43	43	43	43	43	43
Potential sportfishing (man-days)			37,452	74,889	112,341	105,211	98,082	90,952	83,822	76,693
Oxbows without closures (acres)	0	0	3,266	2,177	1,088	0	0	0	0	0
Available size sportfish (lbs/acre)			10	10	10					
Potential sportfishing (man-days)			10,535	7,023	3,510					
Navigation pool (acres)	0	0	10,755	21,510	32,265	32,265	32,265	32,265	32,265	32,265
Available size sportfish (lbs/acre)			32	32	32	32	32	32	32	32
Potential sportfishing (man-days)			111,019	222,039	333,058	333,058	333,058	333,058	333,058	333,058
Total potential sportfishing (man-days)	115,852	115,852	240,739	351,564	462,415	551,775	444,646	437,516	430,386	423,237
										406,405

VII. BIOLOGICAL ASSESSMENT OF THREATENED AND ENDANGERED SPECIES
OF THE RED RIVER WATERWAY PROJECT,
MISSISSIPPI RIVER TO SHREVEPORT, LA, REACH

PURPOSE

This assessment addresses the potential impacts of the Red River Waterway (RRWW) Project, Mississippi River to Shreveport, LA, Reach on threatened or endangered species and fulfills the requirements of Section 7(c) of the 1978 Amendment to the Endangered Species Act. In a letter dated 17 December 1979, the US Army Corps of Engineers (Corps) requested from the US Fish and Wildlife Service (FWS) information concerning those threatened and endangered species, both those listed and those proposed to be listed, which might be impacted by the project. An inclosure to that letter was a list of species which the Corps believed should be addressed by this assessment. The following species were listed: Florida panther, American alligator, red cockaded woodpecker, southern bald eagle, arctic peregrine falcon, Eskimo curlew, ivory-billed woodpecker, and Bachman's warbler. In an 11 February 1980 letter, the FWS expressed concurrence with that list.

The following examines studies and the results of field trips as they might apply to the species of concern. The Corps' conclusions concerning project impacts on subject species are also presented.

ENVIRONMENTAL SETTING

The area of concern includes that portion of the Red River Basin within the State of Louisiana between Shreveport on the north and the confluence of the Red and Mississippi Rivers on the south, a distance of some 275 river miles. The Red River has its headwater in the high plains of west Texas and New Mexico. The river flows eastward from this area, acting as a boundary between Oklahoma and Texas, then Arkansas and Texas, and then into the State of Arkansas. Near Fulton, Arkansas, the river turns and flows southward, entering Louisiana in the northwest corner. From here, it flows south-southeast through Louisiana to its confluence with the Mississippi River at Old River in east-central Louisiana, approximately 65 miles north of Baton Rouge, Louisiana. Tributary streams of the project area drain portions of six parishes: Bienville, Claiborne, DeSoto, LaSalle, Sabine, and Webster. Riparian towns in the project reach include Alexandria, Bossier City, Campti, Clarence, Colfax, Coushatta, Pineville, Montgomery, Natchitoches, and Shreveport. The topography of the Red River Basin is gently rolling to level. Elevations vary from a maximum of 320 feet mean sea level (msl) in the uplands west of Shreveport to 35 feet msl in the Mississippi River alluvial plain at Old River. Elevation of the Red River flood plain varies from approximately 160 feet msl at Shreveport to about 45 feet msl just east of the Marksville Hills in the Mississippi River flood

plain. Local relief generally is no more than 50 to 100 feet. The Red River traverses three land divisions. These divisions are the gently sloping alluvial flood plains of the Red River, the hilly uplands adjacent to the flood plain, and the Mississippi River alluvial flood plain. Each division is the result of, and coincident with, the topography, geomorphology, and the soils variations in the area. Most of the land in the alluvial plain has been converted to agricultural uses. Soybean farming is the dominant agricultural endeavor. The most abundant wooded habitat of the project area is riverine woodlands dominated by cottonwood, willow and sycamore. The riverine habitat varies from sparsely vegetated sandbar to mature cottonwood, willow, sycamore forests and has, therefore, widely varying value to wildlife.

ACTION

The proposed works include the construction and maintenance of the Red River Waterway project which consists of a 9- by 200-foot navigation channel, with five locks and dams and related bank stabilization, from the Mississippi River to Shreveport, LA. The navigation feature will consist of a realigned channel 236 miles in length which is generally confined within the limits of the existing river channel. The locks will have clear dimensions of 84 feet by 685 feet usable chamber length. The total lift will be approximately 141 feet. Recreation is also an integral part of the project. Recreation facilities will be developed at lock and dam sites, at selected sites along the navigation channel, and at oxbow lakes formed by channel realignment. There are two alternatives being considered for accomplishing the stated objective, the B-3M and the B-1 plans. Up to 18,700 acres and 17,200 acres for the two plans, respectively, would be permanently lost as a terrestrial resource. Up to 800 acres of cypress-tupelo swamps would be adversely impacted by the project.

RELATIONSHIP OF PROJECT TO THREATENED AND ENDANGERED SPECIES

Study Method

Gulf South Research Institute (GSRI), under contract with the Corps, published the results of a biological inventory of the project area in January 1975. Threatened and endangered species was covered in their report.

A FWS Habitat Evaluation Procedure (HEP) analysis and a Corps Habitat Evaluation System (HES) were conducted jointly in April 1980. These analyses necessitated field surveys throughout the entire project area. A fish population survey was conducted in July 1979 by FWS, Corps, and State of Louisiana Game and Fish personnel. This survey involved the rotenone-block net technique and covered lakes between Alexandria and Shreveport.

Numerous other field trips and surveys of the project area have been made during the last several years by many Federal and state biologists.

Various texts were consulted during this survey. The most informative were Lowery's Louisiana Birds and The Mammals of Louisiana and Its Adjacent Waters.

A review was made of water quality samples taken in the project area by the United States Geological Survey, GSRI, and the US Army Corps of Engineers.

Results of Surveys

GSRI presented a very sketchy account about endangered species possible within the project area. They did report a total of five alligator sightings during their inventory. They also reported panther sightings made by other persons throughout central Louisiana close to the area of project impact. The HEP team found one dead alligator during its April 1980 field work.

During an intensive water quality sampling program conducted by the Corps on 9-10 October 1979, concentrations of polychlorinated biphenyls (PCBs) were detected at five out of twelve stations in the project area at concentrations exceeding the EPA chronic criteria for freshwater aquatic life. Subsequent water samples were collected from the Red River on 4-5 November 1980 near the following locations: Lee Heights (mile 106), Powhattan (mile 187), below Shreveport (mile 272) and above Shreveport (mile 283). Samples from each location were collected at 6-hour intervals over a 24-hour period to generate 24-hour average values for PCBs. At all four stations, no detectable levels of PCBs were found in any of the collected samples.

Consideration of Effects on Species or Critical Habitat

The RRWW project should not have an adverse impact on the American alligator. Although some river channel will be lost to channel realignment, some new channel will be created. The majority of oxbow lakes and, thus, oxbow habitat will be preserved. Additionally, many acres of aquatic habitat, including backwater areas, will be created. An effort is being made to avoid disposing on or cutting through existing wetland areas. Alligator habitat and, thus, their populations will probably be enhanced as a result of the project even though some adverse impacts will result through increased contact and disturbance by humans.

That portion of the project area with the most expansive woodlands and which would, therefore, most likely provide habitat for the panther is below Lock and Dam #1. Since work below Lock and Dam #1 is confined primarily to the existing river channel and involves no flooding, it is highly unlikely that the project would have a significant impact on panther populations.

Although no bald eagles have been sighted during field surveys of the area, they could certainly be expected to be present as transients. The pools created as a result of Lock and Dams could enhance eagle feeding potential and could, therefore, produce a positive impact on eagle populations. After reviewing the October 1979 water quality data, there was concern that anticipated PCB levels in post-project pools could be high enough to pose a potential danger to bald eagles. The EPA chronic criterion for PCBs is based on the potential for bioaccumulation in aquatic organisms. Subsequent water quality analysis conducted in November 1980 and comparison of projected post-project water quality with other water bodies that are known feeding areas, indicated that adverse effects on eagle reproductive success would be unlikely.

Channel realignment and dredged-material disposal could impact a total of three pine hardwood sites depending on the selected alternative. One of these sites has some mature pines and borders on being suitable habitat for the red-cockaded woodpecker. If the B-3M plan is used, approximately 350 acres of mixed pine hardwoods could be lost at this site. Since intensive field reconnaissance has not discovered any overly mature pines that would be infested with red heart disease and the vast majority of the area is far from approaching the necessary maturity required for providing suitable habitat, it is unlikely that the project would have an immediate significant impact on the woodpecker's population or critical habitat. It should be pointed out, however, that if this alternative is chosen, habitat would be lost that would have the potential of developing into suitable habitat. The Corps, at this time, is leaning toward the selection of a B-1 alternative.

The only habitat suitable for the ivory-billed woodpecker and Bachman's warbler is located in the lower reach of the project area. As with the panther, the fact that work will be confined to the main river channel and no flooding will be caused indicates that no effect on these species would be expected.

The Eskimo curlew and peregrine falcon could be transient to the project area. Project activities should not have any impact on their populations.

Difficulties Encountered in Obtaining Data and Completing Study

The lack of information dealing with bioaccumulation and safe levels of potentially toxic substances in water, as they might relate to the bald eagle, made a determination of potential impact on their populations somewhat speculative. With the exception of having to gather additional water quality information to assess impacts on the bald eagle, no other difficulties were encountered in obtaining information since much field work in the project area had been done.

Conclusions with Respect to Overall Project Impact on Species

Our present level of understanding does not lead us to believe that PCB concentrations would seriously affect the food supply and, thus, reproductive success of the eagle. Therefore, the Corps of Engineers concludes that construction of the Red River Waterway Project, Mississippi River to Shreveport Reach, will not have a significant adverse impact on any threatened or endangered species or critical habitat.



DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LNNPD-RE

8 December 1980

Mr. Gary Hickman
Area Manager
US Department of Interior
US Fish and Wildlife Service
200 East Pascagoula Street
Suite 300
Jackson, MS 39201

Dear Mr. Hickman:

In accordance with the Endangered Species Act of 1973, as amended, a Biological Assessment for Threatened and Endangered Species for the Red River Waterway Project, Mississippi River to Shreveport, LA, is submitted. Please refer to Log Number 4-3-80-A-57 as assigned to this project by Mr. Richard Smith's letter of 11 February 1980.

Based on the inclosed assessment, the US Army Corps of Engineers, New Orleans District, has determined that the construction of this project would not have an adverse impact on listed species or critical habitat.

It is our opinion that initiation of consultation is not necessary at this time.

Sincerely,

1 Incl
As stated

JAMES F. ROY
Chief, Planning Division



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
200 EAST PASCAGOULA STREET, SUITE 300
JACKSON, MISSISSIPPI 39201

Mr. Welch
JCW

January 16, 1981

Colonel Thomas A. Sands
District Engineer
New Orleans District, Corps of
Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

This refers to your December 8, 1980, letter which provided the biological assessment for the Red River Waterway Project, Mississippi River to Shreveport, LA. (log number 4-3-80-A-57). You have determined that the construction of this project would not have an adverse impact on listed endangered or threatened species or Critical Habitat. We concur with this determination and agree that initiation of consultation is not necessary at this time.

Your cooperation in this effort has been appreciated.

Sincerely,

Gary Hickman
Gary Hickman
Area Manager

cc: RD, FWS, Atlanta, GA (AFA/SE)
ES, FWS, Lafayette, LA
Department of Wildlife and
Fisheries, New Orleans, LA

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO.2

APPENDIX E
SUPPLEMENTAL MITIGATION
(PRELIMINARY REPORT)

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND
EIS SUPPLEMENT NO. 2

APPENDIX E
SUPPLEMENTAL MITIGATION
(Preliminary Report)

1. Purpose. The purpose of this appendix is to present the results of analyses that were made to quantify mitigation requirements for project induced losses to wildlife resources. Wildlife habitat losses were analyzed using the Habitat Evaluation System, Habitat Evaluation Procedure, and a traditional user-day analysis. Impacts for the total project and for the project area upstream of River Mile 104 were computed using all three evaluation methods. The latter evaluation was made because mitigation for impacts of the Red River Waterway downstream of River Mile 104 are fulfilled by the establishment of the Tensas River National Wildlife Refuge as authorized in Public Law 96-285.
2. Authority. Studies made and preparation of this appendix were pursuant to provisions of the Fish and Wildlife Coordination Act of 1958 (Public Law 85-624), a portion of which is quoted as follows:

Sec. 2(c) Federal agencies authorized to construct or operate water control projects are hereby authorized to modify or add to the structures and operations of such projects, the construction of which has not been substantially completed on the date of enactment of the Fish and Wildlife Coordination Act, and to acquire lands in accordance with Section 3 of this Act, in order to accommodate the means and measures for such conservation of wildlife resources as an integral part of such projects
3. Previous Mitigation Report. A 7 December 1978 District Engineer Report concerning acquisition of wildlife mitigation lands recommended the purchase and management of 12,000 acres of bottomland hardwoods to offset project-related losses. This recommendation was based on the B-3 Modified (B-3M) plan which, at that time, showed project-related woodland losses of 13,040 acres. The report recommended the development (entirely at non-federal expense) of a 1,000-acre greentree reservoir within the 12,000-acre area to enhance waterfowl-related activities.
4. Need for Mitigation Re-Study. Subsequent to submission of the 1978 report to higher authority, the possible need for additional mitigation measures was realized. A more detailed mapping of the project area showed that there would be more lands flooded as a result of creating the navigational pools than originally anticipated. These increased impacts would be primarily in pools 3, 4, and 5. This new information indicated the need to review project impacts and mitigation requirements, and to review the entire plan selection process.

In addition, in June 1980, Congress passed an act to establish the Tensas National Wildlife Refuge, Public Law 96-285. This refuge will suffice as mitigation for environmental losses caused by six projects including the lower 104 miles of the Red River Waterway Project. Public Law 96-285, therefore, outmoded the 1978 report since mitigation recommendations contained in that report were based on total project impacts, i.e., those above and below Mile 104.

5. Coordination with Other Agencies. Field analysis of the project area was conducted by an interagency team consisting of biologists from the Corps, US Fish and Wildlife Service (USFWS), and the Louisiana Department of Wildlife and Fisheries. The Corps and the USFWS jointly determined the amount of impacted lands resulting from the various project alternatives.

6. Determining Project-Related Losses. For the total project, losses were re-evaluated for the entire project area because channel alignments had changed and the overall recreational plan was altered since preparation of the 1978 mitigation report. Two methods were used by the Corps in estimating project related wildlife losses - the Habitat Evaluation System (HES) and a User-Day analysis which discussed wildlife losses from a monetary standpoint. The USFWS analyzed losses by means of their Habitat Evaluation Procedure (HEP). Both Corps' analyses are described in Appendix D. The HEP analysis is described in Appendix K.

7. Total project impacts as estimated by the methodologies are as follows:

a. Annualized habitat units lost according to HES are as follows:

Pool Elevation in Pool 5			
<u>Project Alternative</u>	<u>135'</u>	<u>137'</u>	<u>145'</u>
B-1	-4,678	-4,827	-6,101
B-3M	-5,076	-5,378	-7,065

b. User-Day analysis showed the following annualized monetary losses:

Pool Elevation in Pool 5			
<u>Project Alternative</u>	<u>135'</u>	<u>137'</u>	<u>145'</u>
B-1	-\$20,176	-\$20,902	-\$26,227
B-3M	-\$20,596	-\$22,129	-\$28,661

c. HEP analysis addressed habitat units lost for selected key species. Gains in habitat units for some species were, at times, used to offset losses experienced by other species.

Average annual habitat unit losses according to HEP are as follows:

	<u>135'</u>	<u>145'</u>
B-1	-16,829	-24,732
B-3M	-18,519	-26,778

Average annual habitat unit losses according to HEP analysis for recreational development is 2,667. The following table (Table E-1) shows the net change in average annual habitat units for the with and without project condition for the B-1, 135-foot plan. It does not include the 2,667 annual habitat units lost because of recreational development.

Table E-1
Changes in Average Annual Habitat
Units For the B-1, 135-Foot Alternative
According to HEP Analysis

<u>Species</u>	<u>Future With Project</u>	<u>Future W/O Project</u>	<u>Change In Ave Annual Habitat Units</u>
Deer	6,045.99	10,515.14	-4,469
Fox	6,462.45	5,995.49	+ 467
Cottontail	6,471.25	4,924.70	+1,547
Dove	8,075.21	6,306.19	+1,769
Bobwhite	5,393.32	3,997.64	+1,396
Squirrel	375.65	1,114.84	- 739
Turkey	766.83	2,872.96	-2,106
Raccoon	2,674.64	6,757.82	-4,083
Swamp Rabbit	2,091.74	7,312.84	-5,221
Wood Duck	1,246.55	3,440.13	-2,194
Woodcock	1,695.99	4,430.33	-2,734
Bullfrog	63.67	525.94	- 462
		TOTAL	-16,829

8. Determining Project-Related Losses Upstream of River Mile 104.

a. An analysis of losses upstream of river mile 104 was performed for the B-1, 145 alternative. The B-1, 145 is the tentatively selected alternative. Annualized habitat units lost according to HES totaled 5,352. The following tables show losses or gains for project implementation and for various types of recreational development. Recreational development shown in Table E 2.a. is on lands that would be impacted by project implementation (dredged-material disposal) even if recreational development were not implemented. Table E 2.b., E 2.c., and E 2.d. reflect the impacts that certain types of recreational development are projected to have on specified habitat types. Note that total habitat unit values (i.e., values summed over all habitat types) are presented for illustrative purposes only since HUV's for various habitat types are not presently compatible.

Table E 2.a.
Changes In Habitat Units (Annualized)
For Project Implementation Above
River Mile 104 (B-1, 145' Alternative)

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Habitat Units</u>
Soybeans	1,869.22	1,572.78	296.44
Pasture	4,394.21	4,493.98	-99.77
Cottonwood/Willow/Sycamore	1,824.46	5,634.77	-3,810.31
Bottomland Hardwood	451.02	1,388.92	-937.91
Willow Sandear	498.40	820.08	-321.68
Pine-Hardwood	40.48	250.86	-210.38
Cypress-Tupelo	9.31	66.77	-57.46
Intense-Rec	17.66	0.	17.66
Low-Use Rec	107.97	0.	107.97
Nat/Wildlife	348.00	0.	348.00
		Subtotal	-4667.43

Table E 2.b.
Changes in Habitat Units (Annualized)
For Intensive Recreational Development
Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Habitat Units</u>
Soybean	3.60	20.83	-17.22
Pasture	132.65	541.85	-411.20
CWS	182.89	480.08	-297.19
WSB	11.02	91.80	-80.77
PH	68.13	192.41	-124.28
		Subtotal	-930.66

Table E 2.c.
Changes In Habitat Units (Annualized)
For Low-Use Recreational Development
Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Habitat Units</u>
Soybean	2.43	7.85	-5.41
Pasture	25.55	39.36	-13.82
CWS	190.24	311.82	-121.57
PH	32.06	53.59	-21.53
		Subtotal	-162.33

Table E 2.d.
Changes in Habitat Units (Annualized)
For Natural/Wildlife Recreational Development
Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Habitat Units</u>
Soybean	216.62	123.17	93.45
Pasture	615.79	467.23	148.57
CWS	522.83	404.85	117.99
BLH	406.47	406.47	0.
WSB	115.84	81.43	34.41
PH	766.91	752.46	14.45
CT	54.90	54.90	0.
		Subtotal	+408.86

The net annualized loss for recreational development, other than development on disposal areas, is 684 habitat units. These losses were from the relatively intense development which included ball fields and playgrounds. Recreational development on natural wildlife areas showed a gain of 409 HUV's in its value to wildlife because of planned wildlife management measures and the preservation and enhancement of wooded habitat. Gains to wildlife on natural/wildlife areas offset some of the losses incurred because of other types of recreational development. By combining the net annual loss of 684 for recreational development with project incurred losses of 4,667, a total annual loss of 5,351 habitat units is realized.

b. The following tables show annualized monetary losses derived from the user-day analysis of impacts above mile 104 for the B-1, 145 plan (Tables E 3.a., E 3.b., E 3.c., and E 3.d.).

Table E 3.a.
Changes In Wildlife Related Dollar Values (Annualized)
On Lands Impacted by Project Implementation Above
River Mile 104 (B-1, 145 Alternative)

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Dollar Units</u>
Soybean	4,165.68	3,505.05	660.63
Pasture	3,739.74	3,824.69	-84.95
Cottonwood/Willow	11,644.50	37,028.48	-25,383.98
Bottomland Hardwood	4,452.02	13,556.68	-9,104.66
Willow Sandbar	3,267.02	5,571.72	-2,304.70
Pine Hardwood	308.84	1,869.16	-1,560.32
Cypress-Tupelo	72.38	518.85	-446.47
Intense Rec	0.	0.	0.
IOW-Use	1,246.37	0.	1,246.37
Nat/Wildlife	5,898.60	0.	5,898.60
		Subtotal	-31,079.48

Table E 3.b.
Changes In Wildlife Related Values (Annualized)
On Lands Impacted by Intensive Recreational Development
Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Change In Dollar Units</u>
Soybean	0.	46.41	-46.41
Pasture	0.	461.20	-461.20
CWS	0.	3,154.80	-3,154.80
WSB	0.	623.70	-623.70
PH	0.	1,322.84	-1,322.84
		Subtotal	-5,618.94

Table E 3.c.
Changes In Wildlife Related Dollar Values (Annualized)
On Land, Impacted By Low-Use Recreational Development
Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Dollar Units</u>
Soybean	0.22	17.49	-17.26
Pasture	5.90	33.50	-27.60
CWS	702.82	2,049.07	-1,346.25
PH	86.10	371.24	-285.14
		Subtotal	-1,676.25

Table E 3.d.
Changes In Wildlife Related Dollar Values (Annualized)
On Lands Impacted By Natural Wildlife Recreational
Development Above River Mile 104

<u>Land Use</u>	<u>Future With Project</u>	<u>Without Project</u>	<u>Changes In Dollar Units</u>
Soybean	1,778.47	274.49	1,503.97
Pasture	5,021.64	397.47	4,624.17
CWS	5,104.85	2,660.41	2,444.44
BLH	4,204.45	3,917.23	287.22
WSB	981.08	553.25	427.84
PH	5,841.39	5,221.80	619.60
CT	474.90	426.60	48.30
		Subtotal	+9,955.55

Annualized net losses for project implementation and recreational development total \$28,419. Losses were significantly offset by gains expected to accrue on natural/wildlife recreational areas. These gains are projected because

much of the user activity will involve wildlife oriented recreation. The converse is true for intensive recreational development where user activity will be oriented towards other pursuits and existing wildlife habitat will be adversely altered.

9. Losses Below Mile 104. Losses below mile 104 can be determined by subtracting habitat unit losses or dollar losses shown for above mile 104 (section 8) from the losses shown for the total project using the B-1, 145 alternative (section 7). Annualized habitat unit losses for below mile 104 total 750 (6,101 minus 5,351). Losses are relatively low below mile 104 primarily because of the absence of project induced flooding. Below mile 104, the river is basically confined within the river banks and, also, little land is impacted by channel realinement. Above mile 104, sizable acreages of land are lost as terrestrial habitat because of extensive flooding and numerous channel realinements, and bendway cutoffs. Another reason losses are low below mile 104 is because the majority of the projects' natural/wildlife recreational development is concentrated in this lower reach. This type of recreational development, as discussed earlier, produces an improvement in habitat quality. Wildlife related dollar value changes actually show a gain for that portion of the project below mile 104. The annualized monetary gain is \$2,192 (\$28,419 minus \$26,227). This is due to the high wildlife related monetary value derived from the concentration of natural/wildlife recreational areas proposed for this lower reach of the waterway.

10. Determining Mitigation Needs. In the mitigation report of December 1978, it was determined that the most feasible way of mitigating losses was by purchase and management of bottomland hardwoods. Although supplemental acres are also based on acquisition of bottomland hardwoods, this does not foreclose the possibility of mitigating with other land types or by designing more environmentally enhancing features into the project. In their Coordination Act Report (Appendix K), the USFWS discusses the possibility of purchasing lands other than bottomland hardwoods between the levees above Lock and Dams 4 and 5.

a. Management Potential - It is not the actual purchase of lands, but the increased management thereof, that mitigates for acreage lost to wildlife productivity. To determine the amount of lands necessary for purchase, one must, therefore, determine how much management is possible on those lands and realize the increased benefits to wildlife above the acres lost to project activities.

(1) HES - The management potential for the HES analysis was computed by annualizing the habitat unit values for bottomland hardwoods with and without management for the period 1975-2040. The annualized habitat unit values for bottomland hardwoods with and without management are 0.86 and 0.75, respectively. The management potential is the difference between these two values ($0.86 - 0.75 = 0.11$). The habitat unit values with and without management for bottomland hardwoods by target year are shown in the following table.

<u>Year</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>2030</u>	<u>2040</u>	<u>Annualized Value</u>
With Management	.71	.76	.81	.83	.85	.87	.89	.91	.93	.86
Without Management	.71	.71	.72	.73	.74	.75	.76	.77	.78	.75

(2) HEP - The management potential used for HEP analysis was .10, which was very similar to that used for HES analysis.

(3) Monetary - The management potential for the User-Day analysis was computed by annualizing the man-day/acre values for bottomland hardwoods with and without management for the period 1975-2040. The annualized man-day/acre values for bottomland hardwoods with and without management are \$9.19 and \$7.18, respectively. The management potential is the difference between these two values ($\$9.19 - \$7.18 = \$2.01$). The Man-day values with and without management for bottomland hardwoods by target year are shown in the following table.

<u>Year</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>2030</u>	<u>2040</u>	<u>Annualized Value</u>
With Management	\$6.93	7.18	7.43	8.09	8.75	9.41	10.07	10.73	11.37	\$9.19
Without Management	\$6.93	6.93	7.00	7.07	7.14	7.21	7.28	7.35	7.42	\$7.18

b. Preservation Credit - In determining the amount of mitigation lands required based on the HES analysis, consideration was given to the credit that would be gained from preserving woodlands purchased for mitigation. This credit is termed the "preservation credit."

Thus, if woodlands that would be bought for mitigation are projected to be partially cleared for agricultural purposes during the project life, credit may be given for preserving these forests. The preservation credit is theoretically calculated by determining the annualized Habitat Unit Value (HUV) of the woodlands with and without acquisition. The difference in these two HUV's is the gain in habitat value achieved by purchasing and preserving for mitigation purposes, woodland that would otherwise be partially cleared. This HUV gain is divided by the woodland acreage involved to convert the gain to a preservation credit in terms of habitat quality indices (HQI). The preservation credit (in HQI) is then added to the management potential (also in HQI) to determine the total credit that would be gained from the purchase and management of each acre of mitigation land. The total credit is divided into the total annualized HUV's lost for the selected plan to determine the required mitigation acreage. In order to determine the credit factor for acres saved due to acquisition of mitigation lands, the annualized clearing rate for bottomland hardwoods in Avoyelles Parish was calculated based on past and projected clearing rates and trends reported in the publication, "Documentation, Chronology, and Future Projections of Bottomland

Hardwood Habitat Loss in the Lower Mississippi Alluvial Plain" (US Fish and Wildlife Service, 1979). Based on these acreages and clearing rates, it was determined that the annualized difference in bottomland hardwoods with and without clearing over the life of the project would be 37 percent. Avoyelles Parish was studied because it was one of the few places in the vicinity of the project area where large tracts of bottomlands suitable for mitigation might still be available for purchase.

(1) A sensitivity analysis was performed for the preservation credit calculation using several different assumptions concerning land clearing rates and the value given to openlands created by woodland clearing. Two options were considered regarding land clearing: (a) clearing would level off in the year 2015; and (b) clearing would continue throughout the project life, until year 2040. As an example, the calculations for Option A are shown in Table E-4. Preservation credit Option A considered only the direct loss of woodlands with clearing stopping in 2015. In 1980, 183,572 acres of bottomlands existed and this decreased to 92,213 acres by 2015. No consideration was given to the value of the openlands generated by land clearing. The calculated preservation credit was .29HQI.

(2) Option F (Table E-5) is the same as Option A except that land clearing was projected to continue until year 2040. This resulted in a preservation credit of .32.

(3) Option B preservation credit considered the value of the openlands created by land clearing and that clearing would level off at 2015. In addition, the concept of the Resource Value Index (RVI) was used in evaluating the relative value given to the openlands and remaining forest resulting from clearing (USFWS HEP Manual, 1980). The RVI is calculated based on a set of value criteria developed for the two habitats involved (openlands and woods) as shown in Table E-6. The RVI, which essentially discounts the habitat value of noncritical lands and strongly weights the habitat value of more critical habitats, was calculated based on the following criteria: (a) replaceability of the habitat; (b) Scarcity of the habitat; (c) Vulnerability of the habitat; and (d) Esthetics of the habitat. A scale of 0 to 1 is used. The calculated RVI is multiplied times the HQI for the habitat which in turn is multiplied by the habitat acreage to yield a HUV adjusted according to the critical nature of the habitat. In the present case, woodlands received a high RVI and openlands a low RVI. The preservation credit obtained for Option B was .25 (Table E-5).

(4) With Option C, a preservation credit of .27 was calculated in the same manner as Option B, except that the clearing rate was predicted to continue throughout the project life.

(5) Options D and E are the analogous to Options B and C, respectively, except that RVI's were not included in the computations. Thus, the full value (.42 HQI) of the openlands created by woodland clearing was given credit. This, in effect, about halved the preservation credit allowed.

(6) Thus, the sensitivity analysis revealed that the preservation credit is greatly affected by use of RVI's. A much smaller influence is

TABLE E-4
PRESERVATION CREDIT CALCULATION
WITH OPTION A

<u>Alterntive</u>	<u>Year</u>	<u>Acreage</u>	<u>HQI</u>	<u>HUV</u>
Without Preservation	1980	183,572	.71	130,336.12
	1985	162,310	.72	116,863.20
	1990	143,835	.73	104,999.55
	1995	128,074	.74	94,774.76
	2015	92,213	.76	70,081.88
	2040	92,213	.78	71,926.14
With Preservation	1980	183,572	.71	130,336.12
	1985	183,572	.72	132,171.84
	1990	183,572	.73	134,007.56
	1995	183,572	.74	135,843.28
	2015	183,572	.76	139,514.72
	2040	183,572	.78	143,186.16
Annualized habitat units - with preservation			138,061	
without preservation			<u>-84,929</u>	
Changes in habitat units			53,132	
Acres			<u>÷183,572</u>	
Preservation credit				.29

TABLE E-5

PRESERVATION CREDITS FOR LAND
ACQUISITION BASED ON CLEARING RATES
FOR EASTERN AVOYELLES PARISH

CREDIT	<u>OPTION</u>					
	A	B	C*	D	E	F
	.29	.25	.27	.13	.14	.32

* Preferred credit

A = Use woodland habitat only; no openland acreage used, no RVI's, clearing stopped at 2015.

B = Use woodland and openland habitats; with RVI's; clearing stopped at 2015.

C = Same as B with clearing continuing until 2040.

D = Use woodland plus openland habitat, clearing stopped at 2015, no RVI's.

E = Same as D with clearing continuing until 2040.

F = Same as A, but clearing continues until 2040.

exerted in the analysis by extending the length of time land clearing occurs. The preservation credit is only slightly higher (Options A and F) when openlands are not considered.

(7) The preferred preservation credit is Option C (.27) because it appears to represent the most likely scenario. The use of RVI's gives only minor value to the noncritical openlands formed by land clearing, but does consider openlands.

(8) By applying wildlife monetary values in place of habitat values in accordance with clearing rates and using the RVI methodology used for Option C, a monetary preservation credit of \$2.81 is derived.

(9) In the USFWS HEP analysis, credit was given for woodland preservation.

TABLE E-6

CALCULATION OF THE RESOURCE VALUE
INDEX (RVI) FOR BOTTOMLAND
HARDWOOD FORESTS AND OPENLANDS

<u>Criteria</u>	<u>BLH Forests</u>	<u>Openlands</u>
1. Replaceability	1.00	.2
2. Scarcity	.92	.1
3. Vulnerability	.90	.2
4. Esthetics	<u>.90</u>	<u>.1</u>
	3.72	.6

$$RVI = \frac{3.72}{4} = .93 \quad \frac{.6}{4} = .15$$

Acreage x HQI x RVI = Adjusted HUV

11. Mitigation Requirements Based on Total Project Impacts, Mississippi River to Shreveport.

a. Bottomland Hardwoods Required According to Monetary Analysis. By applying the \$2.01 management potential and the \$2.81 preservation credit (\$2.01 + \$2.81 = \$4.82) to the annualized monetary losses, the acres required for purchase according to User-Day analysis can be determined:

Elevation in Pool 5

<u>Project Alternative</u>		<u>135'</u>	<u>137'</u>	<u>145'</u>
B-1	net loss	\$20,176	\$20,902	\$26,227
	mgt/credit	÷ \$4.82	÷ \$4.82	÷ \$4.82
		4,186	4,337	5,441
		acres	acres	acres
B-3M	net loss	\$20,596	\$22,128	\$28,660
	mgt/credit	÷ \$4.82	÷ \$4.82	÷ \$4.82
		4,273	4,591	5,946
		acres	acres	acres

b. Bottomland Hardwoods Required According to HES. By applying the .11 management potential and the .27 preservation credit (.11 + .27 = .38) to the annualized habitat units lost, the acres required for purchase according to HES analysis can be determined:

Elevation in Pool 5

<u>Project Alternative</u>		<u>135'</u>	<u>137'</u>	<u>145'</u>
B-1	net loss	4,678	4,827	6,101
	mgt/credit	÷ .38	÷ .38	÷ .38
		12,310	12,703	16,055
		acres	acres	acres
B-3M	net loss	5,076	5,378	7,065
	mgt/credit	÷ .38	÷ .38	÷ .38
		13,357	14,152	18,592
		acres	acres	acres

c. Bottomland Hardwoods Required According to HEP. The USFWS performed their HEP analysis on the B-1 and B-3M alternatives considering only the 135 and 145-foot pools for Pool No. 5. Their analysis was intended not only to show mitigation requirements according to HEP, but also the range of impacts to species between the high and low pool alternatives. Mitigation requirements according to HEP are as follows:

Pool Elevation in Pool 5

<u>Project Alternative</u>	<u>135'</u>	<u>145'</u>
B-1	17,600 acres	20,100 acres
B-3M	18,400 acres	20,900 acres

12. Bottomland Hardwoods Required to Mitigate Losses Upstream of River Mile 104 For the Tentatively Selected Plan (B-1, 145').

a. According to Monetary Analysis

Annual Loss	\$28,419
Mgt/Credit	$\div \$4.82$
	<u>\$5,896 acres</u>

b. According to HES

Annual Loss	5,351 habitat units
Mgt/Credit	$\div 38$
	<u>14,081 acres</u>

13. Mitigation Requirements For Above Mile 104 According to USFWS HEP Analysis. The USFWS provided several possibilities for mitigating losses above mile 104 in their Coordination Act Report (Appendix K). Acres of land varied depending on the degree of management and type of land purchased. Their analysis showed a need for 16,277 acres of bottomland hardwoods as compared to the Corps' HES analysis which was 14,081 acres. Other possibilities evolved around acquisition of lands of mixed habitat between the levees in the pools 4 and 5 area of the project. Amount of batture land needed for mitigation ranged from 8,486 acres with maximum habitat improvement to 26,273 acres with little or no habitat improvement. Habitat improvement involved the planting of bottomland hardwood species. Their mid-management concept, which dealt with the planting of hardwoods species on approximately one half the lands suitable for planting, indicated a need for purchase of 12,597 acres of mixed habitat within the project area.

14. Discussion of Results. Results of all analyses indicated that implementation of the B-1, 135 alternative would have the least adverse impact on the terrestrial environment and, thus, require the least amount of supplemental mitigation. The B-3M, 145 alternative would have the greatest impact on the terrestrial ecosystem. The monetary analysis indicated the least amount of mitigation needs two primary reasons: (1) wildlife management activities on proposed recreational lands created artificially high people-used and (2) the User-Day analysis only accounted for tangible wildlife related values such as hunting and bird watching. Additionally, monetary losses to trapping were not accounted. Habitat losses are more accurately reflected in the two habitat-based analyses. They are not only account for hunting and other wildlife oriented recreation, but also for intangibles.

15. Mitigation Recommendation. A mitigation report, recommending a specific mitigation plan based on the three analyses conducted, will be prepared concurrently with the Final Supplemental EIS and General Reevaluation Report. The Mitigation Report will be transmitted to higher authority and, if necessary, to Congress for authorization. The final Mitigation recommendation will also be presented in the Final Supplemental EIS and General Reevaluation Report.

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO.2

APPENDIX F
WATER QUALITY

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND
EIS SUPPLEMENT NO. 2

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APPENDIX F
WATER QUALITY

1. Applicable Standards and Criteria. The Red River is classified by the State of Louisiana Department of Natural Resources, Division of Water Pollution Control (formerly the Louisiana Stream Control Commission) as suitable for secondary contact recreation, propagation of fish and wildlife, and domestic raw water supply. The Water Quality Criteria document of the State of Louisiana (Ref 1) further defines this combination of uses as follows:

"A surface raw water source, suitable for the growth and propagation of fish, other aquatic and semiaquatic life, both marine and fresh water; waterfowl; fur bearers; and wildlife. This water may be used for warm water fish habitat, wildlife habitat, and other similar uses. This water is also suitable for secondary water contact recreation such as fishing, wading, boating, or activities where ingestion of the water is not probable or as raw water source public water supply, agricultural, industrial and navigational uses."

Specific numerical standards commensurate with designated uses have been established by the State of Louisiana for Red River, Arkansas state line downstream to Three Rivers (approximately R.M. 7), and are listed in Table F-1. General criteria established by the State of Louisiana and applicable to the Red River specifically regarding substances attributed to waste discharges or the activities of man as opposed to natural phenomena are listed in Table F-2. In addition, the US Environmental Protection Agency (EPA) has promulgated water quality criteria which are applicable to the entire Red River system commensurate with designated uses. Water quality criteria are qualitative or quantitative estimates of the concentration of a water constituent or pollutant in ambient waters that, when not exceeded, would ensure a water quality suitable for a specified water use. EPA criteria for the protection of freshwater aquatic life are taken from Quality Criteria for Water, published by EPA in 1976 (Ref 2), and from the Federal Register (Ref 3), and are shown in Table F-3.

2. Present Conditions. Routine sampling programs on the Red River from the Mississippi River to Shreveport are conducted by the US Geological Survey (USGS), the US Army Corps of Engineers, and the State of Louisiana. The most extensive and consistent long-term water quality data set for the Red River in the study area is that collected during the past several years by USGS. Summary values for four stations are shown in Table F-4. The data indicate Red River water quality can be considered "good" in terms of traditional water

quality parameters. Dissolved oxygen (DO) levels are consistently high, varying from 5 to 6 mg/l in the warmer months, up to 12 or 13 mg/l in the winter months, exceeding concentrations usually accepted as that necessary to sustain aquatic life. Biochemical oxygen demand (BOD) concentrations generally are on the order to 3 to 6 mg/l, but have ranged up to 10 mg/l in the summer months. Dissolved solids, including chlorides and sulfates, have historically been high in the Red River Basin as a result of naturally occurring salt deposits and upstream brine discharges (Ref 4). There has been a general reduction in chloride and sulfate concentrations since the late 1960's, however, because of brine release controls in the upper basin (Ref 6). Similarly, fecal coliform bacteria levels have consistently exceeded State Water Quality Standards (the Red River is not designated for primary contact recreation). The occurrence of pesticide, heavy metal and polychlorinated biphenyl (PCB) concentrations are important because of the potential for direct toxicity, and also for bioaccumulation. Dissolved constituent concentrations are in a continual state of interaction with suspended sediments and bottom deposits through complex processes of adsorption and desorption. Data for heavy metal, pesticide and PCB concentrations in Red River water (dissolved and suspended phase) and bottom sediment are available from the USGS monthly sampling program. Summary heavy metal concentrations above Shreveport and at Moncla, Louisiana, are shown in Table F-5. Summary PCB and pesticide frequency of detection data are shown in Table F-6.

Additional data on metals, pesticide and PCB concentrations in water (Table F-7) and sediments (Table F-8) in the project area were taken by Gulf South Research Institute (GSRI) in 1975, and by the Corps of Engineers in 1976. These data were discussed in a previous Corps of Engineers report (Ref 5). Sediment contaminant concentrations give the level of gross amount of contaminant present in the sediment; however, concentration data are not generally useful as an indicator of potential harm to aquatic organisms. These are no approved criteria with which the detected sediment concentrations may be compared. EPA published a list of 64 pollutant categories in November 1980, designated as toxic under Section 307 (a) (1) of the Clean Water Act (Ref 3). A partial list of pollutants for which fresh water aquatic criteria have been established is shown in Table F-3. Other pollutants not covered by one of the categories, but listed on other criteria documents are also shown. A comparison with Tables F-5 and F-7 indicates that values for surface water total cadmium, copper, chromium, mercury, lead, and zinc exceeded recommended 24-hour average values for freshwater aquatic life. Cadmium, copper and lead consistently exceeded the maximum concentration criteria and will probably continue to exceed the criteria, based on historical data. The significance of these levels of heavy metals to aquatic life in the Red River is not specifically known. However, the river currently supports a moderately productive, diverse aquatic fauna and flora with no apparent adverse effects. Complex physicochemical interactions that occur with sediment particles influence bioavailability.

For the period 1974-1980, DDT and its metabolite DDE, Diazinon, Dieldrin, 2, 4-D and 2, 4, 5-T were frequently found in Red River water (Table F-6). For DDT and metabolites, the criterion to protect freshwater aquatic life is 0.0010 ug/l as a 24-hour average, with the concentration never to exceed 1.1

ug/l at any time (Table F-3). Available USGS data does not include 24-hour averages. However, for those months in which DDT and DDE were detected over the 6-year time frame, maximum concentrations did not exceed the maximum recommended criterion. Diazinon is an organophosphorus insecticide frequently detected in the Red River water. Aquatic life criteria have not been established for Diazinon, and it is not listed by the EPA as one of the 126 priority pollutants. EPA Water Quality Criteria (1972) recommended a maximum Diazinon concentration for freshwater life of 0.009 ug/l. Diazinon exceeds this maximum recommended value in the Red River although concentrations remain below the 0.04 ug/l level. Due to complex physical, chemical, and biological interactions which are poorly understood, the ultimate significance of Diazinon in Red River water and its effects on aquatic life are unknown. Specific criteria for 2, 4-D and 2, 4, 5-T have not been established, however, reported acute and chronic toxicity levels for freshwater life are much higher than maximum concentrations measured in the Red River. Restrictions have been placed on DDT and its metabolites, 2, 4-D and 2, 4, 5-T by EPA. These restrictions undoubtedly have caused, and will continue to cause, changes in the observed concentrations of pesticides in water and adsorbed to sediments in the Lower Red River Basin.

3. Water Quality Modeling. In order to assess impacts on water quality three water quality simulation models (QUAL-II, EPARES, WRECEV) were applied to the Red River. This was necessary due to the pervasive influence of the Red River Waterway (RRWW) project on the physical river system, to indicate potential water quality changes as a result of the project, and to support predictions of system responses to varying river flows. The Corps of Engineers, New Orleans District, contracted with the Water Resources Division of Camp, Dresser & McKee, Inc., (CDM) Austin, Texas, to perform the modeling studies.

The problem of predicting post-project water quality is complex and there is inherent uncertainty in the use of any mathematical model as a predictive tool. However, the state-of-the-art was applied to calibrate and verify these models to simulate water quality conditions for the B-3 modified plan in the Red River. Analysis of model output and predictions of post-project conditions was based on experience with other run-of-the-river navigation projects, knowledge of modeling assumptions, and detailed study of historical water quality conditions in the Red River. A general description of the models and results of their simulations are described below. Detailed and more technical information can be found in the CDM Report (Ref 6).

a. QUAL-II. The QUAL-II model was used as a steady state model to describe without project and with project (B-3 modified plan) water quality conditions. QUAL-II includes the major interactions of the nutrient cycles, algae production, benthic oxygen demand, carbonaceous oxygen uptake, atmospheric aeration, and their effect on the behavior of dissolved oxygen. QUAL-II was first calibrated for existing river conditions, using available water quality data and the results of special, intensive water quality surveys made by the Corps of Engineers at critical low flow periods to generate synoptic data needed for model calibration (Ref 7). Water quality simulations of future conditions used year 2000 population and wastewater flows, and assumed best available technology economically achievable (BATEA) for industrial loadings. Reaeration coefficients were estimated using various

formulations to account for channel hydrogeometry, surface wind mixing and wave action. With project simulations account for tainter gate reaeration from dam releases. The same coefficient values determined during the QUAL-II model calibration process were applied to all future conditions simulations. The QUAL-II model represents all without project future conditions, and with project future conditions in stream segments which are upstream of the deeper pool waters, i.e., reservoir water with depths greater than 20 to 25 feet which occur up to approximately 10 miles upstream of each dam structure. The QUAL-II model was run for five selected hydrologic conditions, consisting of:

(1) High flow condition: 10 percent exceedance flow - That discharge which, on the average, is exceeded 10 percent of the time (46,000 cfs at Shreveport).

(2) Mean annual flow condition: Mean annual flow condition - That discharge which, on the average, is exceeded 50 percent of the time (24,600 cfs at Shreveport).

(3) Low flow condition: 80 percent exceedance flow - That discharge which, on the average, is exceeded 80 percent of the time (4,275 cfs at Shreveport).

(4) Extreme low flow condition: 10-year, 60-day average low flow, or 60Q10. That low flow discharge which has a 60-day duration and a 10-year recurrence interval (2,550 cfs at Shreveport).

(5) Theoretical extreme low flow condition: 10-year, 7-day average low flow, or 7Q10. That low flow discharge which has a 7-day duration and 10-year recurrence interval (1,495 cfs at Shreveport).

b. EPARES. The EPARES model simulates algal-DO-nutrient interactions and depth-related behavior in the pool areas upstream of each dam. The EPARES model operates as a dynamic model, and includes the chemical, biochemical and biological processes and reaction kinetics necessary to describe interactions as they occur with depth in the water column of an impoundment. The model simulates the hydraulic, water quality and biologic responses of a reservoir to headwater and tributary inflows, wastewater point sources, environmental energy exchanges, and reservoir releases. Simulated results are interpreted as being average conditions across the most downstream 10-mile pool segments at a particular river stage. The QUAL-II water quality simulations were used as input to the EPARES model. The same future municipal and industrial point source loadings, reaction rates and coefficients used in QUAL-II were used in EPARES. Simulated water quality results were analyzed at the end of the 80 percent exceedance, 60Q10 and 7Q10 low flow periods, with 60Q10 conditions assumed prior to the 7Q10 simulation. Reaeration coefficients representative of a range of surface conditions were used along with high and low vertical diffusion coefficients to define a range of vertical water quality profiles that could occur in each of the navigation pools.

c. WRECEV. This model is a fully dynamic, hydraulic routing and constituent transport model capable of accepting time-varying inflows of changing quality. Its primary purpose in this study is the simulation of

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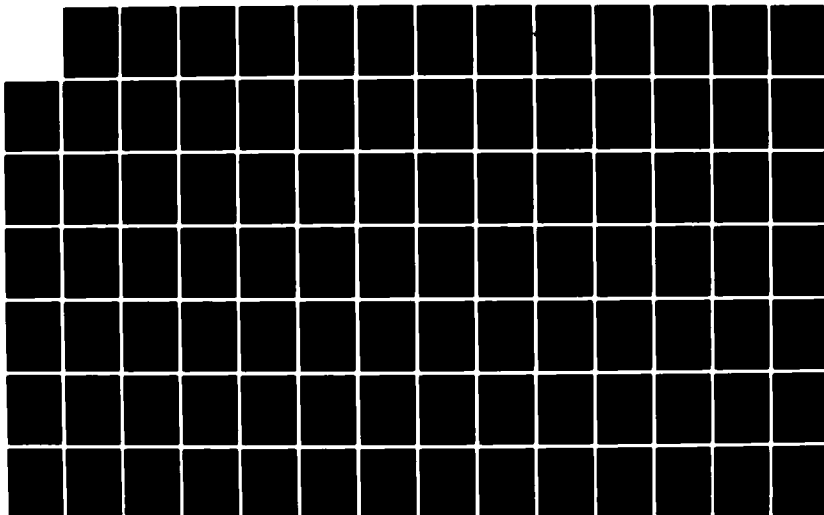
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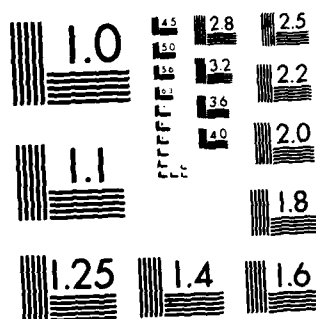
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water quality variations in channelized segments following storm events. Five separate WRECEV models were developed to simulate dissolved oxygen conditions downstream of the locks and dams resulting from storm runoff into each upstream pool.

d. Modeling Results. The following discussion summarizes water quality conditions simulated by the QUAL-II and EPARES models.

(1) Model Simulation, 10 Percent Exceedance Flow (High Flow). Model simulations for both the without project and with project conditions under high flow indicated little variation among simulated values for all parameters. Figure F-1 illustrates without project simulation, while Figure F-2 illustrates with project simulation. Within pool simulations for the 10 miles immediately upstream of the dams were not performed for the high flow condition because sensitivity analyses made with the pool models indicated that vertical water quality variations were insignificant with little or no change in quality in any pool.

(2) Model Simulation, Mean Annual Flow. Simulated without project water quality parameter variations from upstream to downstream during mean annual flow were similar to those obtained for high flows with the exception of dissolved oxygen (DO), which indicated a general decline from above Shreveport to River Mile "0". Fecal coliform displayed a general reduction downstream. Figure F-3 illustrates the system response. Other parameters, such as BOD, nutrients and chlorophyll, remained unchanged throughout the system. System with project simulations were again very similar to the without project simulated conditions, with little variation indicated among individual parameters. Figure F-4 illustrates the with project simulation. DO simulations for pools 1 through 5 are illustrated in Figures F-5 through F-9, with only pool 5 shown for temperature, chlorophyll, ammonia-nitrogen and orthophosphate (Figure F-10). The latter parameters varied little from the upstream to downstream pools, while DO showed the most variable results.

Dissolved oxygen simulation results display both high and low diffusion-re-aeration cases, with the area between the two profiles shaded to indicate the possible range within which DO levels may occur. As can be seen from the curves, the range is narrow except for the most upstream pools during the summer, due mainly to the geometric properties of the reservoirs. Pools 4 and 5 have considerably more surface area, thus effects of reaeration are more pronounced.

(3) Model Simulation, 80 Percent Exceedance Flow (Low Flow). System-wide without project water quality parameters are illustrated in Figures F-11 to F-13. Temperature remained constant, however DO showed daily ranges of 1.5 to 2.5 mg/l about the simulated 12:00 noon concentration. Without project nutrient levels were predicted to remain low, while algal biomass increased in a downstream direction as far as mile 34. Fecal coliforms were shown to generally decline from upstream to downstream.

System-wide with project water quality conditions are shown in Figures F-14 through F-16. Although water temperature remained generally unchanged, the other water quality parameters in the Red River System responded to slack-

water conditions. Simulated algal populations, using chlorophyll "a" as a measure of biomass, show lower concentration per unit of water with the project than without the project. Although this trend seems opposite to what would be expected in a low flow situation, greater algal biomass would be present under with project conditions due to greater water volume. Inspection of the high and low reaeration dissolved oxygen curves reveals that reaeration under post-project conditions during low flow for pools 3, 4, and 5 may be as important in controlling dissolved oxygen as the diurnal dissolved oxygen fluxes caused by increased algal populations. The overall response of fecal coliforms to the more slack-water conditions that will occur with the project is a general decrease in concentration in each of the five reservoirs.

Within pool simulations for 6:00 A.M. and 6:00 P.M. were selected to display time periods where critical water quality conditions could occur. Figures F-17 through F-21 display these time periods for temperature, dissolved oxygen, chlorophyll "a" and ammonia - N. Water column temperatures show basically isothermal conditions, with minor surface heating during the day. Thermal stratification is not indicated. Dissolved oxygen levels are the same or similar from surface to bottom at 6:00 A.M., however the 6:00 P.M. profiles reflect algal production (decreased nutrient, increased chlorophyll "a") of oxygen in near-surface waters. Pool 4 reflects the greatest surface to bottom dissolved oxygen variation, ranging from a high value near 6 mg/l at the surface at 6:00 A.M. to approximately 9 mg/l at 6:00 P.M. for the high reaeration coefficient. Minimum near bottom values range from near 1.0 mg/l at the bottom at 6:00 A.M. for the low reaeration coefficient to near 2.0 mg/l at 6:00 P.M.

(4) Model Simulation, 60Q10 Flow Condition (Extreme Low Flow).

Statistically, the 60Q10 flow condition has a 10 percent probability of occurrence in any single year, and provides for a travel time through the Red River System equivalent to its flow duration, 60 days.

System-wide without project water quality conditions are displayed in Figure F-22. Water temperatures are high and DO exhibits pronounced diurnal variations, with minimum concentrations falling to about 3 mg/l. Algal populations increase downstream, creating occasional DO supersaturation conditions during the day, with diurnal DO fluxes of 3 to 5 mg/l. Simulated fecal coliform levels, DO and BOD decrease significantly from upstream to downstream while other parameters remain generally constant throughout the system.

The simulated system-wide with project conditions (Figure F-23) reflects the effect of solar radiation upon the pooled water. Temperatures in the Red River are 1°F to 2°F warmer than in the free-flowing conditions. Low reaeration coefficient DO simulations in pools 3, 4, and 5 show significant declines from the tailwater to just above the deeper pooled portions of the three upper reservoirs. Simulated 12:00 noon DO values 10 miles above Locks and Dams 3, 4, and 5 are about 3 mg/l as compared with tailwater concentrations of about 6 mg/l. Diurnal variations range from 2 to 3 mg/l for both the high and low reaeration coefficient model runs. Nutrient simulations are similar to those estimated for the without project condition, while fecal coliform levels decrease in response to increased detention times behind

the locks and dams. Chlorophyll-a levels are lower than pre-project conditions, but the total biomass of algae is increased because of greater water volume. Chlorophyll-a shows a gradual increase downstream to a maximum in pool 1.

In the deeper reservoir pools, simulated temperature profiles do not indicate onset of stratification, although the 6:00 P.M. profiles do show slight surface temperature increases. The important influence of algal populations on DO is emphasized for the low flow condition when natural reaeration is reduced. Surface DO concentrations (high reaeration) range from about 5 mg/l at 6:00 A.M. to approximately 10 mg/l at 6:00 P.M. The simulation curves for DO demonstrate potential water quality problems occurring below four meters in depth in all pools, with anoxic conditions predicted for pool 4 at 6:00 A.M. using the low reaeration coefficient. Figures F-24 through F-28 display the pool simulations.

(5) Model Simulation, 7Q10 Flow Condition (Theoretical Extreme Low Flow). The 7Q10 flow condition is a theoretical situation with a flow travel time of 90 days through the system. Low flows of this duration do not naturally occur on the Red River. In operating the models for the 7Q10 flow, the simulated 60Q10 water quality conditions were assumed to be representative of the Red River immediately prior to the 7Q10 discharge period.

Without project system-wide response to the 7Q10 flow is very similar to that simulated for the 60Q10 flow conditions, with the exception of two interesting phenomena. Temperatures in the 7Q10 simulation are approximately 2° to 3°F lower than the 60Q10 simulation while algal biomass peaks approximately 80 miles farther upstream than in the 60Q10 flow condition. Figure F-29 displays the 7Q10 simulations.

With project system responses are very similar to that simulated for the 60Q10 case. Orthophosphate, however, peaks in pool 5, a reaction not observed under the 60Q10 condition. Simulated responses are displayed in Figure F-30.

In the deeper reservoir pools, (Figures F-31 through F-35), 7Q10 profiles reveal smaller minimums of DO than that predicted for the 60Q10 flow condition. Anoxic conditions are predicted for the lower 6 meters of water in pool 4 using the low reaeration coefficient.

(6) WRECEV Simulation. Stormwater simulations using the WRECEV model did not reveal significant water quality effects in the RRWW pools. For the 1-year storm and 7Q10 baseflow condition in Pool No. 2 which receives storm runoff from Alexandria, Louisiana, BOD levels increased from near zero before the storm to over 3 mg/l during the storm. Within four days after the storm, BOD levels returned to ambient conditions. DO concentrations actually increased in the pool due to the 5 mg/l DO concentration in the influent stormwater as compared to low ambient DO concentrations on the bottom. For the 5-year storm and mean annual flow condition, DO levels in Pool No. 2 were essentially unchanged. Neither the 1-year or 5-year storms produced significant effects in DO levels in any of the reservoirs. Additional details on this modeling effort can be found in reference (6).

(7) Staged Construction. Staged construction simulations were performed for 60Q10 and 7Q10 flow conditions to estimate system response to project construction. Results of this simulation effort, however, were considered to be outliers with respect to possible water quality conditions in the Red River Waterway.

4. Analysis of Water Quality Studies. The construction of locks and dams on the Red River will create physical, chemical, and biological changes in the Red River system. Changes are associated with increased detention time, increased water depth, lower water velocity and increased water volume.

Run-of-the-river reservoirs have characteristics not shared by classic reservoir systems: (a) run of the river reservoirs are comparatively shallow; (b) water storage is minimal; (c) river current velocities are slowed, but not stopped; and (d) inflow to the reservoir will approximately equal the outflow. These characteristics have important consequences for predicting changes in reservoir water quality parameters.

During this study, three parameters were identified as key constituents which will govern water quality in the Red River after project construction. These are: dissolved oxygen; chlorophyll "a", or algal biomass; and fecal coliforms. Other water quality parameters will change due to the project, however, none are projected to strongly influence water quality or the beneficial uses of the Red River.

a. Dissolved Oxygen. DO during high to medium flow conditions is not expected to appreciably change over that condition presently observed in the Red River. During lower flow events, DO levels are predicted to be above 70 percent saturation during most of the year. Background biochemical oxygen demand in the Red River is low and is not projected to substantively increase in the future enough to change ambient dissolved oxygen in the Red River, however, a reduction of water velocity, with attendant lower reaeration, higher water temperatures and increased biological activity will seasonally drop DO to less than 4 mg/l, the minimum State of Louisiana standard, near the bottom in the deeper reservoir pools. However, this situation may be short-lived or occur diurnally. It is unlikely that bottom water will become anoxic except under exceptionally adverse river flow and climatic conditions. Surface diurnal fluctuations of oxygen will occur in the ranges predicted by the simulation model. Constant river flow, natural reaeration processes, reaeration resulting from dam releases, susceptibility of the relatively shallow pools to wind mixing, lack of stable thermal stratification and the normally high DO content of Red River water will tend to keep overall DO levels high. 7Q10 flow conditions, aggravated by normal waste loads from municipal and industrial sources, high water temperatures, windless and cloudy days, and low releases from project dams could lead to anoxic, or extremely low, oxygen tensions in bottom waters in pool No. 4. Insufficient DO in the water column can cause fish kills and/or anaerobic decomposition of organic material.

b. Algal Biomass. Algal activity is stimulated by several factors. Warm temperatures, which generally correspond to low flow conditions, increase

photosynthetic rates. In the Red River turbidity controls algal growth for most of the year, except under low flow conditions when *suspended sediments* are greatly reduced and light penetration is increased. Nutrient supplies in the Red River system are available in the water column and are expected to be maintained at least at current concentrations in the future. An increase in primary productivity is anticipated in the entire navigation pools during warm weather. Algal blooms occur on the Red River at the present time; however, the project will increase the likelihood and extent of blue-green algae blooms by providing more favorable environmental conditions. The deeper pool areas, where hydraulic mixing processes have the least effect, will be most likely to experience these blooms during calm, sunny weather common to the project area. Blue-green algae are common in enriched waterbodies and have gas vacuoles, making them rise to the water surface to form a green scum. Blue-green algal blooms may be disagreeable to fishermen, swimmers, boaters, or people on the banks. Algal blooms may reduce oxygen levels via nocturnal respiration, during decomposition or during extended periods of cloudy days.

c. Fecal Coliforms. Fecal coliform densities reach high levels in certain areas of the Red River, particularly near Shreveport and Alexandria, Louisiana. Fecal coliforms are indicator bacteria used to measure the extent of recent fecal contamination of a waterbody. Environmental conditions are generally unfavorable for this class of bacteria in natural waters. Increased detention times in reservoirs, together with effects of pH, temperature, increased predation and exposure to sunlight will tend to reduce over-all fecal coliform levels in Red River pools.

d. Pollutant Behavior. Reservoirs and pools can serve as pollutant sinks with increased settling of suspended materials. Large amounts of suspended material in the Red River offer continually renewed sorptive capacity that can remove materials such as heavy metals, PCBs and pesticides from the water column. Dissolved metals and pesticides may be removed through sedimentation, or transported out of the system with the suspended load. Water quality modeling studies to simulate pesticide and heavy metal/water/sediment interactions were not performed for the RRWW project. Pesticide and heavy metal behavior in aqueous river systems is complex. Predictive capabilities have not progressed to the point where they can be used to reliably and accurately represent natural system processes. Under anoxic conditions, sediments containing heavy metals, PCBs and pesticides would release contaminants to the overlying water column and result in increases in concentrations in overlying waters. The potential for release is greatest mainly during seasonal low flow conditions when DO levels are decreased in lower waters. However, anoxic conditions are not routinely expected in the Red River, and significant project-induced increases in suspended or dissolved pesticides, PCBs or heavy metals are unlikely. The likelihood of extensive density stratification, produced by extreme combinations of low flow and high temperature, cannot be assessed. The most important effect would probably be temperature shock on organisms during rapid destratification.

e. Bioaccumulation. There are many routes of access for heavy metals and pesticides to enter the food chain. Metal-organic compounds may be taken up by biogenic particles, as well as by mineral grains settling through the water column and accumulating on the bottom. Uptake by aquatic organisms could occur through various mechanisms, including ingestion of suspended particulate

matter, ingestion of bottom detrital materials, and ingestion in food materials. The fate of very fine, particulate-bound contaminants after ingestion by living organisms is poorly understood. The lower velocities and longer detention times in post-project pools will lead to higher primary productivity and more intimate and time-extensive interactions between soil, sediments and the aquatic ecosystem. The waterway will, however, retain run-of-the-river characteristics, with high and low flow periods, alternate deposition and scouring of sediments, and working of shallow sediments by wind and wave action. There is no data to positively suggest greater potential for bioaccumulation in the Red River Waterway than occurs in the Red River at the present time.

f. Maintenance Dredging. Annual maintenance dredging will be performed over approximately 8 miles of riverbed below Lock and Dam No. 1. Maintenance dredging will also be performed in Pool No. 5 over 2 to 6 riverbed miles. Maintenance dredging will be conducted infrequently in Pool Nos. 1 through 4. Dredged material will be contained in upland disposal sites, with effluent returning to the Red River. Studies conducted by the Dredged Material Research Program have shown the efficiency of properly designed and operated confined upland sites in minimizing the harmful effects of dredged material disposal. Suspended solids plumes originating at the cutterhead will not increase suspended solid levels above the range normally found in the Red River. Suspended dredged material will pass through the dredge pipeline and be detained in the upland disposal sites, limiting the release of oxygen-demanding materials and nutrients into the river. Dredging below Lock and Dam No. 1 will have limited effects on the oxygen levels along this riverine segment. Return water disposal into Pool No. 5 could affect DO levels, particularly during the low flow periods. The release of contaminants is a complex subject governed by many factors. Metals and pesticides have a tendency to remain strongly bound to the sediments, even if the sediments are resuspended.

g. Applicable Standards and Criteria.

(1) The Red River Waterway should meet State of Louisiana Numerical Water Quality Standards (Table F-1) most years and during most months of any given year. Dissolved oxygen, however, is projected to fall below the 4 mg/l minimum criteria during summer low flows, near the bottom in the deeper pools of the Red River Waterway. Low dissolved oxygen levels will often be short-lived, however, and will not ordinarily affect beneficial uses of the waterway or fish and wildlife. Fecal and total coliform levels should decrease over present conditions due to increased detention times and natural die-off. Whether the Red River will exhibit decreases in coliform levels sufficient to allow its classification for primary contact recreation is unknown. The Red River Waterway will also meet Louisiana General Surface Water Quality Criteria (Table F-2) most years and during most months of any given year. During summer low flow periods, blue-green algal blooms are possible which may cause surface algal scums to form in deeper-pooled portions of each reservoir.

(2) EPA's criteria for freshwater aquatic life (Table F-8) should continue to be exceeded for several metals, and occasionally for DDT and its metabolites. These pollutants have historically been present in the river

system at moderate to high levels, and their amounts are not expected to substantially change because of the project. It is anticipated that prolonged anoxic conditions in the Red River Waterway would rarely occur, therefore, significant releases of heavy metals or pesticides from sediments would not normally present a problem.

LIST OF REFERENCES

1. State of Louisiana Water Quality Criteria, Louisiana Stream Control Commission, 1977.
2. Quality Criteria for Water, US Environmental Protection Agency, Office of Water Planning and Standards, PB-263943, July 1976.
3. Water Quality Criteria Documents; Availability. US Environmental Protection Agency, Federal Register, Vol. 45, No. 231, Friday, November 28, 1980.
4. Water Quality Characteristics of the Red River in Louisiana. US Geological Survey, 1978.
5. Red River Waterway, Mississippi River to Shreveport, Louisiana Reach, Final Supplement No. 1 to the Final Environmental Statement, US Army Corps of Engineers, New Orleans District, 1977.
6. Final Report Mathematical Water Quality Modeling of Proposed Locks and Dams on the Red River, Camp Dresser & McKee, Inc., 1981.
7. Two Intensive Water Quality Surveys Conducted on the Red River Between Shreveport, Louisiana and the Mississippi River During the Periods of September 17-18, 1979 and October 1-2, 1979, Camp Dresser & McKee, and US Army Corps of Engineers, New Orleans District, File Report, 1979.

TABLE F-1

RED RIVER NUMERICAL WATER QUALITY CRITERIA

Chlorides. Maximum of 184 mg/l.

Sulfates. Maximum of 112 mg/l.

Dissolved Oxygen - 5 mg/l Minimum. This value should apply at all times except in naturally dystrophic waters or where natural conditions cause the DO to be depressed. For short periods of time, diurnal variations below the standard specified may occur. However, no waste discharge or activity of man shall lower the DO concentration to the point where the diurnal variation falls below the specified minimum. For a diversified warm water biota including game fish, the daily DO concentration shall be above 5 mg/l, assuming normal seasonal and daily variations are above this concentration. However, they may range between 5 mg/l and 4 mg/l for short periods of time during a 24-hour period, provided the water quality is favorable in all other respects.

pH. Minimum of 6.0
Maximum of 8.5

Bacterial Standard. The monthly arithmetic average of total coliform most probable number (MPN) shall not exceed 10,000/100 ml, nor shall the monthly arithmetic average of fecal coliform exceed 2,000/100 ml.

Temperature - Maximum of 34°C. Maximum rise of 2.8°C above ambient temperature for streams and rivers. Maximum rise of 1.7°C above ambient temperature for lakes and reservoirs.

Total Dissolved Solids. Maximum of 780 mg/l.

Source: State of Louisiana Water Quality Criteria, 1977.

TABLE F-2

STATE OF LOUISIANA GENERAL SURFACE WATER QUALITY CRITERIA

<u>Type</u>	<u>Description</u>
Aesthetics	<p>The waters of the state shall be maintained in an aesthetically attractive condition and shall meet the generally accepted aesthetic qualifications.</p> <p>All waters shall be free from such concentrations of substances attributable to wastewater or other discharges sufficient to:</p> <ol style="list-style-type: none"> (1) settle to form objectionable deposits; (2) float as debris, scum, oil, or other matter to form nuisances; (3) result in objectionable color, odor, taste, or turbidity; (4) injure or be toxic or produce adverse physiological response in humans, animals, fish, shellfish, wildlife, or plants; and, (5) produce undesirable or nuisance aquatic life.
Color	<p>True color shall not be increased to the extent that it will interfere with present usage and projected future use of the streams and water bodies.</p> <ol style="list-style-type: none"> (1) Waters shall be virtually free from objectionable color. (2) The source of supply should not exceed 75 color units on the platinum-cobalt scale for domestic water supplies. (3) Increased color (in combination with turbidity) shall not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.
Floating, Suspended, and Settleable Solids	<p>There shall be no substances present in concentration sufficient to produce distinctly visible turbidity, solids or scum, nor shall there be any formation of slimes, bottom deposits, or sludge banks attributable to waste discharges from municipal, industrial, or other sources including agricultural practices. Settleable and suspended solids shall not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.</p>

TABLE F-2 (CONTINUED)

STATE OF LOUISIANA GENERAL SURFACE WATER QUALITY CRITERIA

<u>Type</u>	<u>Description</u>
Taste and Odor	Taste and odor producing substances shall be limited to concentrations in the waters of the state that will not interfere with the production of potable water by reasonable water treatment methods, or impart unpalatable flavor to food fish, including shellfish, or result in offensive odors arising from the waters, or otherwise interfere with the reasonable use of the waters.
Toxic Substances	Shall not be present in quantities that alone or in combination will be toxic to animal or plant life. In all cases the level shall not exceed the TLM 96/10. Bioassay techniques will be used in evaluating toxicity utilizing methods and species of test organisms suitable to the purpose at hand. In cases where the stream is used as a public water supply, the level of toxic substances shall not exceed the levels established by the United States Public Health Service drinking water standards latest edition.
Oil and Greases	There shall be no free or floating oil or grease present in sufficient quantities to interfere with the designated uses, nor shall emulsified oils be present in sufficient quantities to interfere with the designated uses.
Foaming or Frothing Materials	None of a persistent nature.
Nutrients	The naturally occurring nitrogen-phosphorous ratio shall be maintained. On completion of detailed studies on the naturally occurring levels of the various macro and micro nutrients the state will establish numerical limits where possible.
Turbidity	There shall be no substantial increase in turbidity from ambient conditions due to waste discharges.
Other Materials	Limits on other substances not specified in these revised water quality standards shall be in accordance with recommendations set by the Louisiana Department of Health and Human Resources Administration for municipal raw water sources.

Source: State of Louisiana Water Quality Criteria, 1977.

TABLE F-3

EPA WATER QUALITY CRITERIA

Parameter	AQUATIC LIFE		HUMAN HEALTH
	Hard Freshwater (200 mg/l CaCO_3) 20.0 (min)	Soft Freshwater (50 mg/l CaCO_3) 20.0 (min)	
Alkalinity mg/l CaCO_3			
Ammonia Un-ionized mg/l	.020	.020	
Arsenic ug/l	440 (acute)	440 (acute)	*
Barium mg/l			1.0
Beryllium ug/l	130 (acute) 5.3 (chronic)	130 (acute) 5.3 (chronic)	*
Cadmium ug/l	6.3 (acute) .051 (chronic)	1.5 (acute) .012 (chronic)	10.0
Chlorine, Total ug/l	10.0	10.0	
Chromium, Hexavalent ug/l	21.0 (acute) 0.29 (chronic)	21.0 (acute) 0.29 (chronic)	50.0
Chromium, Trivalent ug/l	9,900 (acute) 44.0 (chronic)	4,200 (acute) 44.0 (chronic)	170
Color, PCU			75
Copper ug/l	43.0 (acute) 5.6 (chronic)	12.0 (acute) 5.6 (chronic)	1,000 (taste and odor)
Cyanide ug/l	52.0 (acute) 3.5 (chronic)	52.0 (acute) 3.5 (chronic)	200
Total Dissolved Gases 110 Percent Saturation			
Hardness, CaCO_3 mg/l	150-300	0.0-75.0	
Iron mg/l	1.0	1.0	0.3

TABLE F-3 (Continued)

EPA WATER QUALITY CRITERIA				
Parameter	AQUATIC LIFE			HUMAN HEALTH
	Hard Freshwater (200 mg/l CaCO ₃)	Soft Freshwater (50 mg/l CaCO ₃)		
	400 (acute) 20.0 (chronic)	74.0 (acute) 0.75 (chronic)		
Lead ug/l				50.0
Manganese ug/l				50.0
Mercury ug/l	4.1 (acute) 0.20 (chronic)	4.1 (acute) 0.20 (chronic)		0.144
Nickel ug/l	3,100 (acute) 160 (chronic)	1,100 (acute) 560 (chronic)		13.4
Nitrate mg/l				10.0
Nitrite mg/l				1.0
Aldrin ug/l	3.0 (acute)	3.0 (acute)		*
Dieldrin ug/l	2.5 (acute) 0.0019 (chronic)	2.5 (acute) 0.0019 (chronic)		*
Aldrin + Dieldrin ug/l	3.0 (acute)	3.0 (acute)		*
Chlordane ug/l	2.4 (acute) 0.0043 (chronic)	2.4 (acute) 0.0043 (chronic)		*
2, 4-D ug/l				100.0
2,4,5-TP ug/l				10.0
DDT ug/l	1.1 (acute) 0.001 (chronic)	1.1 (acute) 0.001 (chronic)		*
Demeton ug/l	0.1	0.1		
Endosulfan ug/l	0.22 (acute) 0.056 (chronic)	0.22 (acute) 0.056 (chronic)		74.0

TABLE F-3 (Continued)

EPA WATER QUALITY CRITERIA			
Parameter	AQUATIC LIFE		HUMAN HEALTH
	Hard Freshwater (200 mg/l CaCO ₃)	Soft Freshwater (50 mg/l CaCO ₃)	
Endrin ug/l	0.18 (acute) 0.0023 (chronic)	0.18 (acute) 0.0023 (chronic)	1.0
Guthion ug/l	0.01	0.01	
Heptachlor ug/l	0.52 (acute) 0.0038 (chronic)	0.52 (acute) 0.0038 (chronic)	*
Lindane ug/l	2.0 (acute) 0.08 (chronic)	2.0 (acute) 0.08 (chronic)	*
Malathion ug/l	0.1	0.1	
Methoxychlor ug/l	0.03	0.03	100.0
Mirex ug/l	0.001	0.001	
Parathion ug/l	0.04	0.04	
Toxaphene ug/l	1.6 (acute) 0.013 (chronic)	1.6 (acute) 0.013 (chronic)	*
pH	6.5 - 9.0	6.5 - 9.0	5.0 - 9.0
Phenol ug/l	10,200 (acute) 2,560 (chronic)	10,200 (acute) 2,560 (chronic)	3.5 (toxicity) 0.3 (taste and odor)
Phosphorous, Elemental ug/l	0.10	0.10	
Phthalate Esters ug/l	940 (acute) 3.0 (chronic)	940 (acute) 3.0 (chronic)	(various criteria for different chemical forms)
PCB ug/l	2.0 (acute) 0.014 (chronic)	2.0 (acute) 0.014 (chronic)	*

TABLE F-3 (Continued)

EPA WATER QUALITY CRITERIA				
Parameter	AQUATIC LIFE		HUMAN HEALTH	
	Hard Freshwater (200 mg/l CaCO ₃)	Soft Freshwater (50 mg/l CaCO ₃)		
Selenium ug/l	260 (acute) 35.0 (chronic)	260 (acute) 35.0 (chronic)	10.0	
Silver ug/l	13.0 (acute) 0.12 (chronic)	1.2 (acute) 0.12 (chronic)	50.0	
Chlorides mg/l			250	
Sulfates mg/l			250	
Sulfides ug/l	2.0	2.0		
Zinc ug/l	570 (acute) 47.0 (chronic)	570 (acute) 47.0 (chronic)	5,000 (taste and odor)	

* No acceptable risk level has been identified. EPA has estimated the incremental increase of cancer risk over a human lifetime from consumption of water or aquatic organisms.

TABLE F-4

CHARACTERISTICS OF SELECTED WATER QUALITY PARAMETERS FOR THE LOWER RED RIVER

Station Parameters, Units	Mean Value	Max. Value	Min. Value	Sampling Period	Number Samples
Shreveport, River Mile 277					
Temperature, °C	19.2	32.0	2.5	7/74 - 5/79	78
Diss. Oxygen, mg/l	8.8	13.0	6.3	7/74 - 5/79	75
BOD-5, mg/l	2.9	8.0	0.0	7/74 - 5/79	68
pH	7.7	8.2	6.8	6/57 - 5/79	79
NO ₃ - N, mg/l	0.12	0.54	0.00	10/74 - 6/79	71
Total P, mg/l	0.15	0.43	0.02	7/74 - 6/79	77
Boyce, River Mile 125					
Temperature, °C	19.3	33.5	3.5	11/72 - 5/79	157
Diss. Oxygen, mg/l	8.4	12.3	4.8	11/72 - 5/79	156
BOD-5, mg/l	3.0	9.8	0.1	11/72 - 4/79	145
pH	7.4	8.8	6.2	11/72 - 5/79	151
NO ₃ - N, mg/l	0.12	0.73	0.00	7/74 - 6/79	73
Total P, mg/l	0.20	0.80	0.05	7/74 - 6/79	75
Alexandria, River Mile 105					
Temperature, °C	20.0	31.5	3.0	1/69 - 5/79	78
Diss. Oxygen, mg/l	8.5	14.2	4.8	7/72 - 5/79	73
BOD-5, mg/l	3.2	8.0	0.0	7/72 - 4/79	67
pH	7.6	8.6	6.7	4/52 - 5/79	350
NO ₃ + NO ₂ - N, mg/l	0.15	0.63	0.00	10/73 - 4/79	64
Total P, mg/l	0.21	0.61	0.06	10/73 - 4/79	64
Moncla, River Mile 68					
Temperature, °C	19.3	33.0	4.0	12/70 - 5/79	165
Diss. Oxygen, mg/l	9.0	*	5.6	12/70 - 5/79	160
BOD-5, mg/l	3.0	8.9	0.4	12/72 - 4/79	149
pH	7.5	8.5	6.3	11/72 - 5/79	154
NO ₃ - N, mg/l	0.12	0.75	0.00	7/74 - 6/79	72
Total P, mg/l	0.22	0.34	0.06	7/74 - 6/79	73

* Data not available

Source: US Geological Survey

TABLE F- 5

MONTHLY AVERAGE HEAVY METALS CONCENTRATION, IN ug/l, RED RIVER, LA,
PERIOD OCTOBER 1974 - SEPTEMBER 1980

Above Shreveport, Louisiana

Mo.	Arsenic		Cadmium		Copper		Lead		Mercury		Zinc	
	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.
Oct	2.3	1.3	1.4	0.4	4.6	2.7	3.6	1.1	0.12	0.03	32.9	32.9
Nov	3.4	1.0	1.1	0.5	12.8	4.5	6.5	0.5	0.06	0.002	18.6	11.5
Dec	1.8	1.0	0.5	0.5	7.9	4.8	7.4	2.3	0.06	0.05	34.3	8.8
Jan	1.7	0.8	0.3	0.3	7.7	6.5	7.9	0.8	0.1	0.04	20.6	11.3
Feb	2.4	0.8	0.6	0.2	8.8	6.7	7.4	0.6	0.1	0.12	18.6	5.5
Mar	3.4	1.3	0.5	0.5	8.9	4.2	8.3	2.2	0.1	0.08	34.3	14.5
Apr	2.9	0.8	0.3	0.2	24.4	4.7	7.1	0.8	0.11	0.07	35.7	13.3
May	3.0	1.5	0.4	0.4	17.0	5.6	8.1	1.8	0.18	0.10	40.0	15.2
Jun	3.1	1.5	0.8	0.8	12.9	4.8	11.1	0.8	0.10	0.00	48.6	14.7
Jul	2.0	0.8	0.7	0.7	8.3	5.2	5.8	2.7	0.11	0.07	26.3	8.3
Aug	2.4	1.7	0.6	0.5	5.0	3.0	5.1	1.3	0.17	0.05	21.4	11.3
Sep	2.1	1.5	1.9	0.7	4.1	3.5	3.6	0.5	0.17	0.02	14.3	9.2

Dissolved Hexavalent Chromium Detected:

Jan 1975, 1 ug/l

Dec 1978, 2 ug/l

Feb 1980, 1 ug/l

Moncla, Louisiana

Mo.	Arsenic		Cadmium		Copper		Lead		Mercury		Zinc	
	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.
Oct	1.8	0.8	1.0	0.3	6.3	2.3	6.5	1.3	0.05	0.00	26.0	15.7
Nov	2.2	1.2	0.6	0.3	10.7	4.8	11.4	1.2	0.10	0.02	16.0	12.2
Dec	3.5	1.2	1.8	0.5	7.8	5.8	13.0	2.2	0.07	0.03	43.3	11.5
Jan	3.7	1.2	2.2	0.7	7.8	5.0	7.4	1.3	0.05	0.05	31.7	15.0
Feb	3.7	1.0	1.0	0.3	14.3	5.8	12.5	1.3	0.13	0.08	40.0	18.0
Mar	3.7	0.8	0.7	0.3	15.0	5.4	10.2	1.2	0.10	0.08	38.3	13.3
Apr	3.5	0.8	1.0	0.4	14.0	5.5	13.2	2.2	0.07	0.06	33.3	8.8
May	3.4	0.5	0.4	0.4	14.0	6.0	11.8	3.2	0.02	0.00	36.0	19.0
Jun	3.4	1.0	1.2	1.2	18.8	7.0	40.0	4.0	0.24	0.10	54.0	16.0
Jul	2.6	1.2	0.5	0.5	9.6	7.0	14.3	1.7	0.12	0.12	28.3	20.2
Aug	2.7	1.5	1.2	1.2	7.8	4.6	9.4	1.2	0.15	0.15	21.7	7.2
Sep	2.7	1.8	1.8	0.5	6.8	4.8	6.7	0.5	0.08	0.08	23.3	12.7

Dissolved Hexavalent Chromium Detected:

Dec 1978, 3 ug/l

SOURCE: US Geological Survey

TABLE F-6

Frequency of Occurrence of PCB and Pesticides in the Red River,
Louisiana, 1974 to 1980, Above Shreveport and at Moncla, Louisiana

Chemical	Above Shreveport			Water			Sediment			Moncla		
	Total Samples	Total		Total Samples	Total		Total Samples	Total		Total Samples	Total	
		Detected	Samples		Detected	Samples		Detected	Samples		Detected	Samples
PCB	71	0	27		2	68		1	23		1	23
Aldrin	72	2	27		1	69		0	22		0	22
Chlordane	72	0	27		0	69		0	22		3	22
DDD	72	0	27		16	69		2	22		5	22
DDG	72	14	27		23	69		12	22		9	22
DDT	73	13	27		15	70		15	22		7	22
Diazinon	73	19	17		0	69		34	20		0	20
Dieldrin	73	7	27		2	70		10	22		1	22
Endrin	73	0	17		2	70		1	22		0	22
Ethion	73	0	16		0	69		0	16		0	16
Heptachlor	73	0	27		0	70		0	22		0	22
Heptachlor Epoxide	73	0	27		0	70		1	22		1	22
Lindane	73	1	27		1	58		1	22		1	22
Malathion	73	0	17		0	57		0	15		0	15
Methoxychlor	42	1	4		0	38		0	4		0	4
Methyl Parathion	73	3	17		0	57		0	15		0	15
Mirex	44	0	8		0	40		0	8		0	8
Parathion	73	0	17		0	69		0	16		0	16
Silvex	70	1	*		*	70		5	*		*	*
Toxaphene	73	0	27		0	70		0	22		0	22
2,4-D	70	28	*		*	70		37	*		*	*
2,4,5-T	70	30	*		*	70		26	*		*	*

*Not Analyzed

SOURCE: US Geological Survey

TABLE F-7
HEAVY METAL CONCENTRATIONS FOR WATER SAMPLES
COLLECTED IN THE RED RIVER STUDY AREA

Stations	Mercury (Hg)	Arsenic (As)	Lead (Pb)	Zinc (Zn)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	No. of Samples
Shreveport (Mile 274)	1.0	0.65	28.1	261	0.1	11	10	20	1
Coushatta (Mile 218)	1.27	0.84	17.2	131	0.2	20	18.8	36	1
Natchitoches (Mile 180)	1.0	1.0	5.2	27.7	0.2	6	2.9	5	1
Alexandria (Mile 102)	1.18	3.1	28.1	212	0.1	17	14.4	31	1
Moncla (Mile 68)	0.9	1.63	26.3	261	0.2	18	17	33	1

Source: US Army Corps of Engineers

Unit = ug/l Total

Period of Record = 29 April 1976

TABLE F-8
PESTICIDE CONCENTRATIONS ¹ FOR SEDIMENT SAMPLES COLLECTED IN THE RED RIVER STUDY AREA

Stations	Aldrin	Chlordane	Dieldrin	DDD (TDE)	DDE	DDT	Endrin	Heptachlor	Heptachlor Epoxide	Lindane	Methoxychlor	Nitrex	Toxaphene	Organophosphate	PCB	Stilvex	2,4-D	2,4,5-T
Old River (mile 5)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Frazier Swamp (mile 47)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hog Lake (mile 84)	ND	ND	ND	0.044	1.443	1.555	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alexandria (mile 102)	ND	ND	ND	0.540	0.430	0.814	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Montgomery (mile 155)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Porters Island (mile 205)	ND	ND	ND	ND	ND	2.713	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Howard (mile 244)	ND	ND	ND	ND	ND	0.322	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bagley Island (mile 268)	ND	ND	ND	0.557	1.947	1.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Shreveport (mile 274)	ND	ND	ND	0.385	0.838	0.739	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

¹ Pesticide concentration expressed in ug/kg (dry)

ND = None detected

Source: Gulf South Research Institute

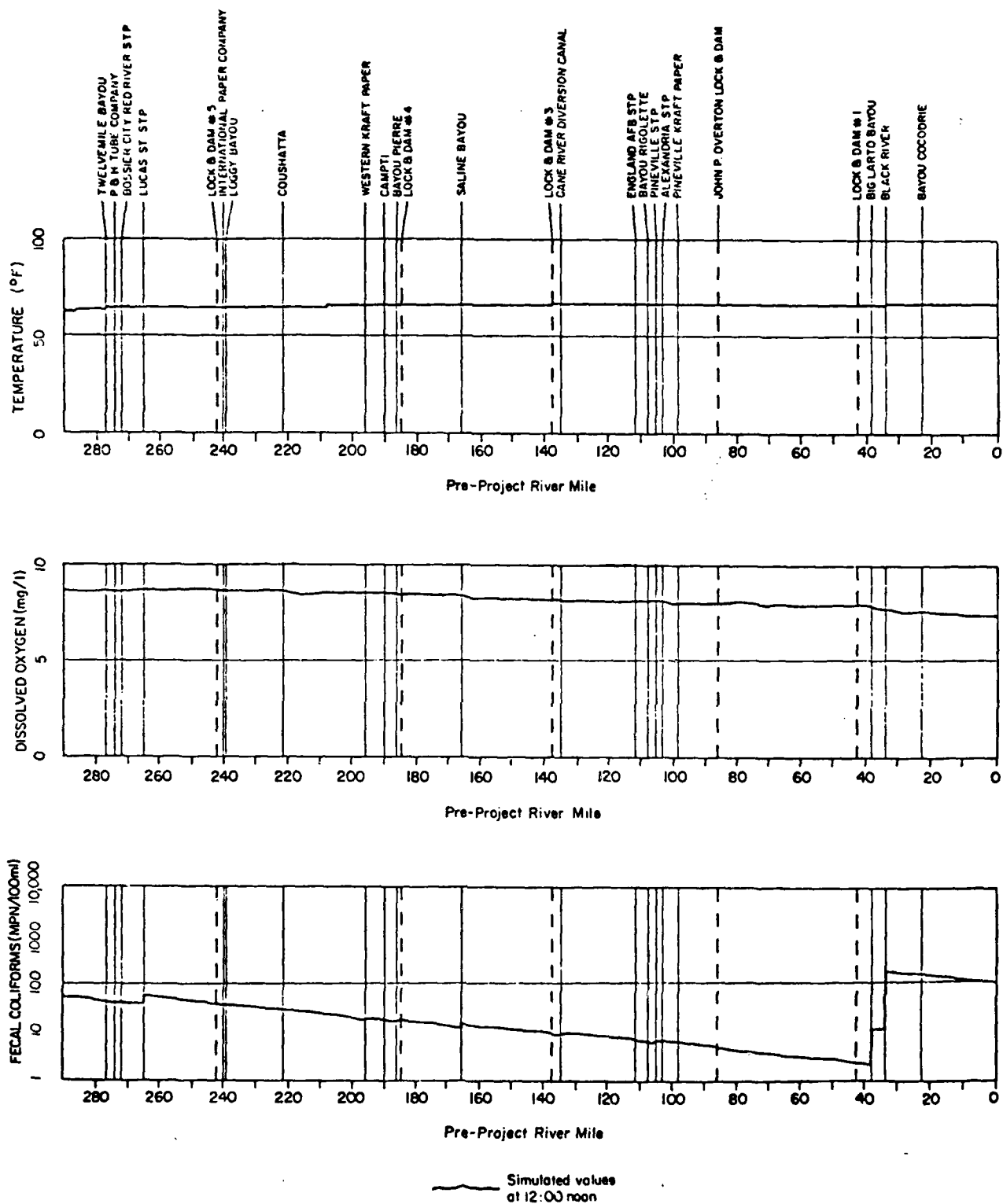


Figure F-1
Systemwide Pre-Project Quality for 10% Exceedance Flow Condition

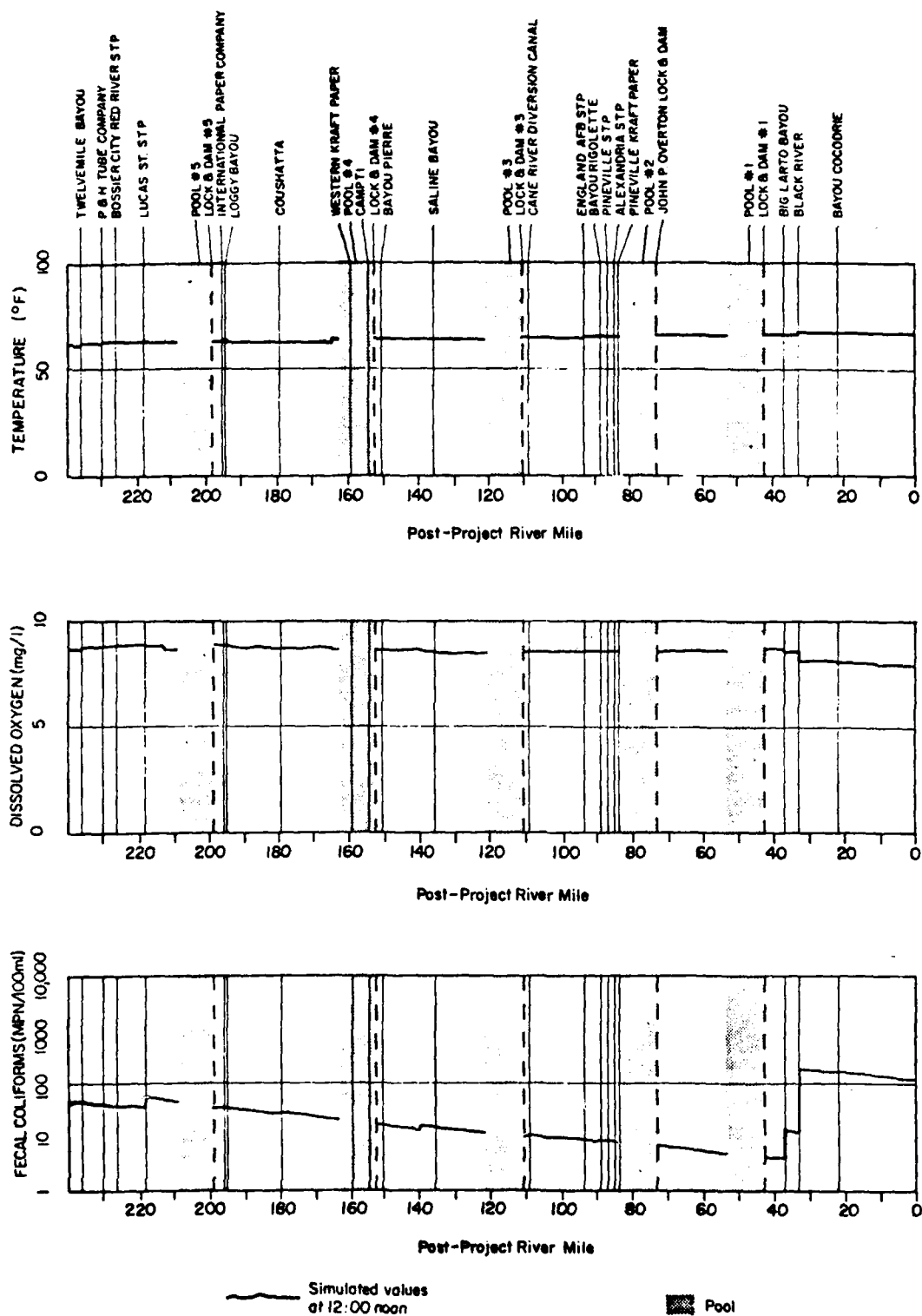


Figure F-2
Systemwide Post-Project Quality for 10% Exceedance
Flow Condition

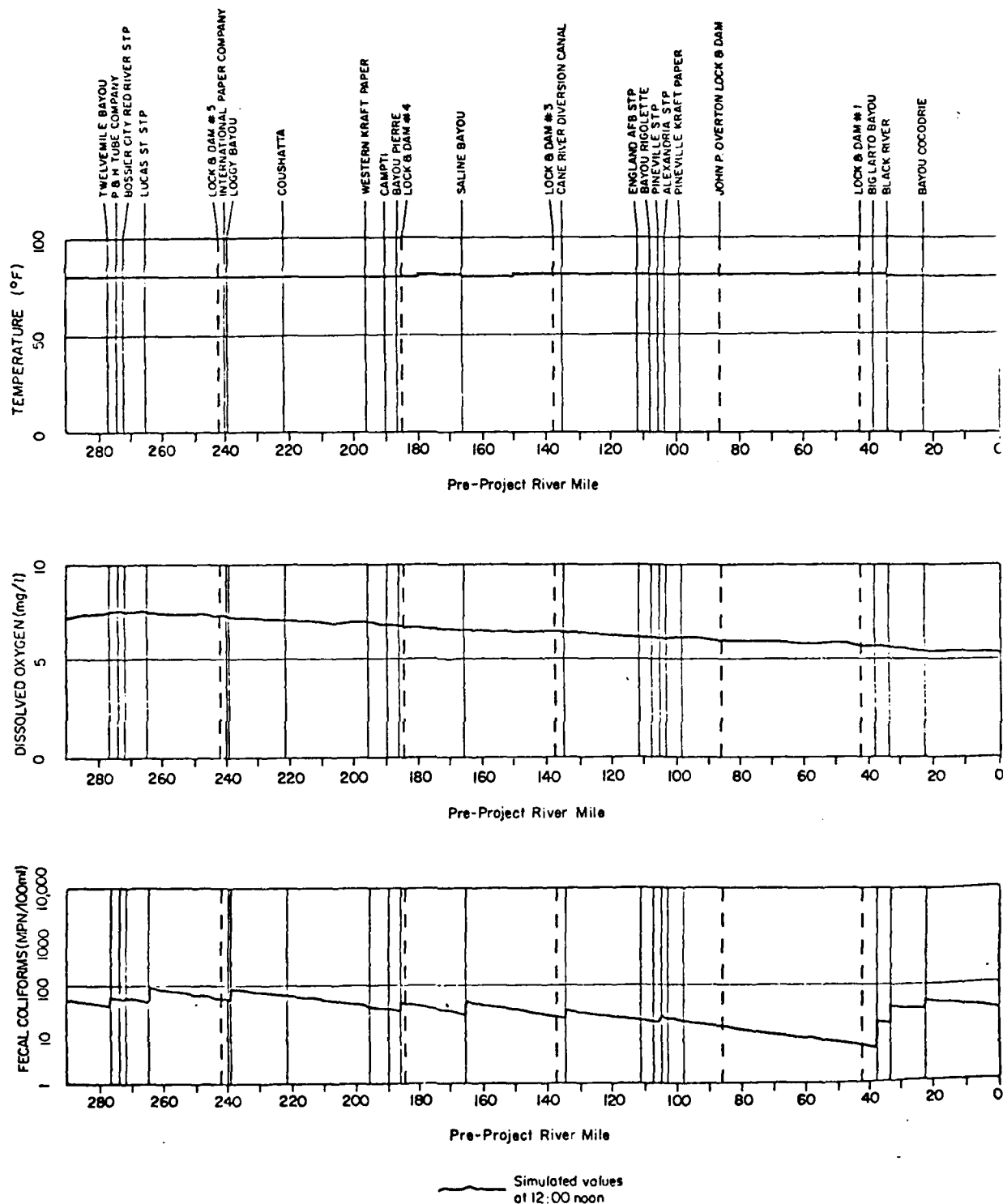


Figure F-3
 Systemwide Pre-Project Quality for Mean Annual
 Flow Condition

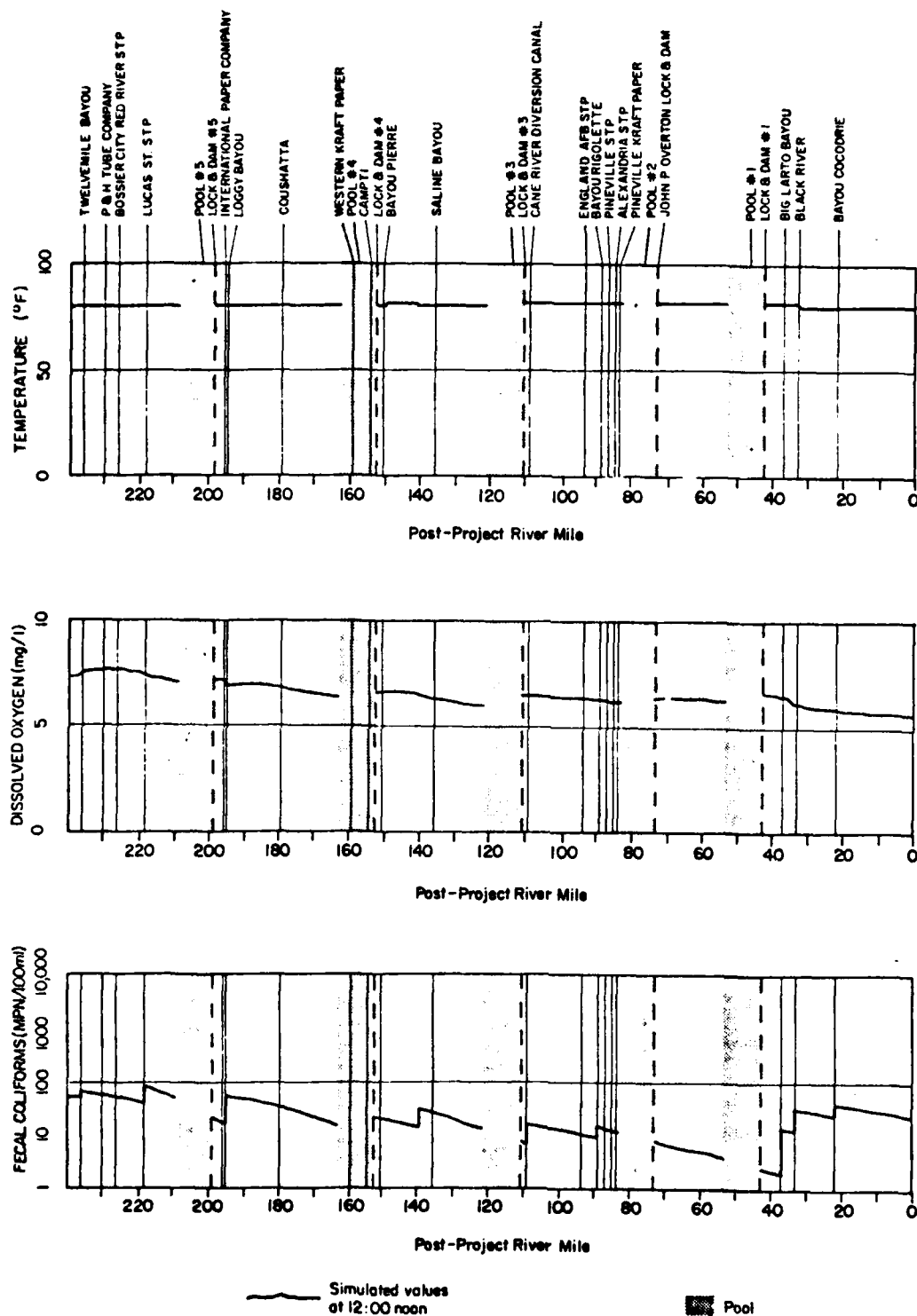


Figure F-4
Systemwide Post-Project Quality for Mean Annual Flow Condition

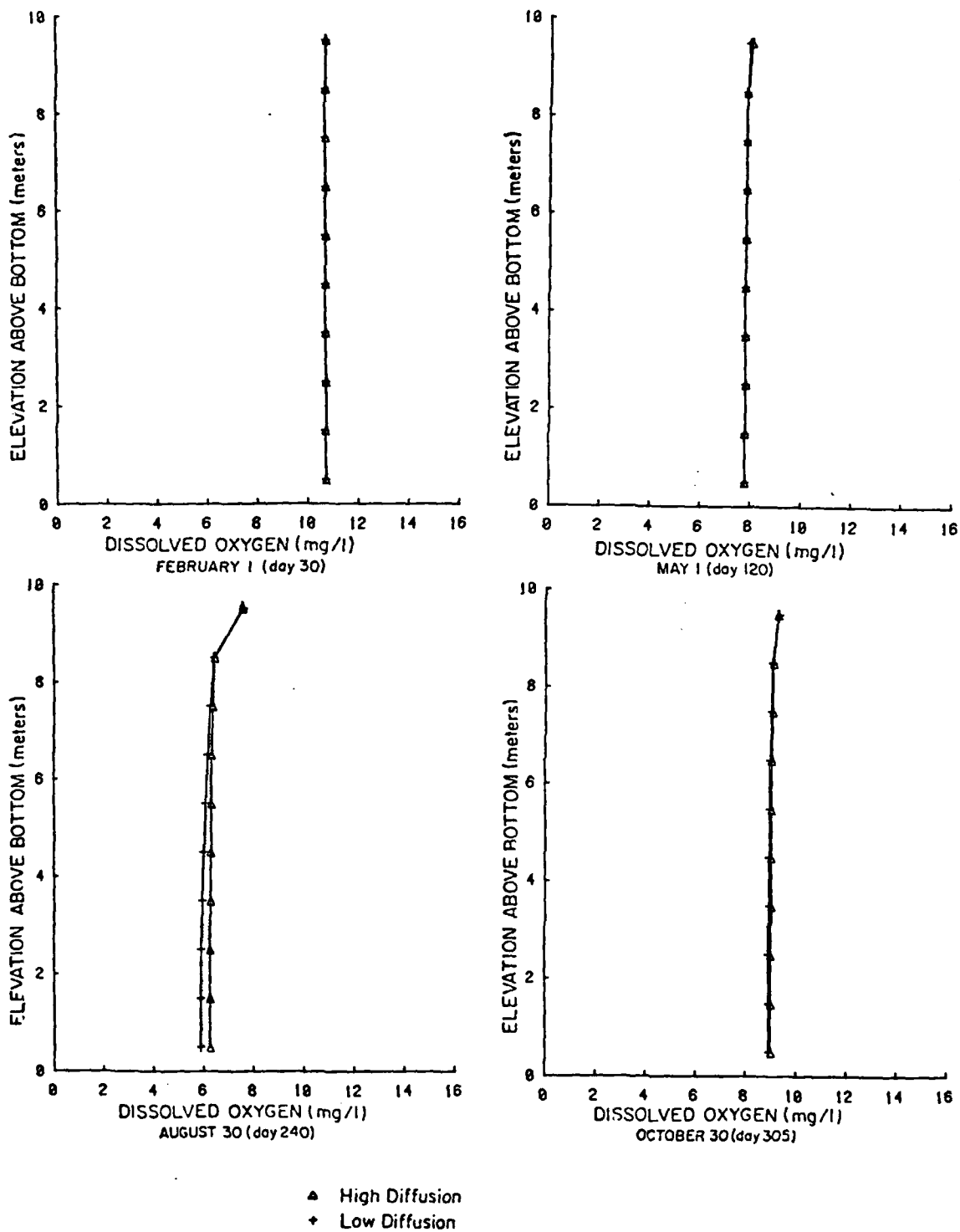
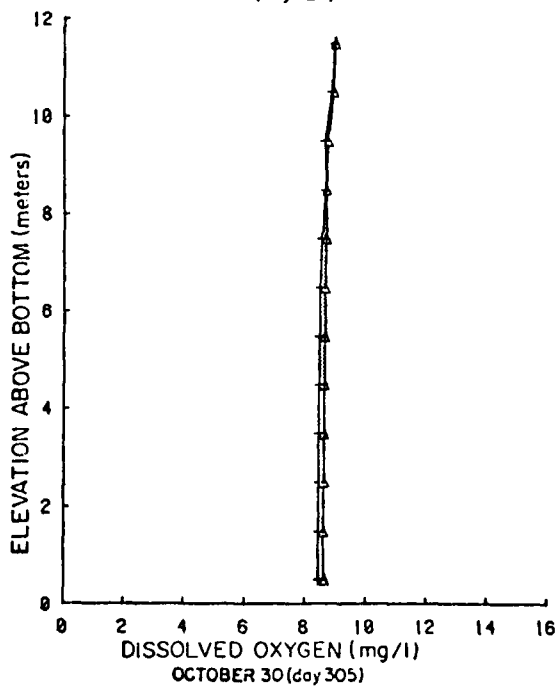
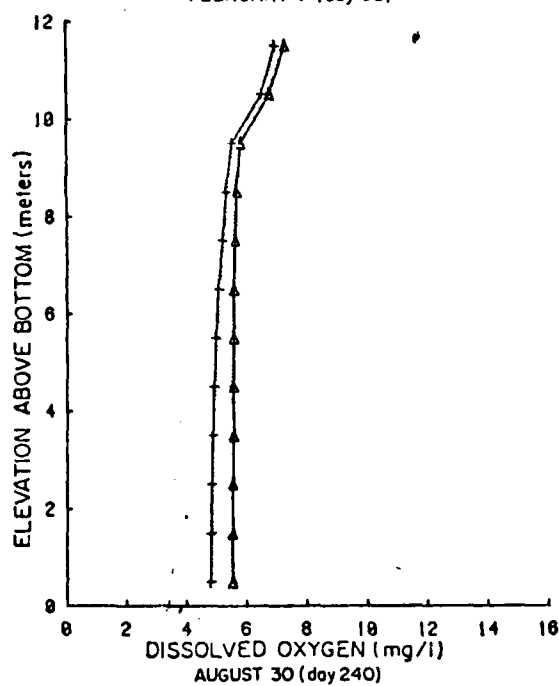
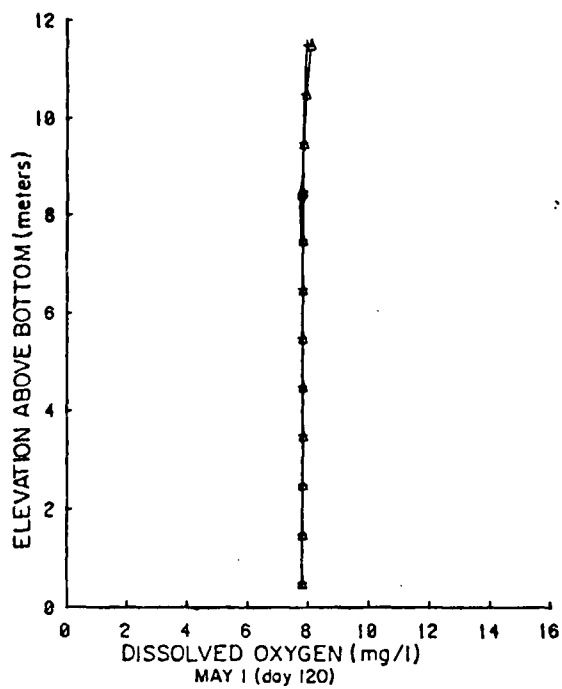
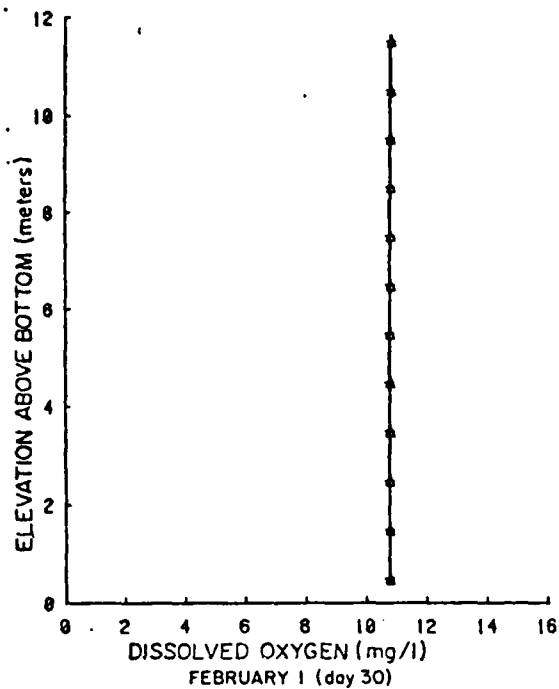
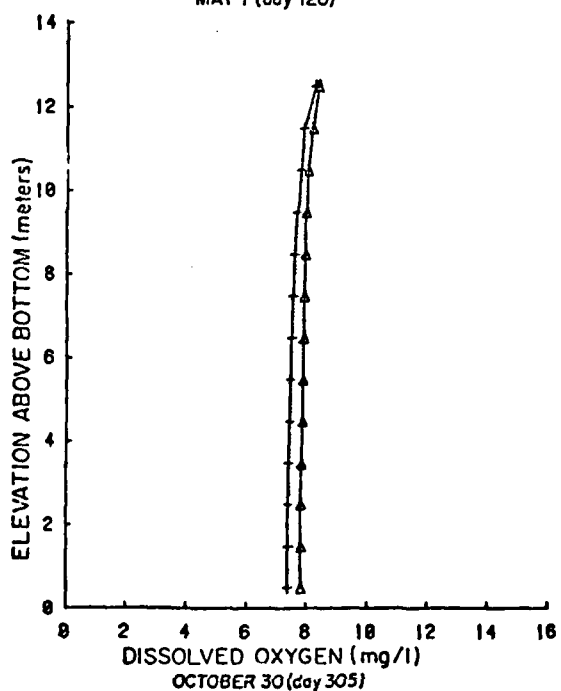
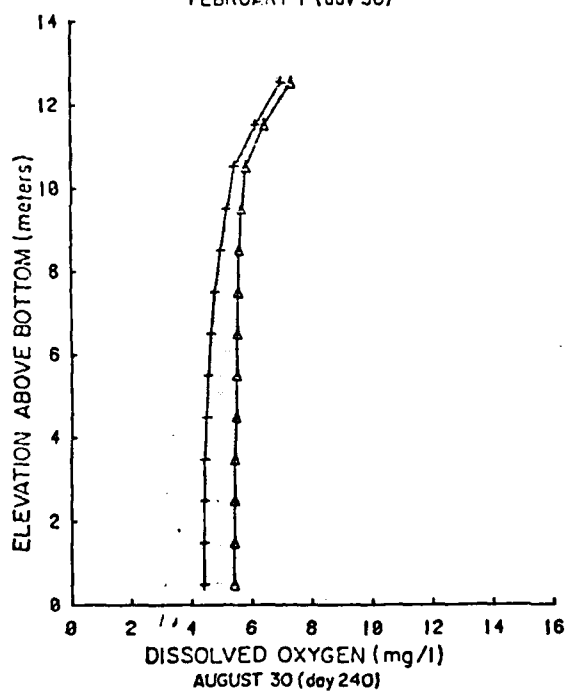
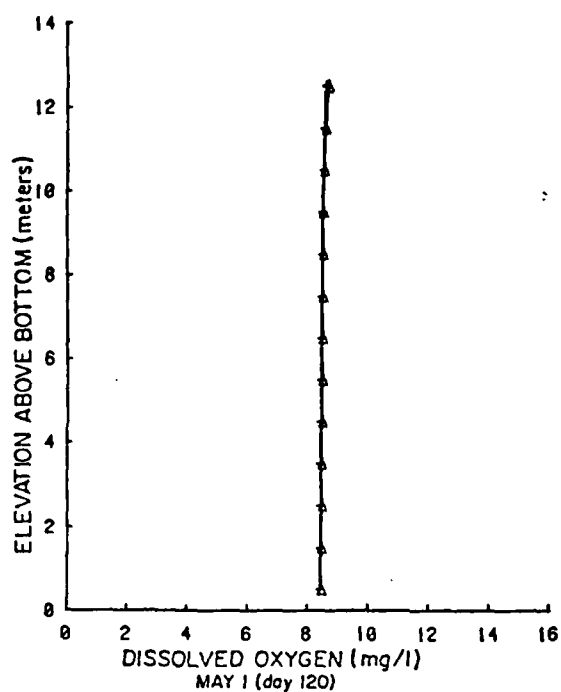
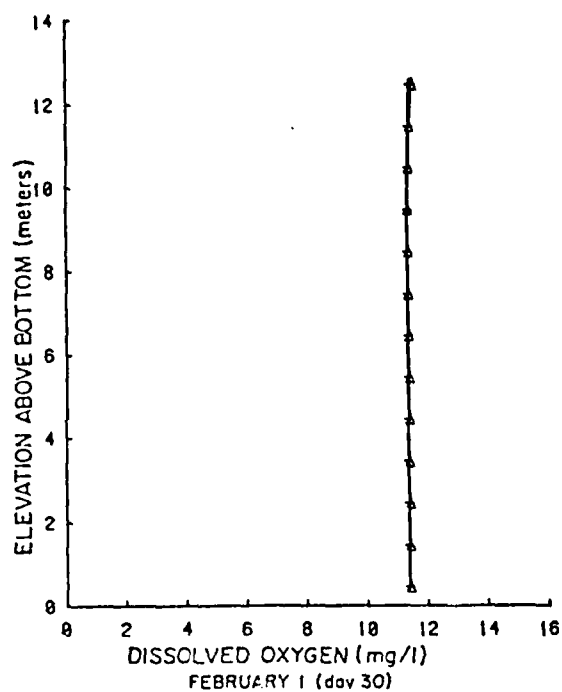


Figure F-5
 Post-Project Pool No. 1 Quality for Mean Monthly Flow Condition



▲ High Diffusion
+ Low Diffusion

Figure F-6
Post-Project Pool No. 2 Quality for Mean Monthly Flow Condition



▲ High Diffusion
+ Low Diffusion

Figure F-7
Post-Project Pool No. 3 Quality for Mean Monthly Flow Condition

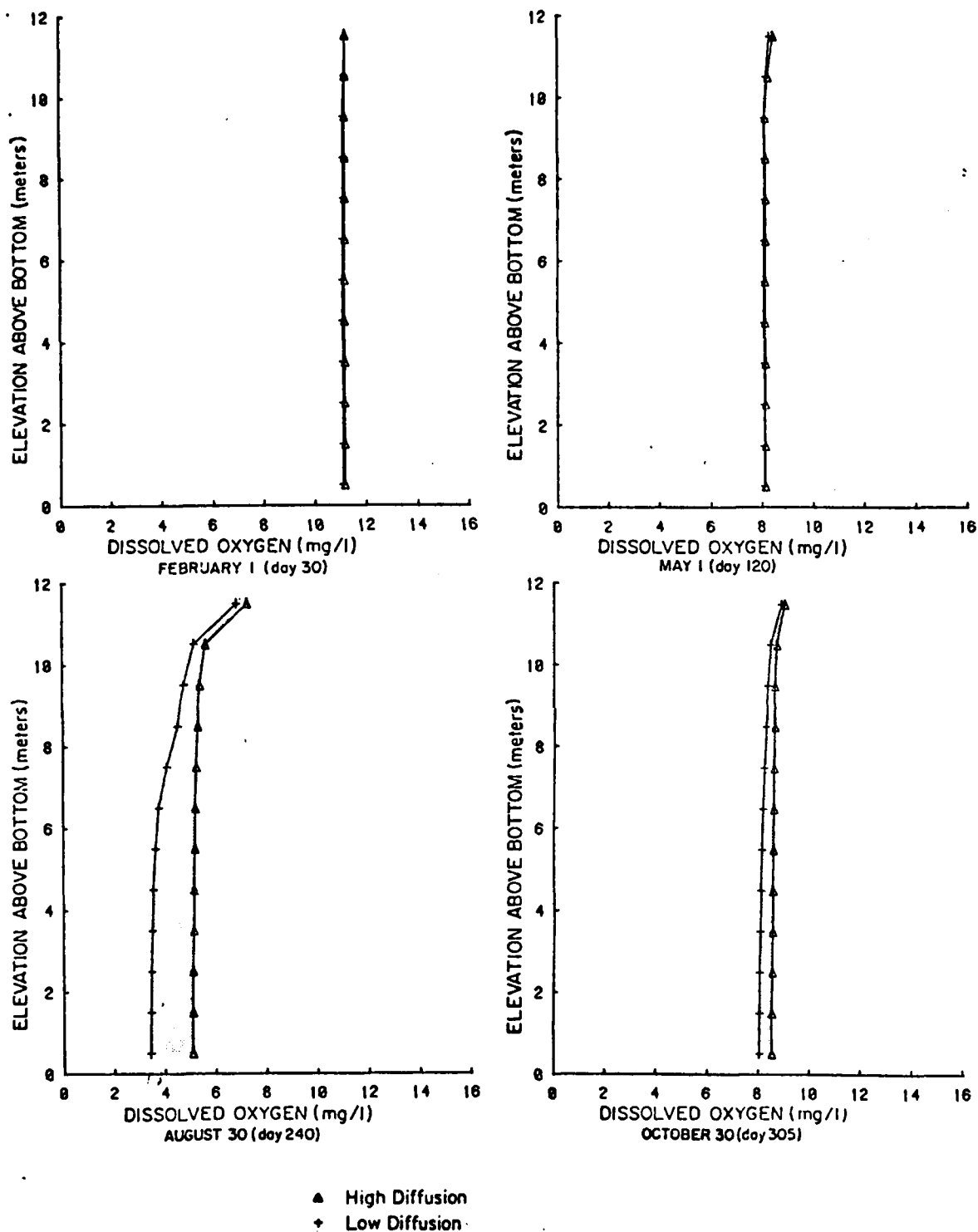


Figure F-8
 Post-Project Pool No. 4 Quality for Mean Monthly Flow Condition

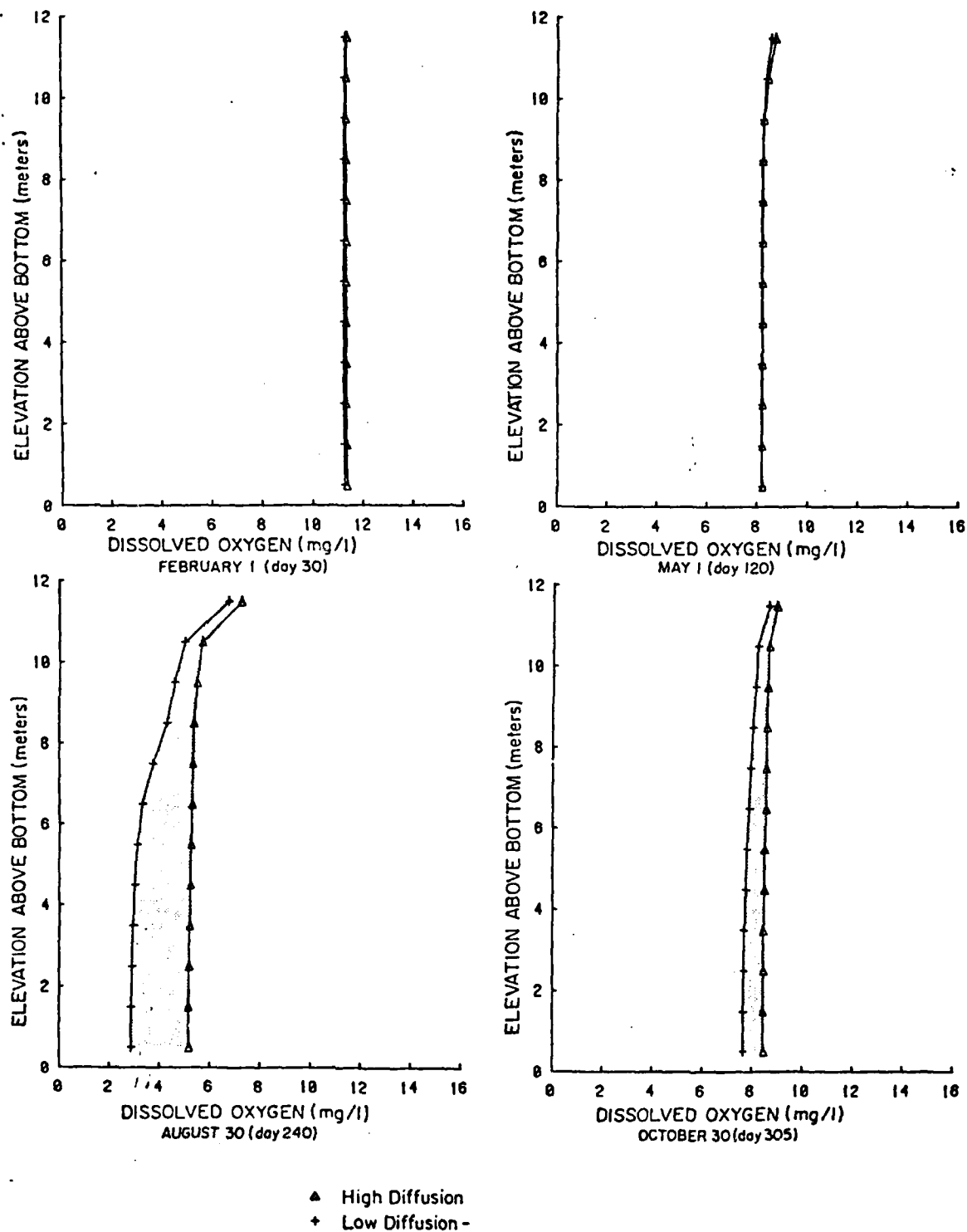
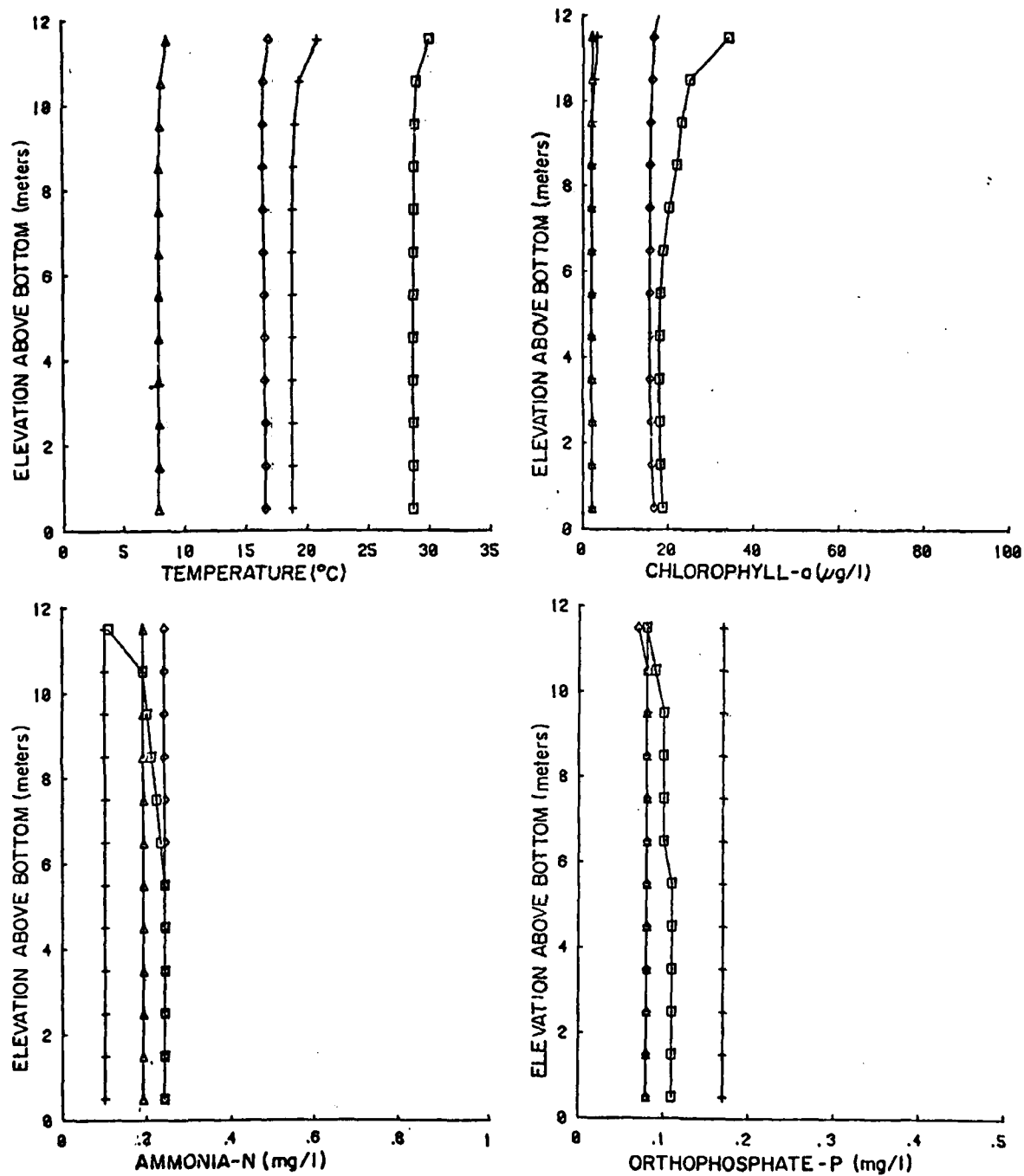


Figure F-9
Post-Project Pool No. 5 Quality for Mean Monthly Flow Condition



▲ FEBRUARY 1 (day 30) + MAY 1 (day 120) ◻ AUGUST 30 (day 240) ◊ OCTOBER 30 (day 305)

Figure F-10
Post-Project Pool No. 5 Quality for Mean Monthly Flow Condition

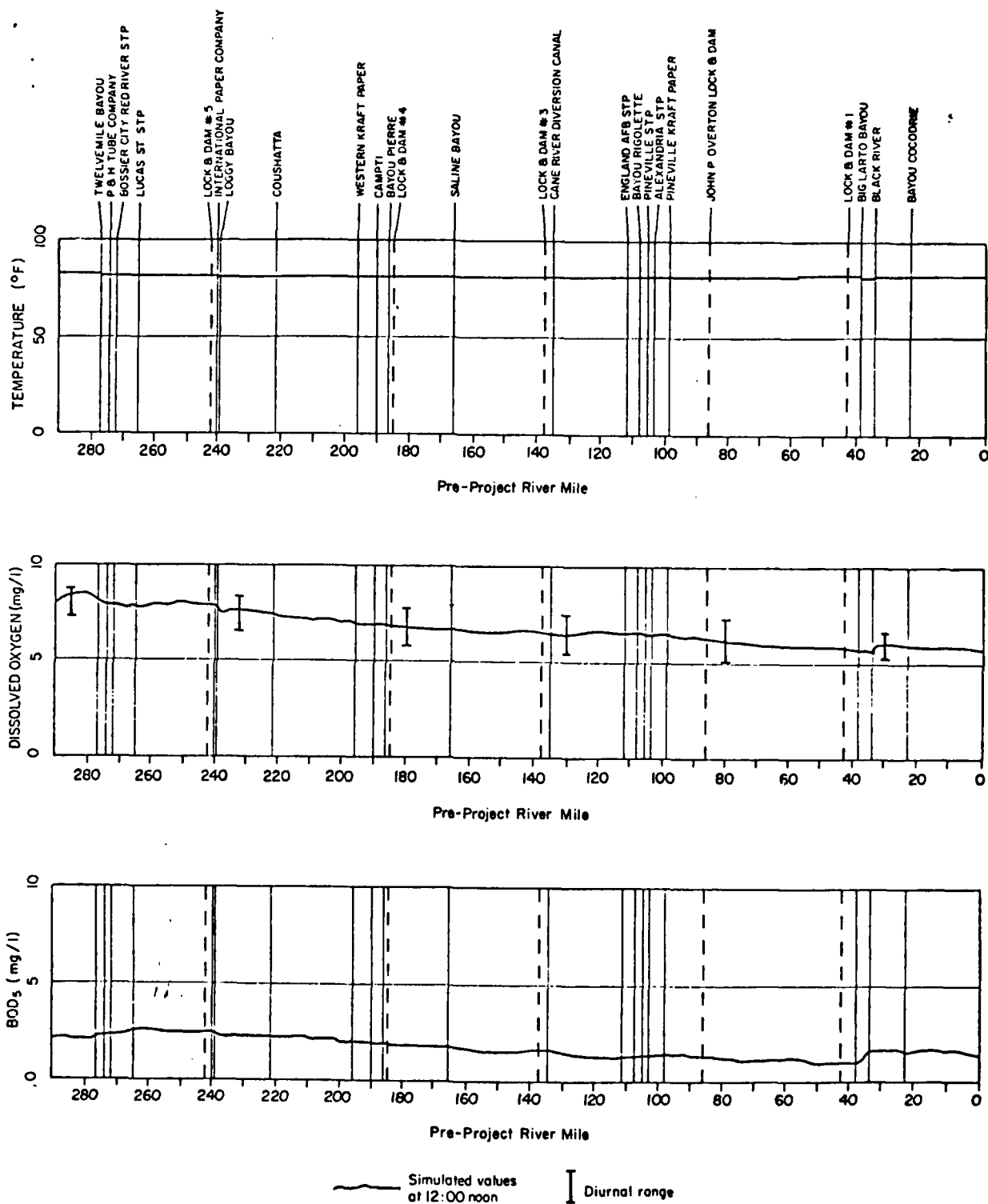


Figure F-11
Systemwide Pre-Project Quality for 80% Exceedance Flow Condition

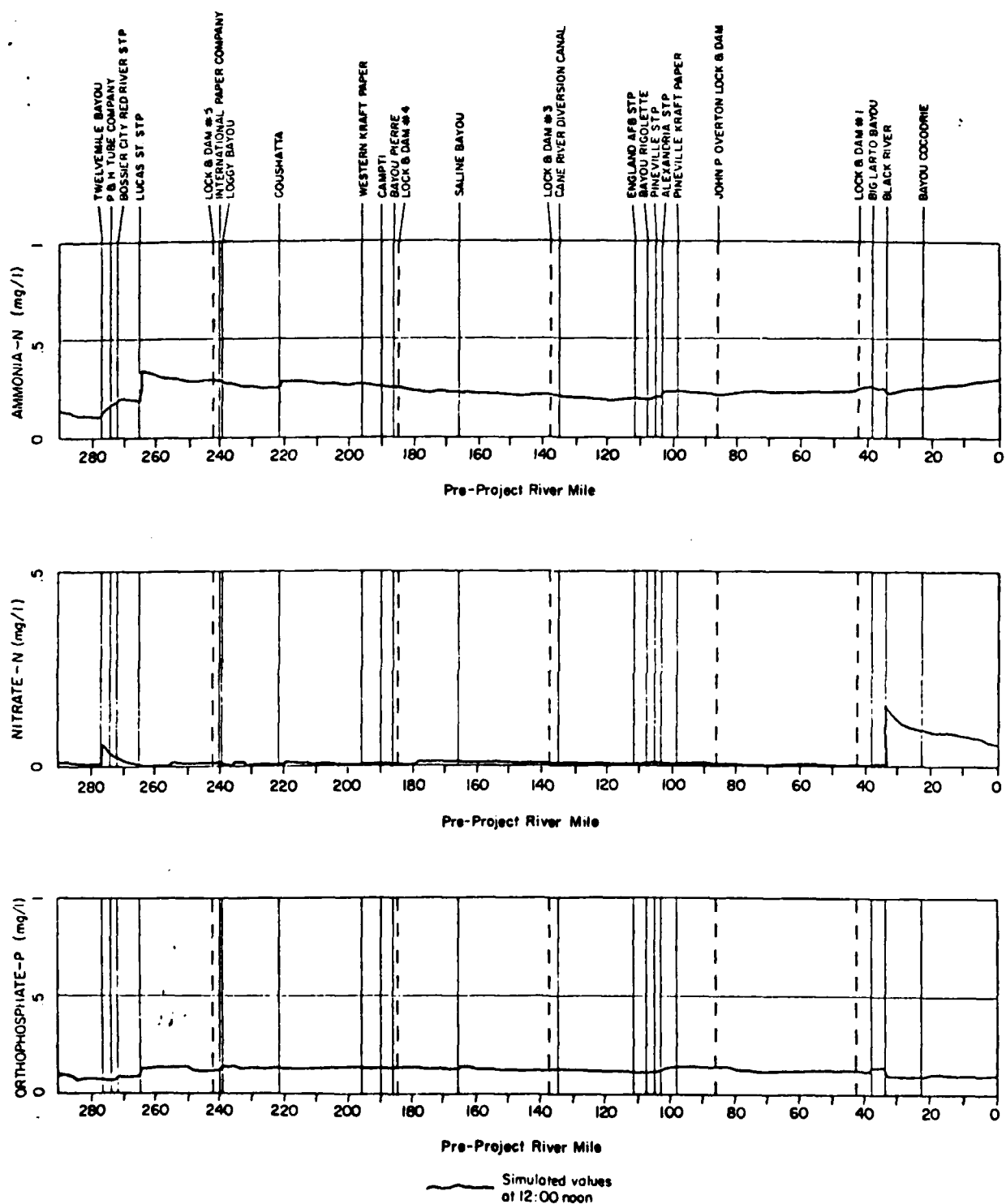


Figure F-12
Systemwide Pre-Project Quality for 80% Exceedance Flow Condition

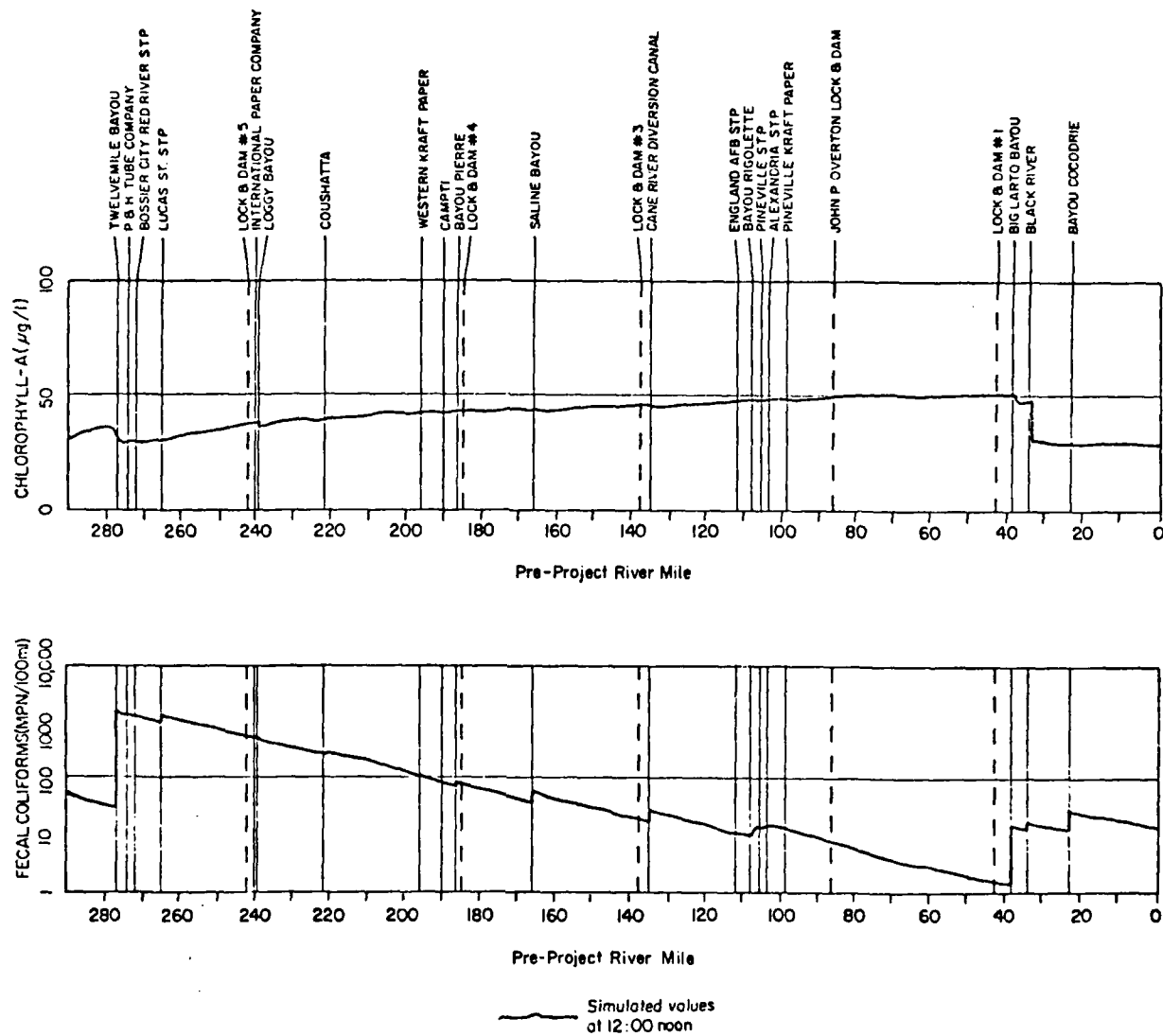
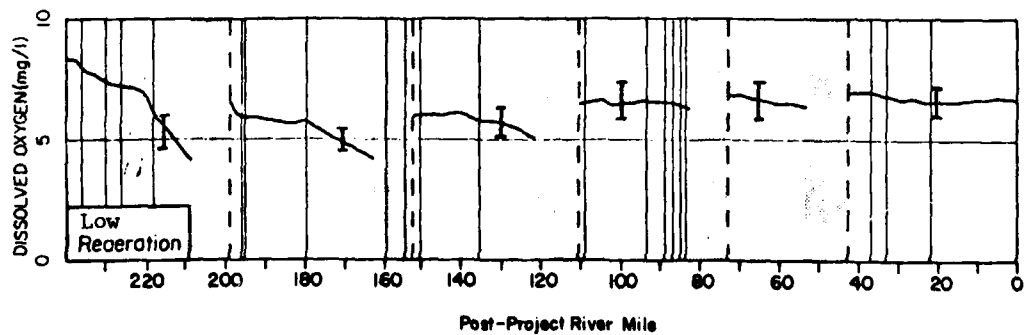
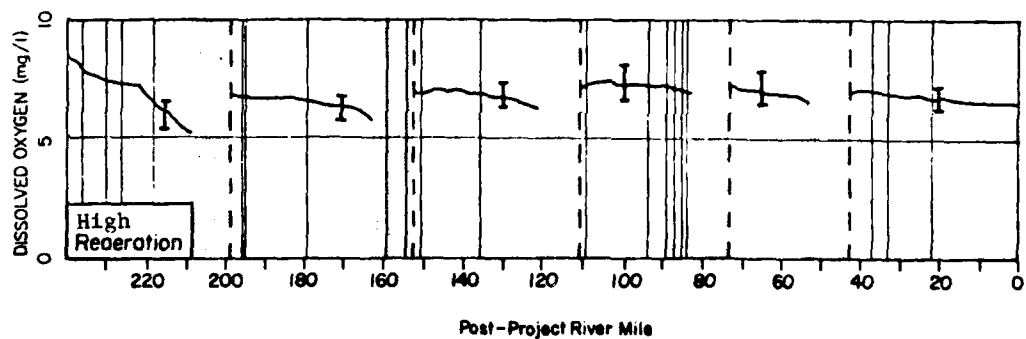
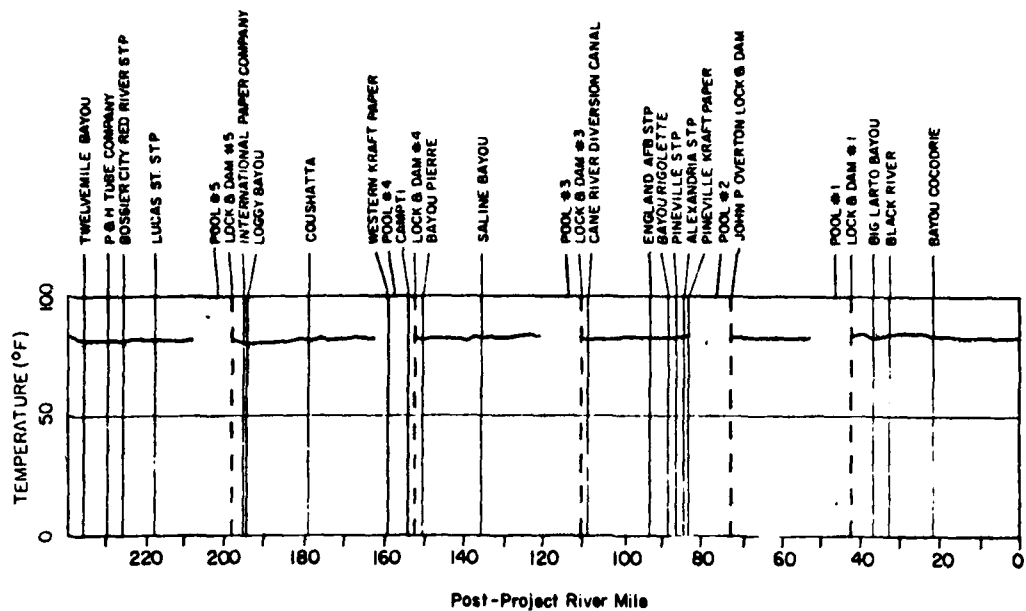


Figure F-13
Systemwide Pre-Project Quality for 80% Exceedance Flow Condition



— Simulated values at 12:00 noon I Diurnal range Pool

Figure F-14
Systemwide Post-Project Quality for 80% Exceedance Flow Condition

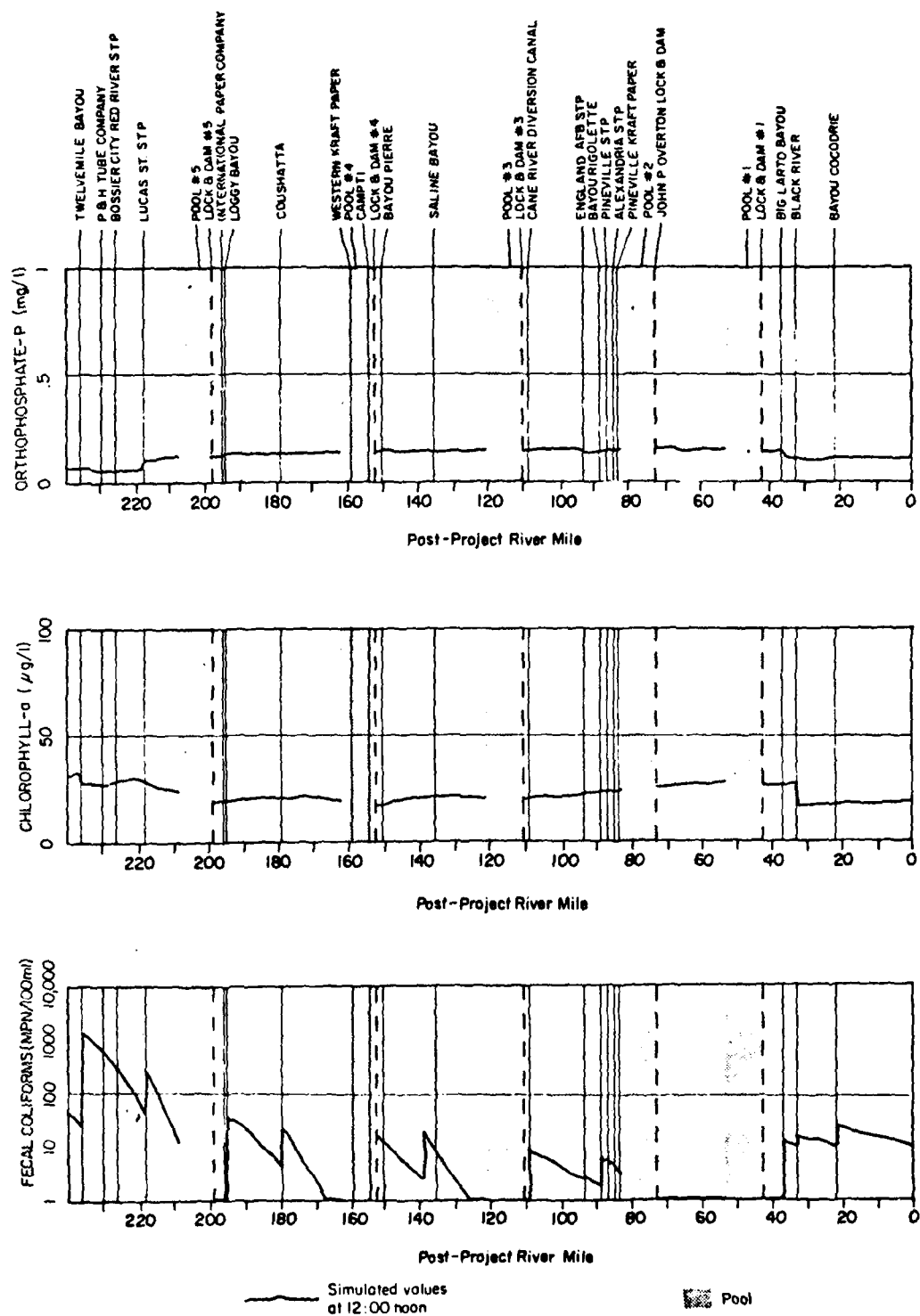


Figure F-15
Systemwide Post-Project Quality for 80% Exceedance Flow Condition

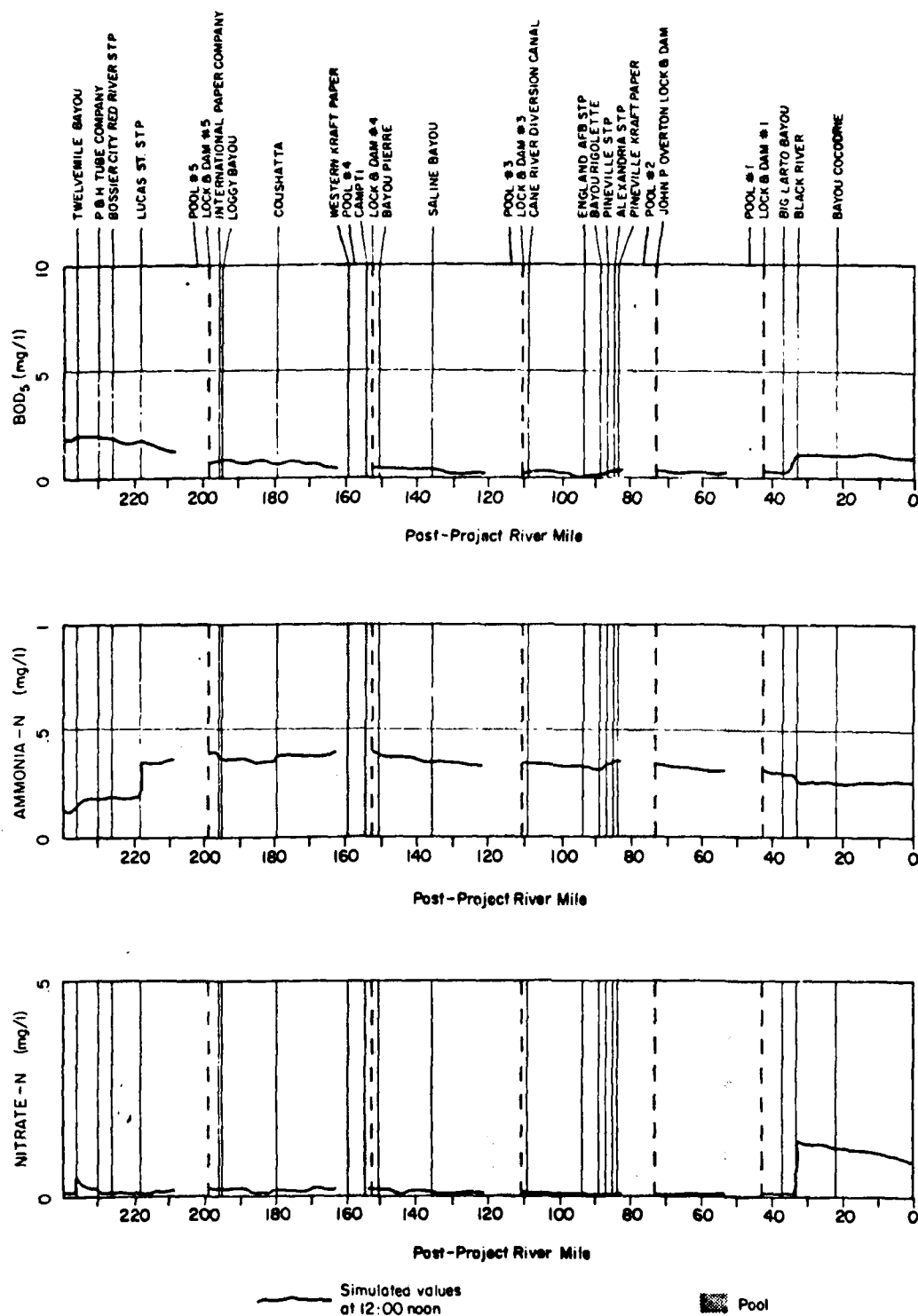
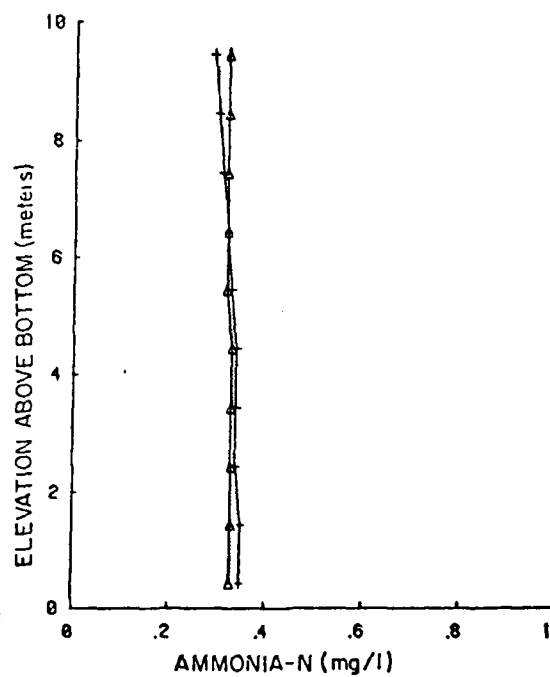
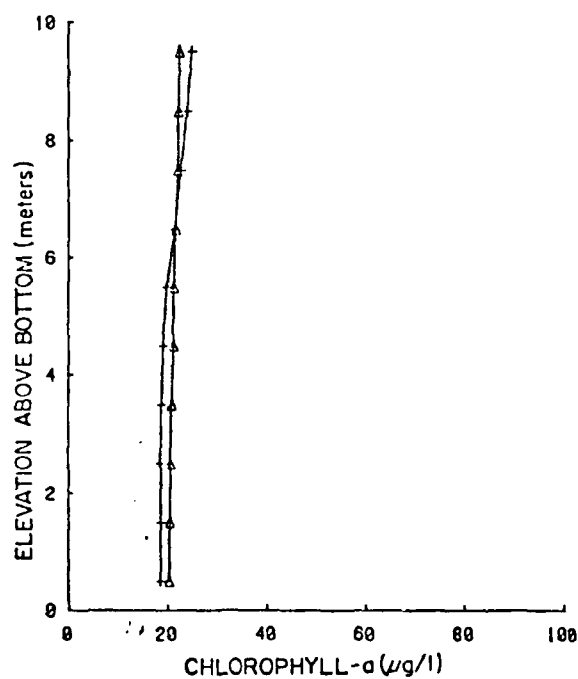
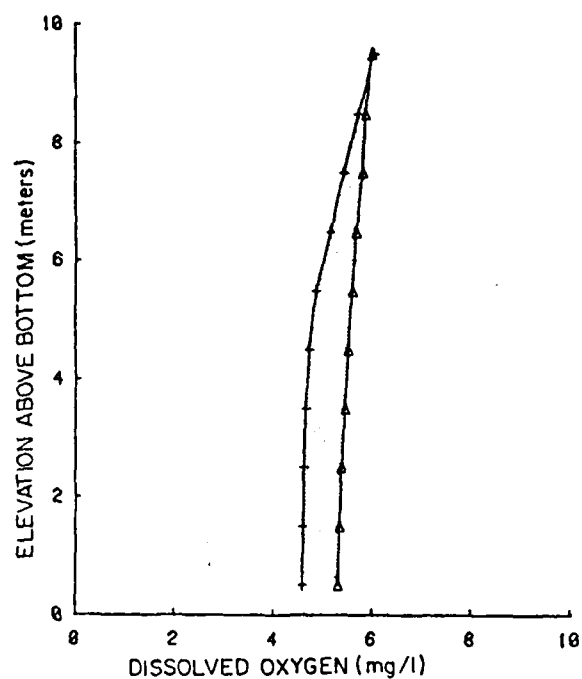
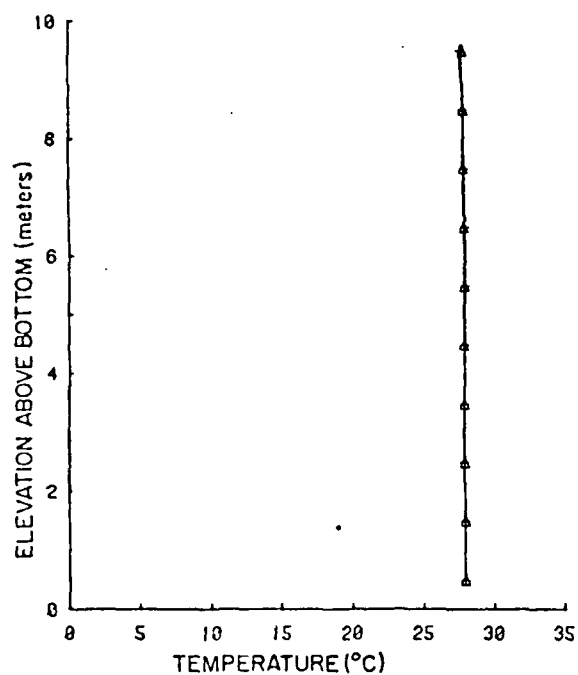


Figure F-16
Systemwide Post-Project Quality for 80% Exceedance Flow Condition



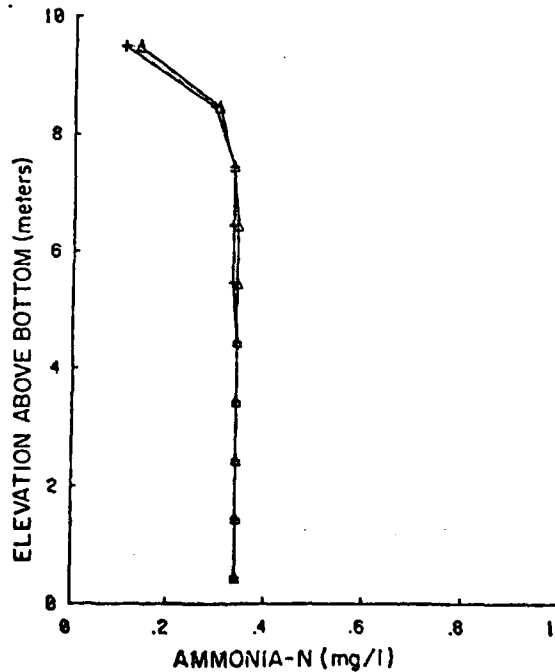
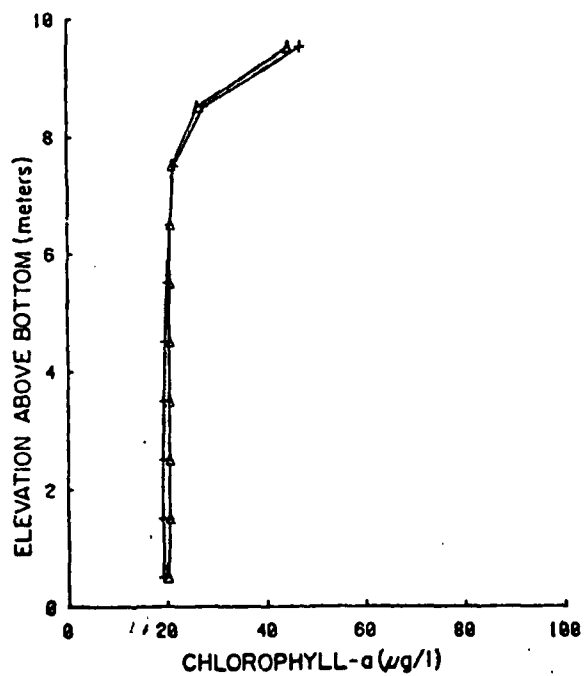
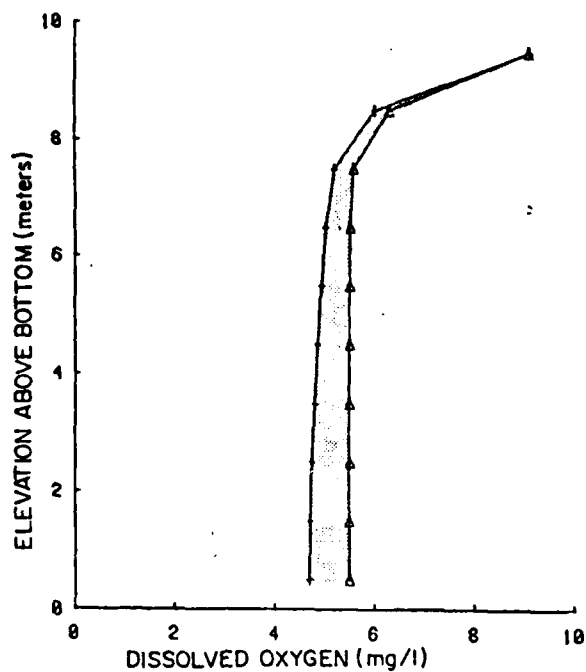
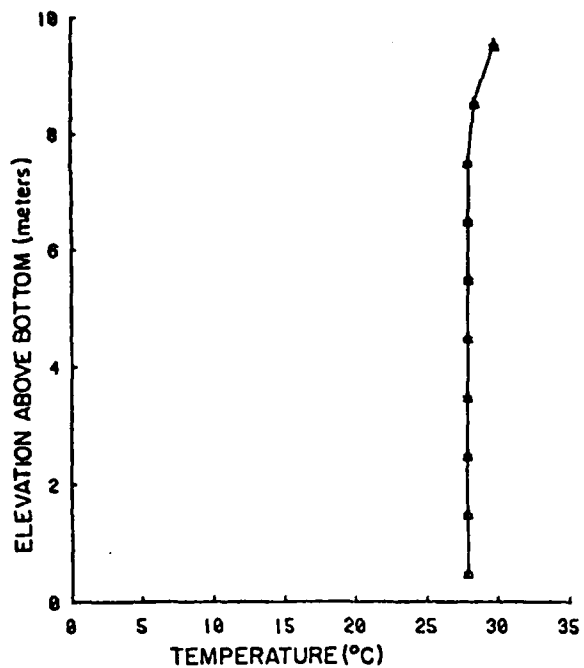
Pool #1 at 6:00 A.M.

▲ High Diffusion -

+ Low Diffusion -

Figure F-17

Post-Project Pool No. 1 Quality for 80% Exceedance Flow Condition

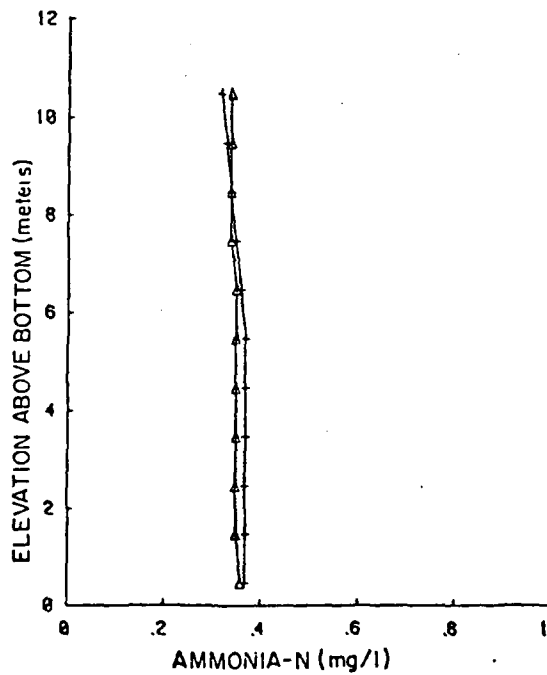
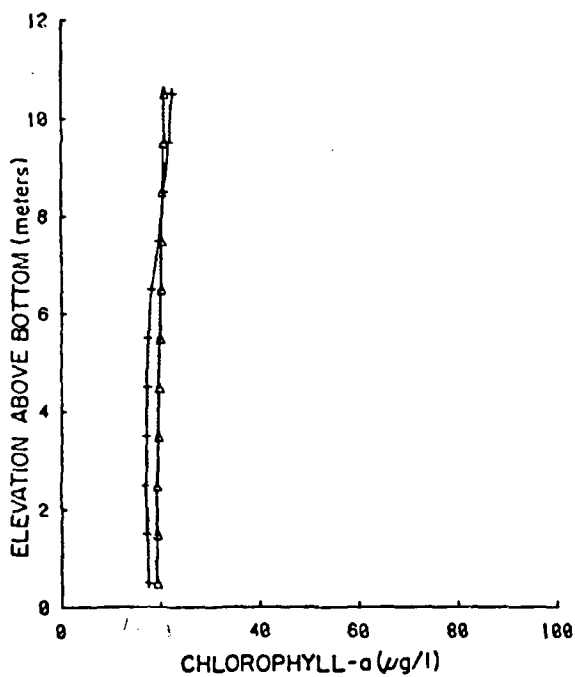
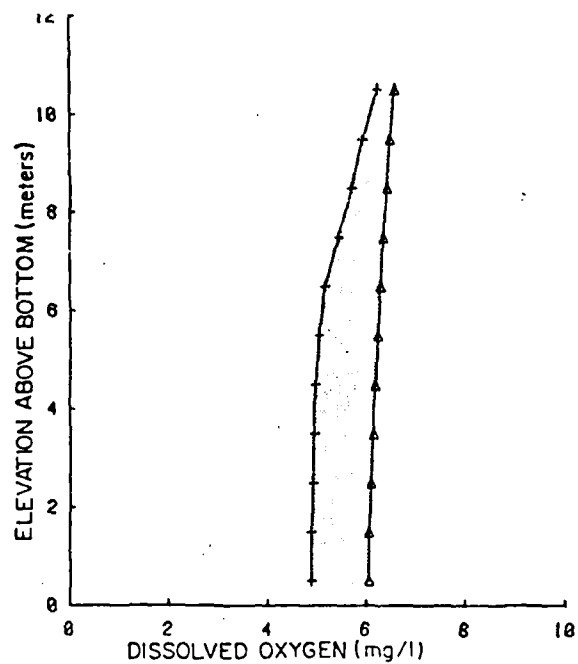
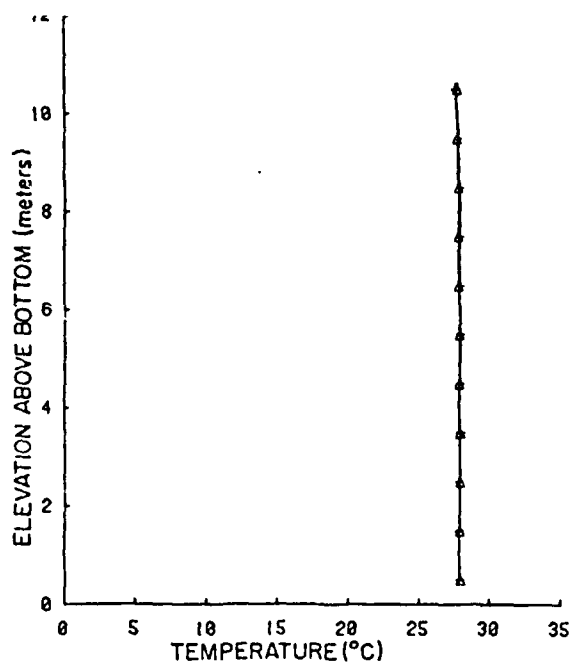


Pool # 1 at 6:00 P.M.

▲ High Diffusion -

+ Low Diffusion -

Figure F-17 (Cont'd)
Post-Project Pool No. 1 Quality for 80% Exceedance Flow Condition



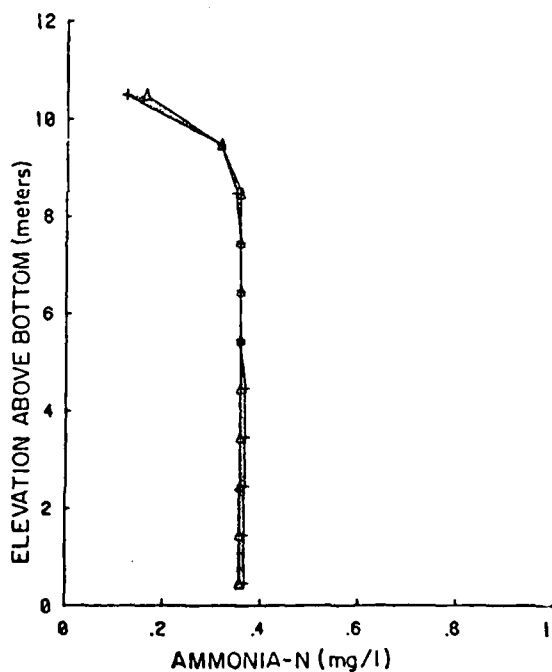
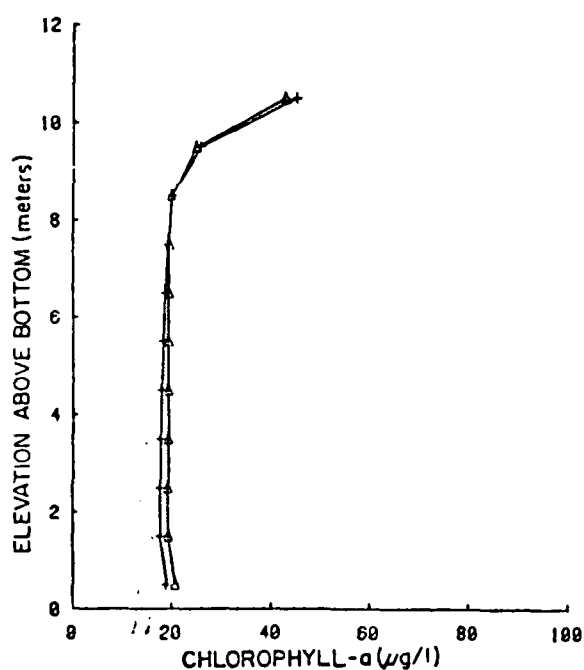
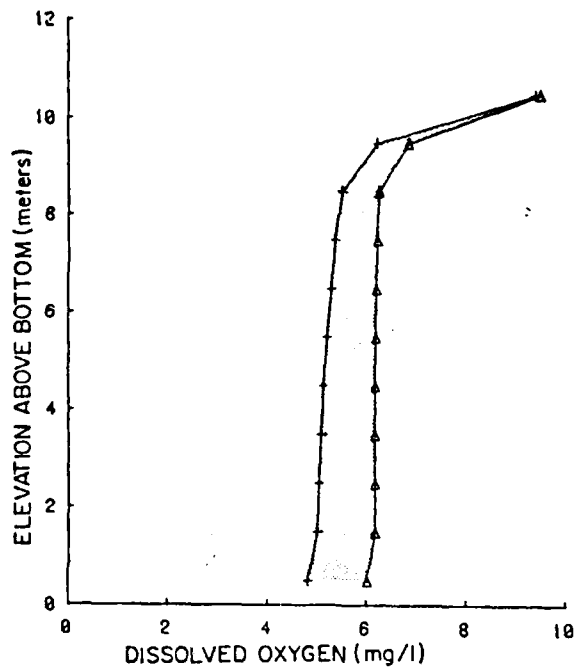
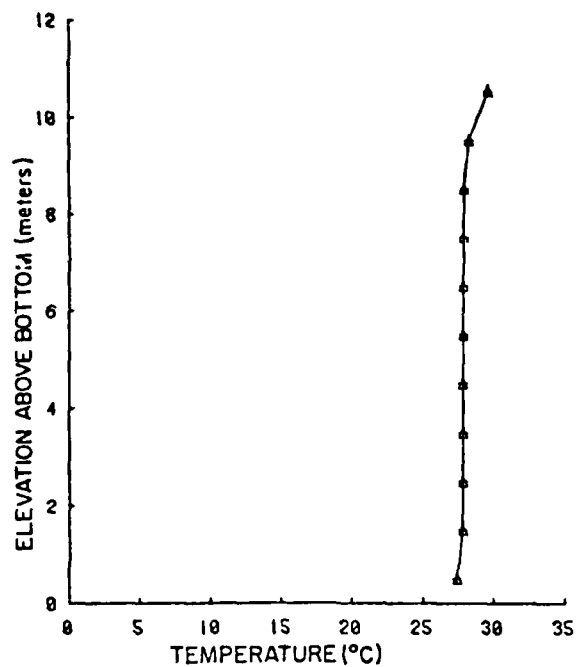
Pool # 2 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure 1-18

Post-Project Pool No. 2 Quality for 80% Exceedance Flow Condition



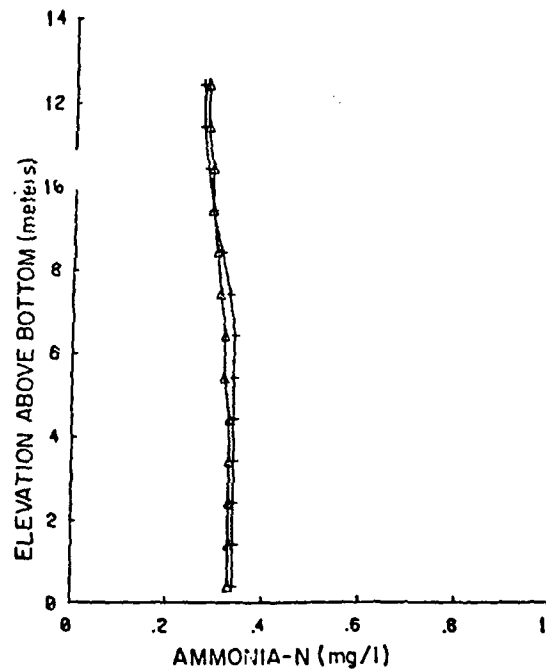
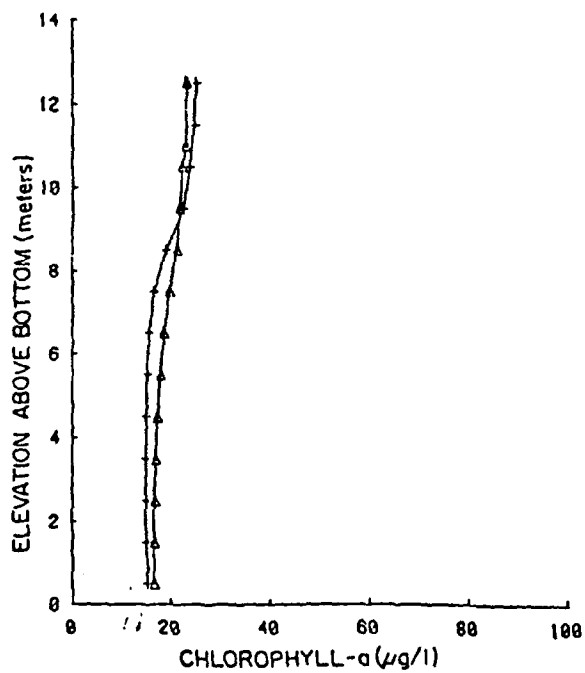
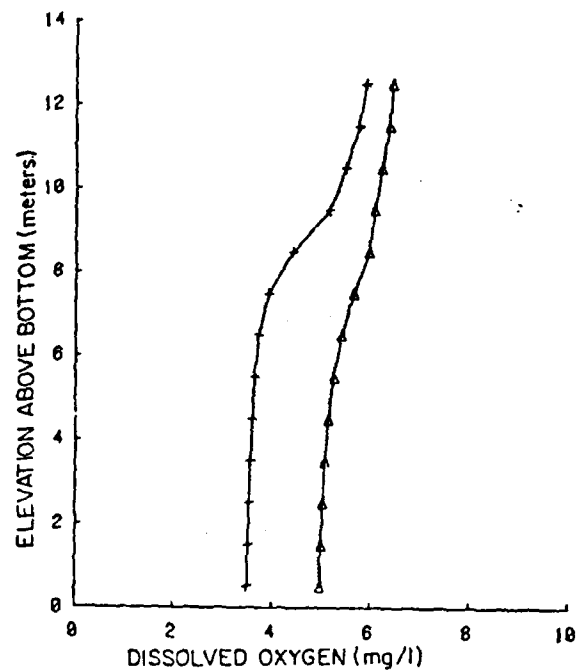
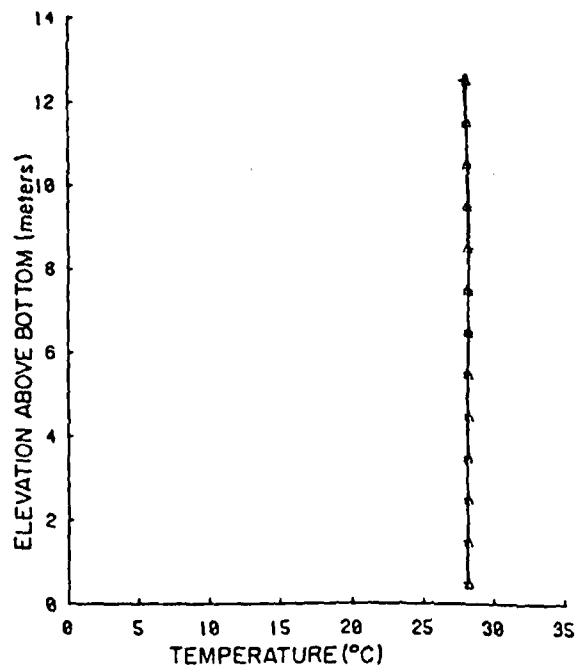
Pool # 2 at 6:00 P.M.

▲ High Diffusion

✦ Low Diffusion

Figure F-18 (Cont'd)

Post-Project Pool No. 2 Quality for 80% Exceedance Flow Condition



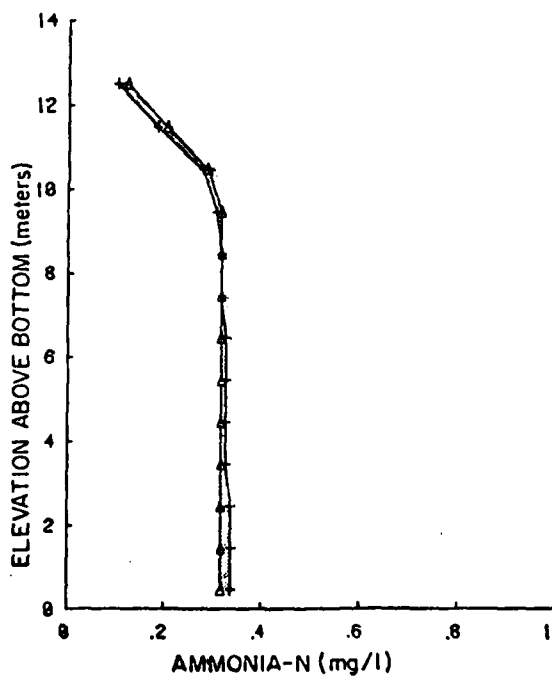
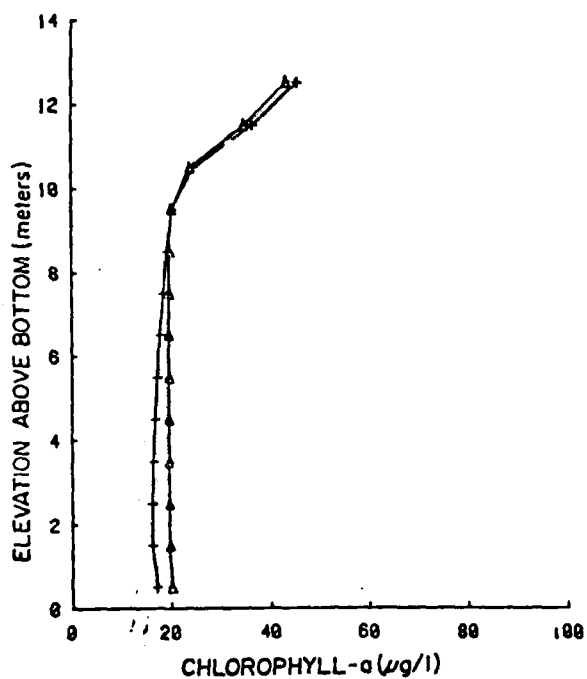
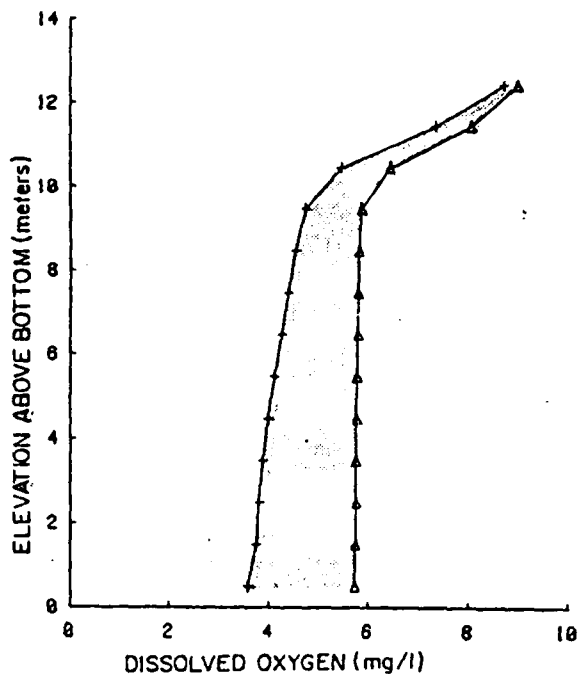
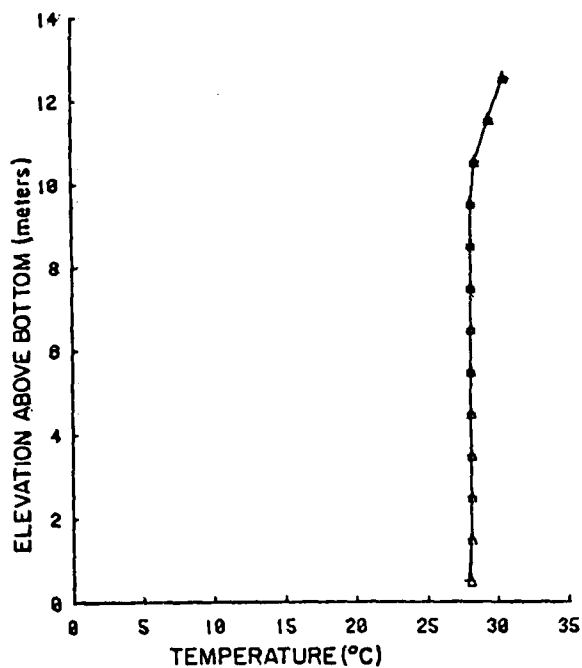
Pool # 3 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-19

Post-Project Pool No. 3 Quality for 80% Exceedance Flow Condition

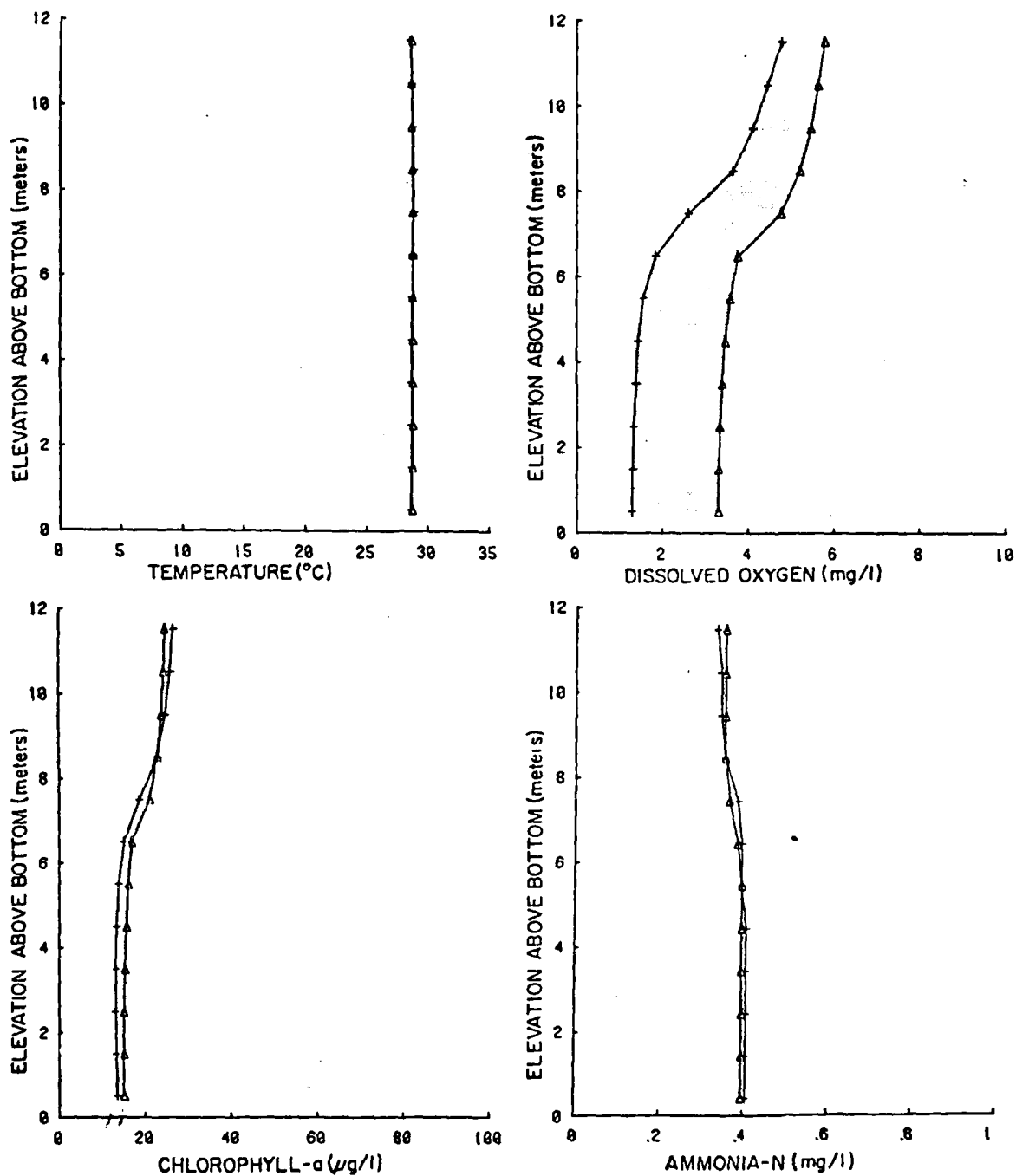


Pool # 3 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-19 (Cont'd)
Post-Project Pool No. 3 Quality for 80% Exceedance Flow Condition

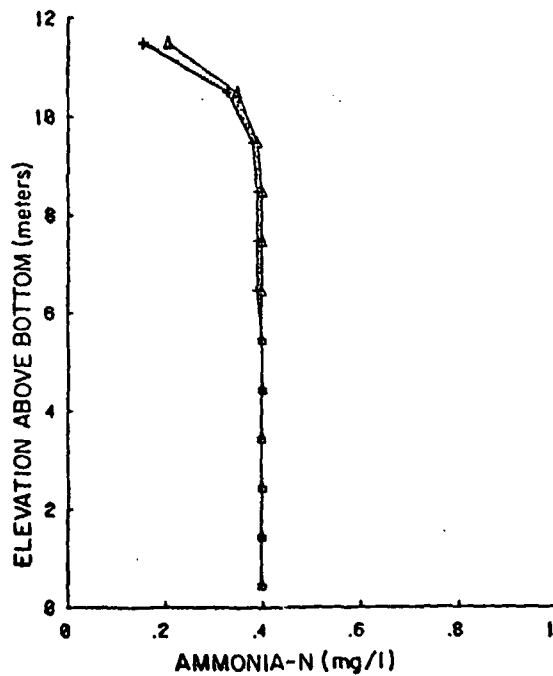
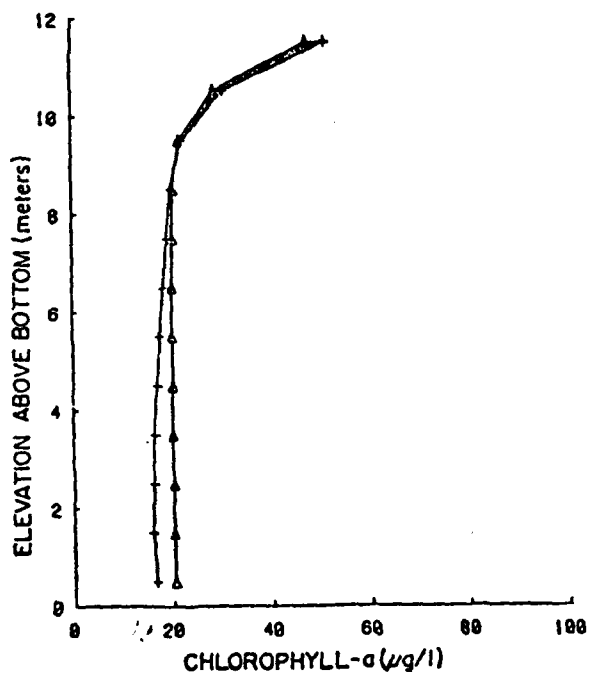
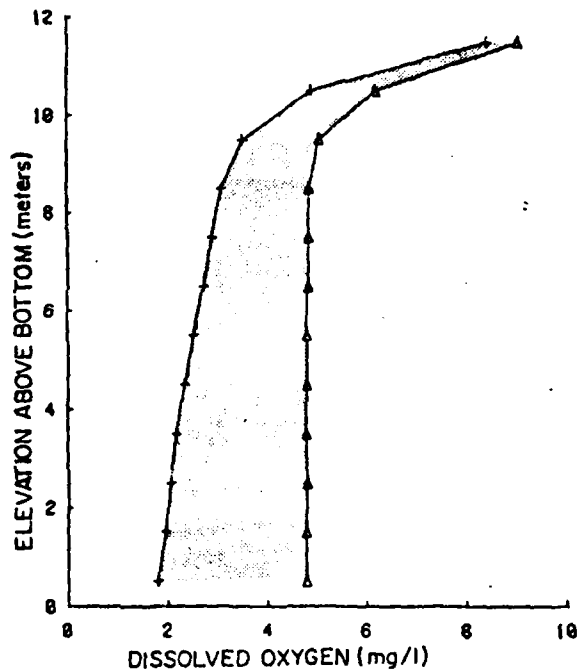
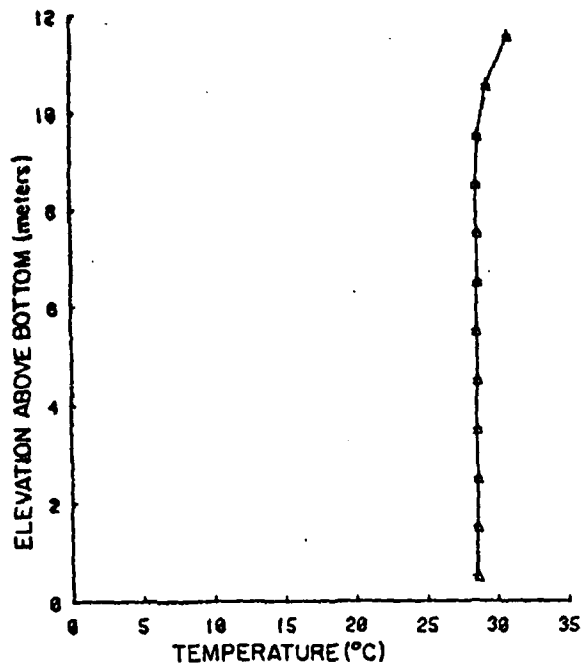


Pool # 4 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-20
Post-Project Pool No. 4 Quality for 80% Exceedance Flow Condition

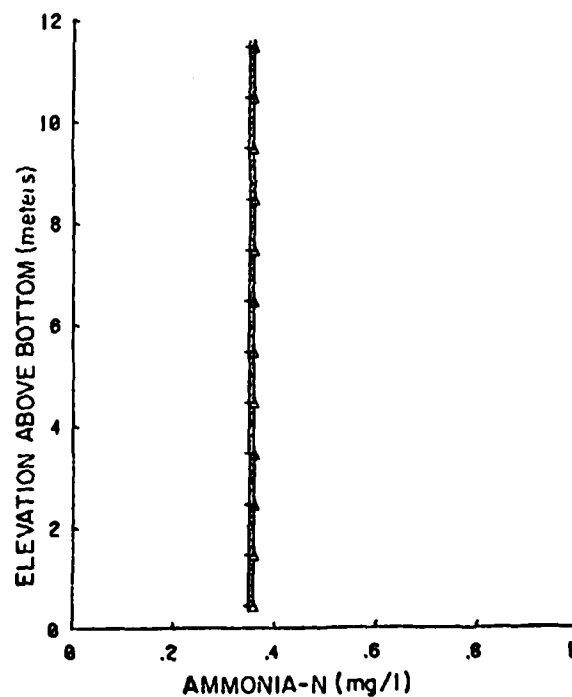
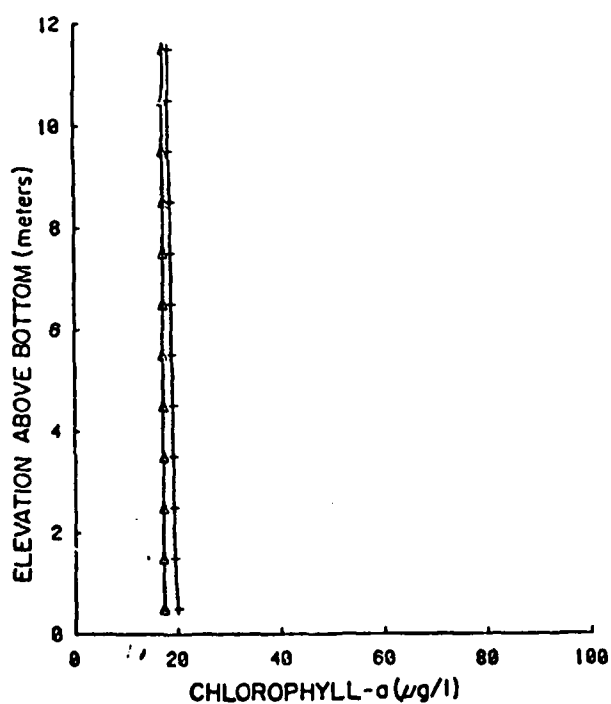
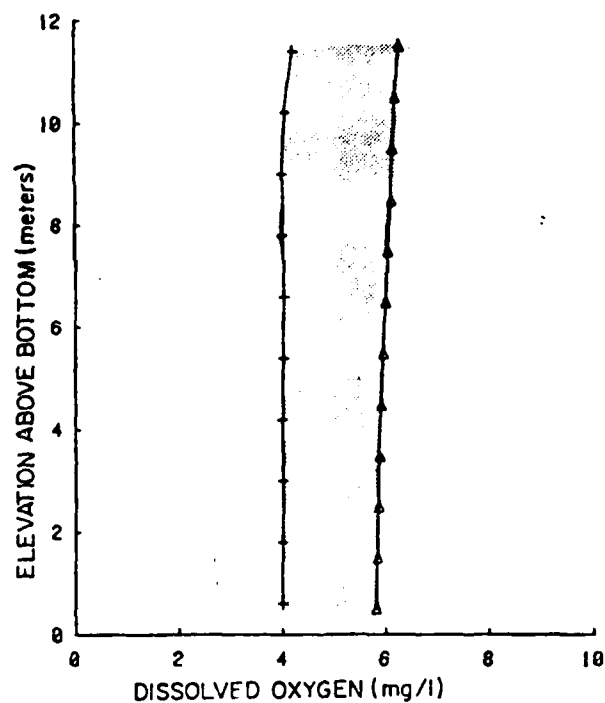
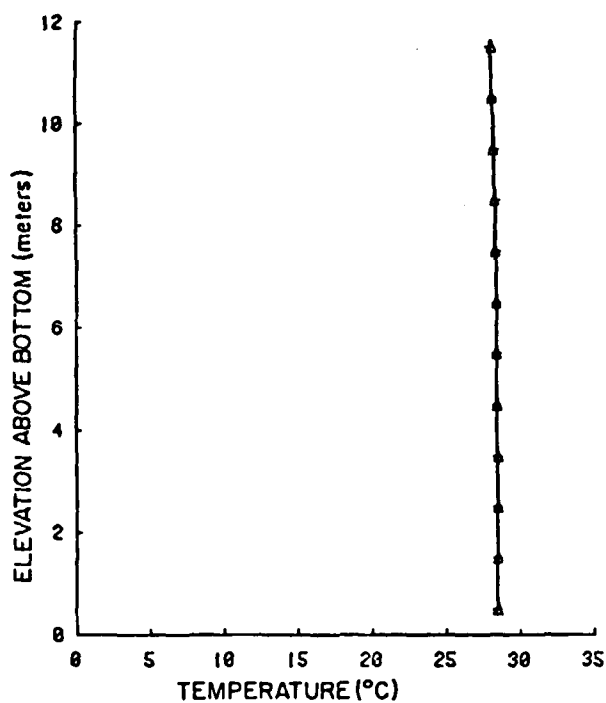


Pool # 4 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-20 (Cont'd)
Post-Project Pool No. 4 Quality for 80% Exceedance Flow Condition

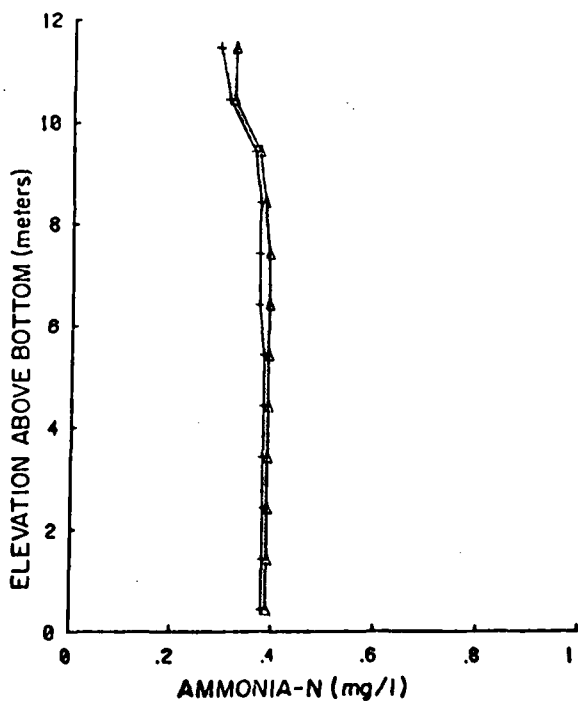
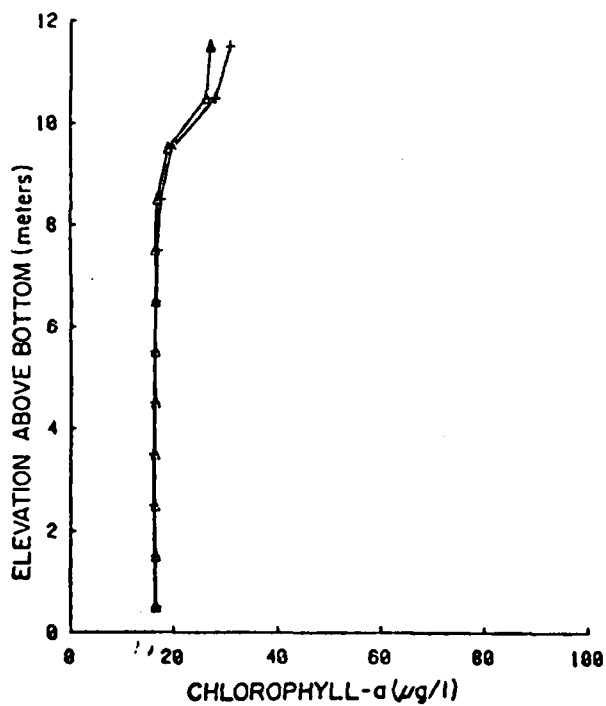
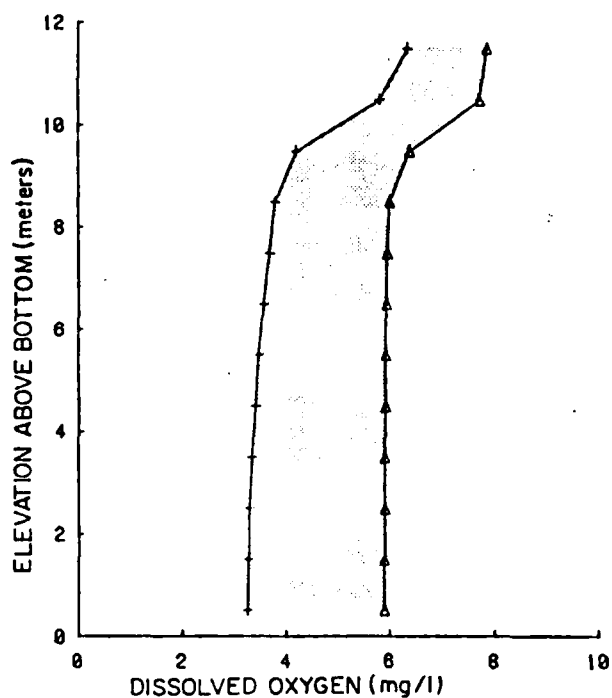
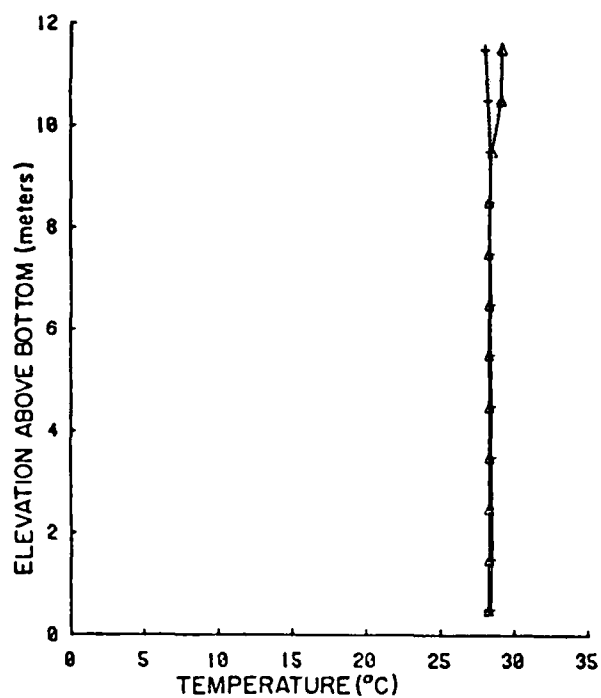


Pool # 5 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-21
Post-Project Pool No. 5 Quality for 80% Exceedance Flow Condition



Pool # 5 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-21 (Cont'd)

Post-Project Pool No. 5 Quality for 80% Exceedance Flow Condition

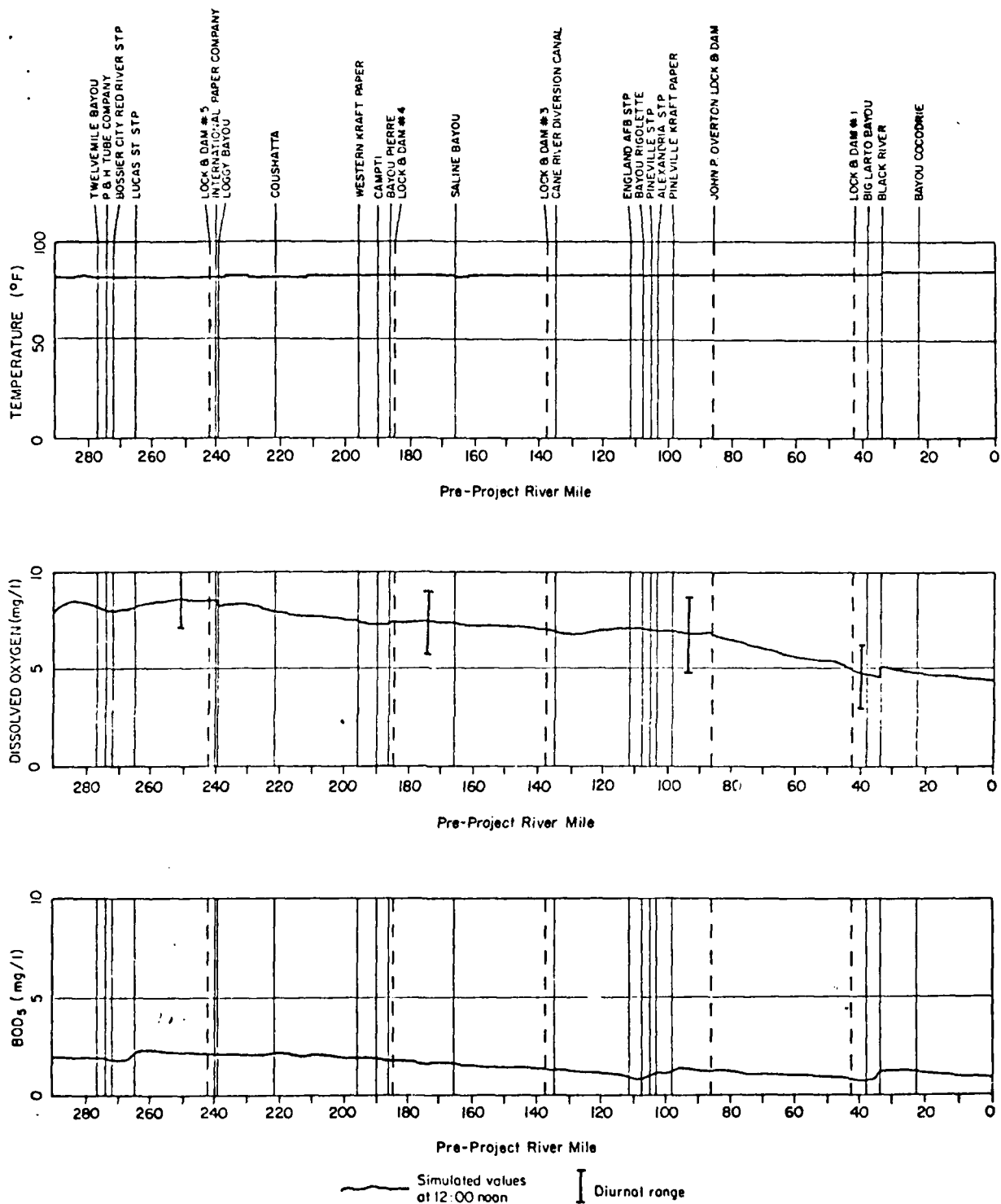
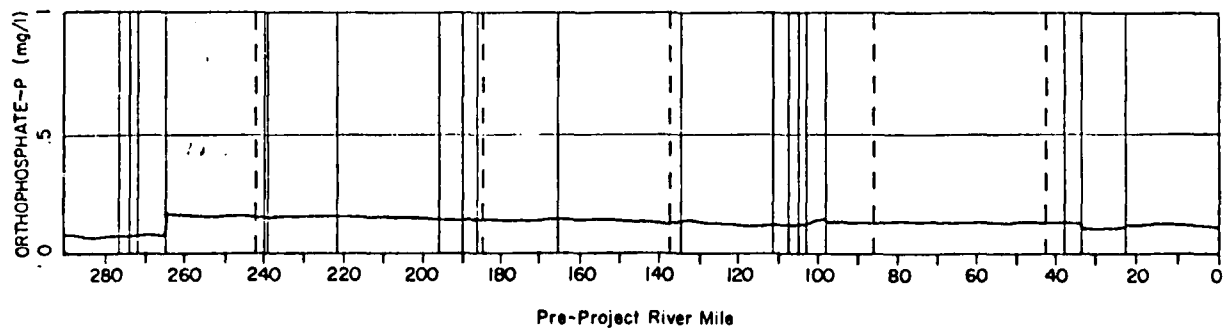
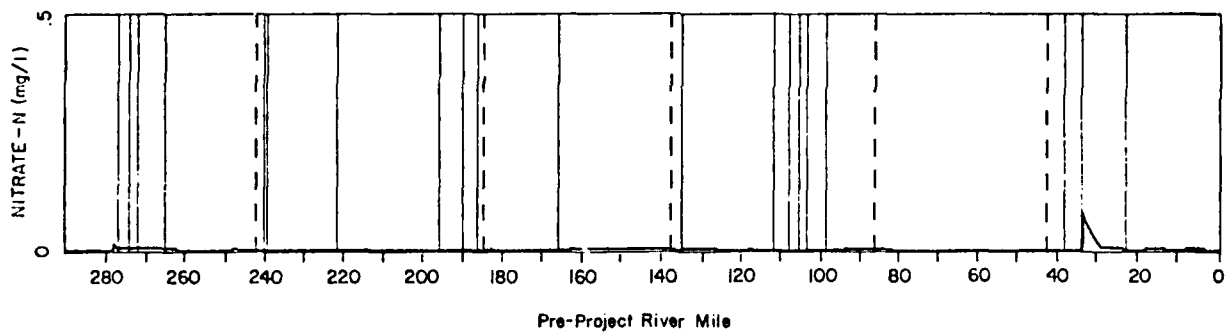
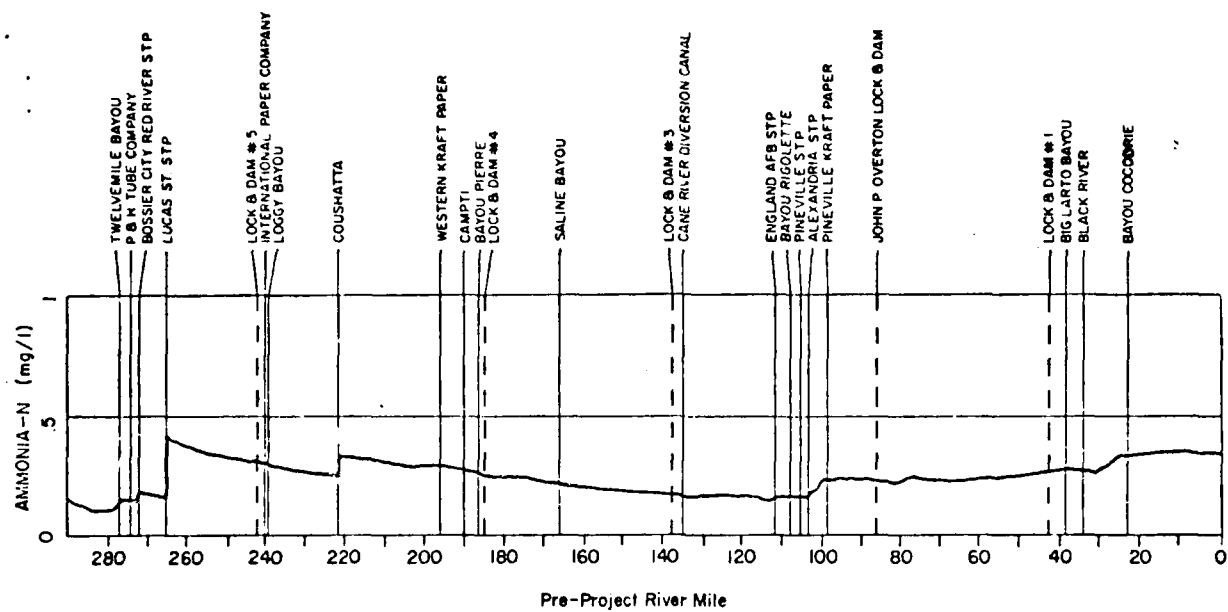


Figure F-22
 Systemwide Pre-Project Quality for 60Q10 Flow Condition



— Simulated values
at 12:00 noon

Figure F-22 (Cont'd)

Systemwide Pre-Project Quality for 60Q10 Flow Condition

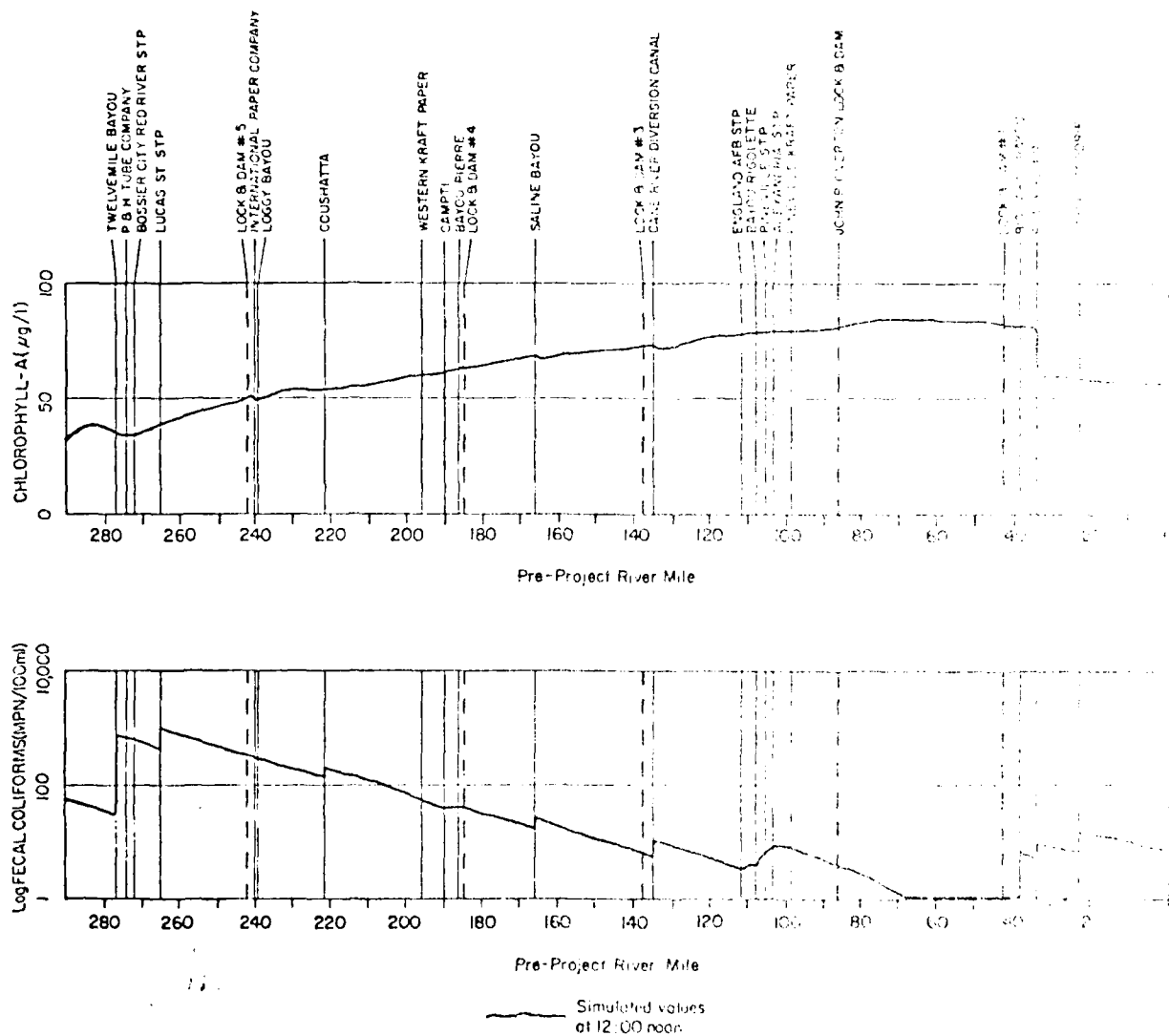
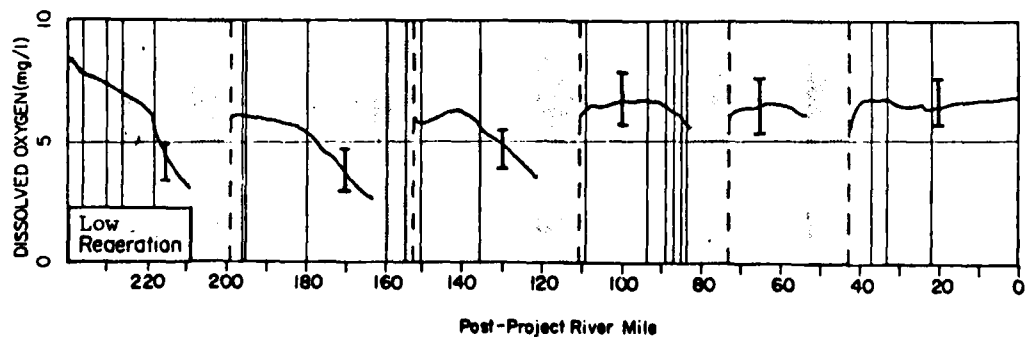
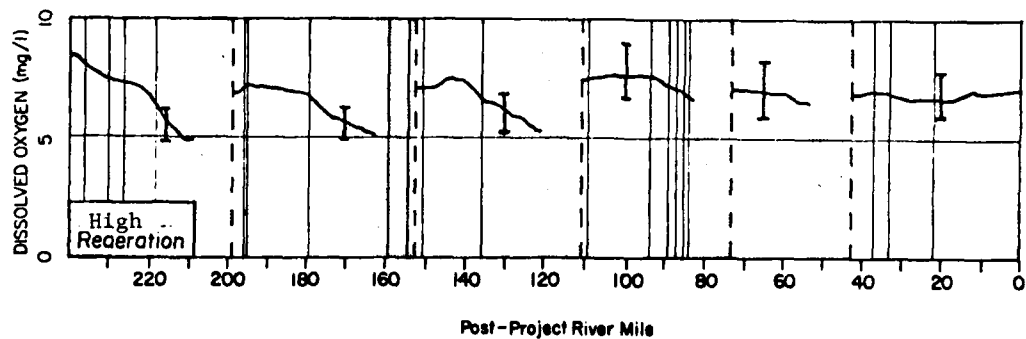
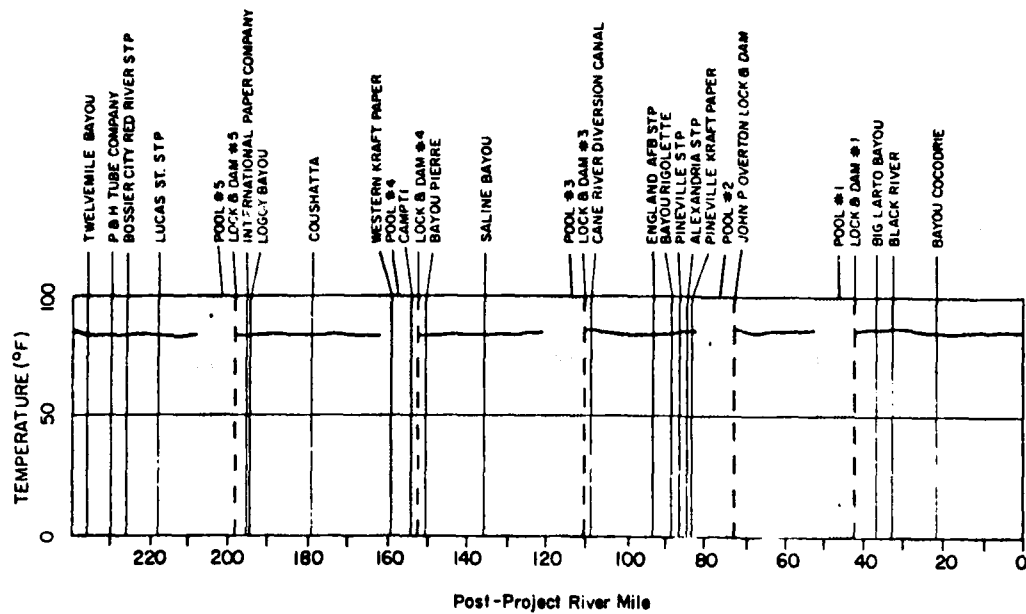


Figure F-22 (Cont'd)

Systemwide Pre-Project Quality for 60Q10 Flow Condition



Simulated values at 12:00 noon
 Diurnal range
 Pool

Figure F-23
 Systemwide Post-Project Quality for 60Q10 Flow Condition

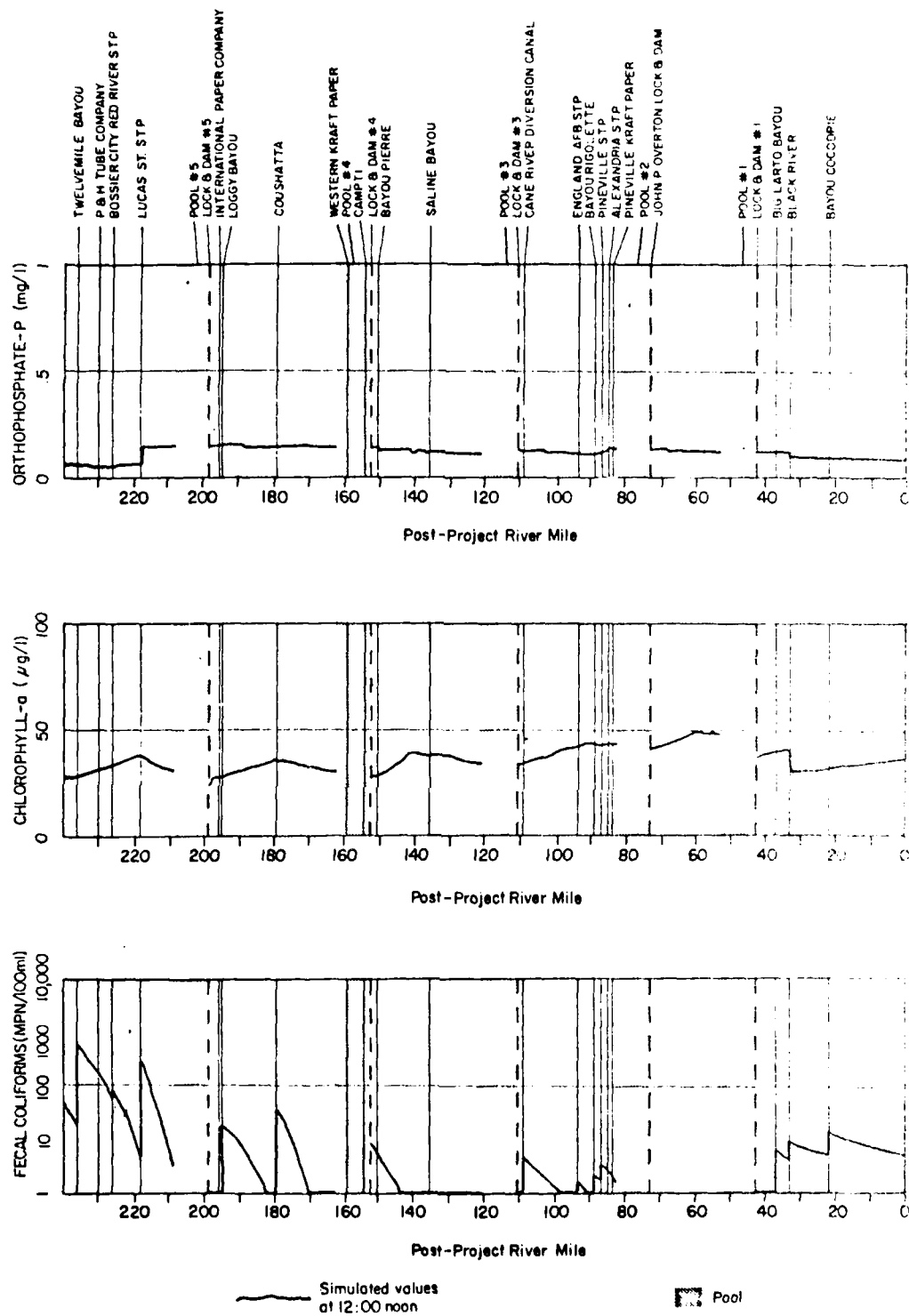


Figure F-23 (Cont'd)

Systemwide Post-Project Quality for 60Q10 Flow Condition

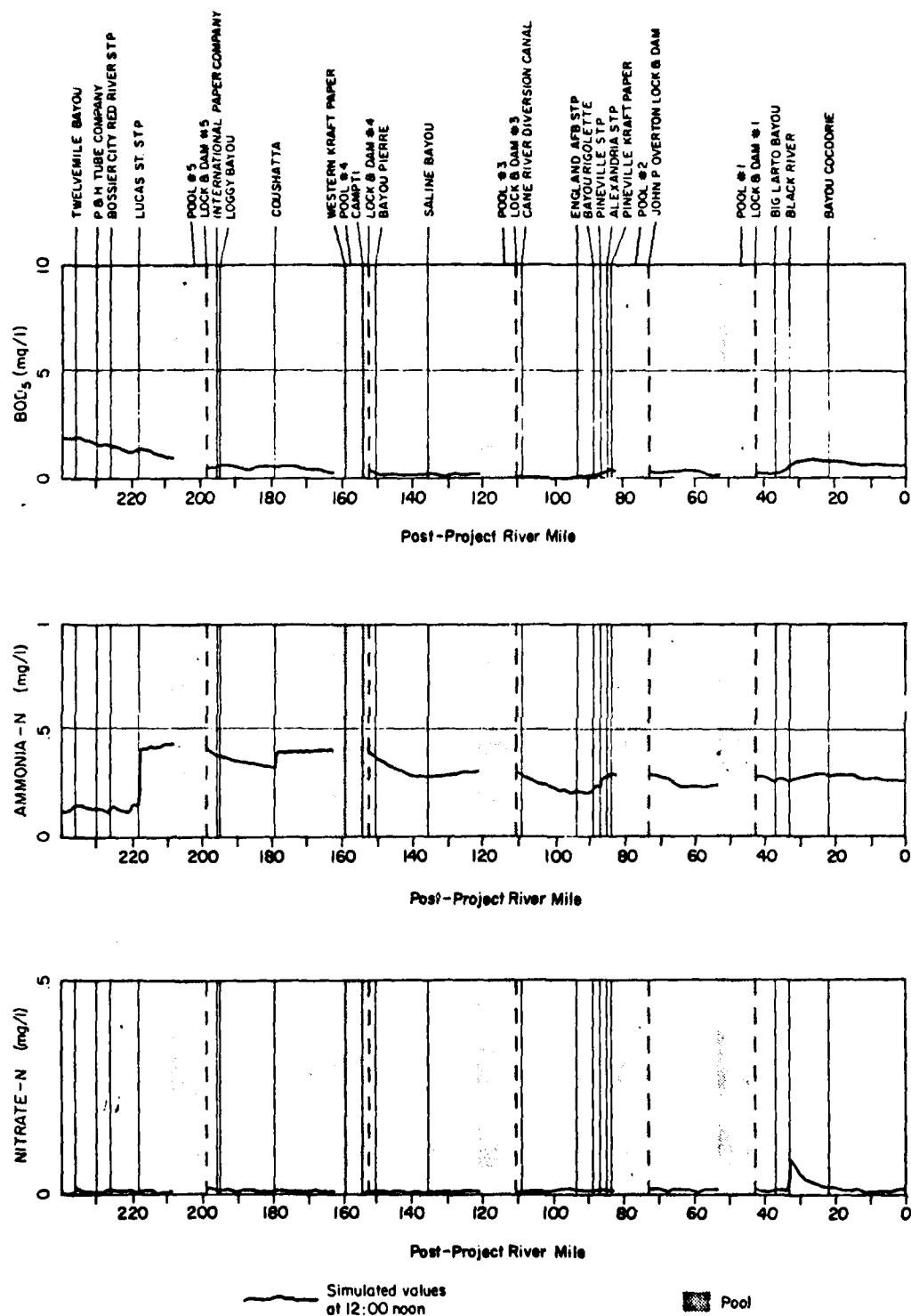
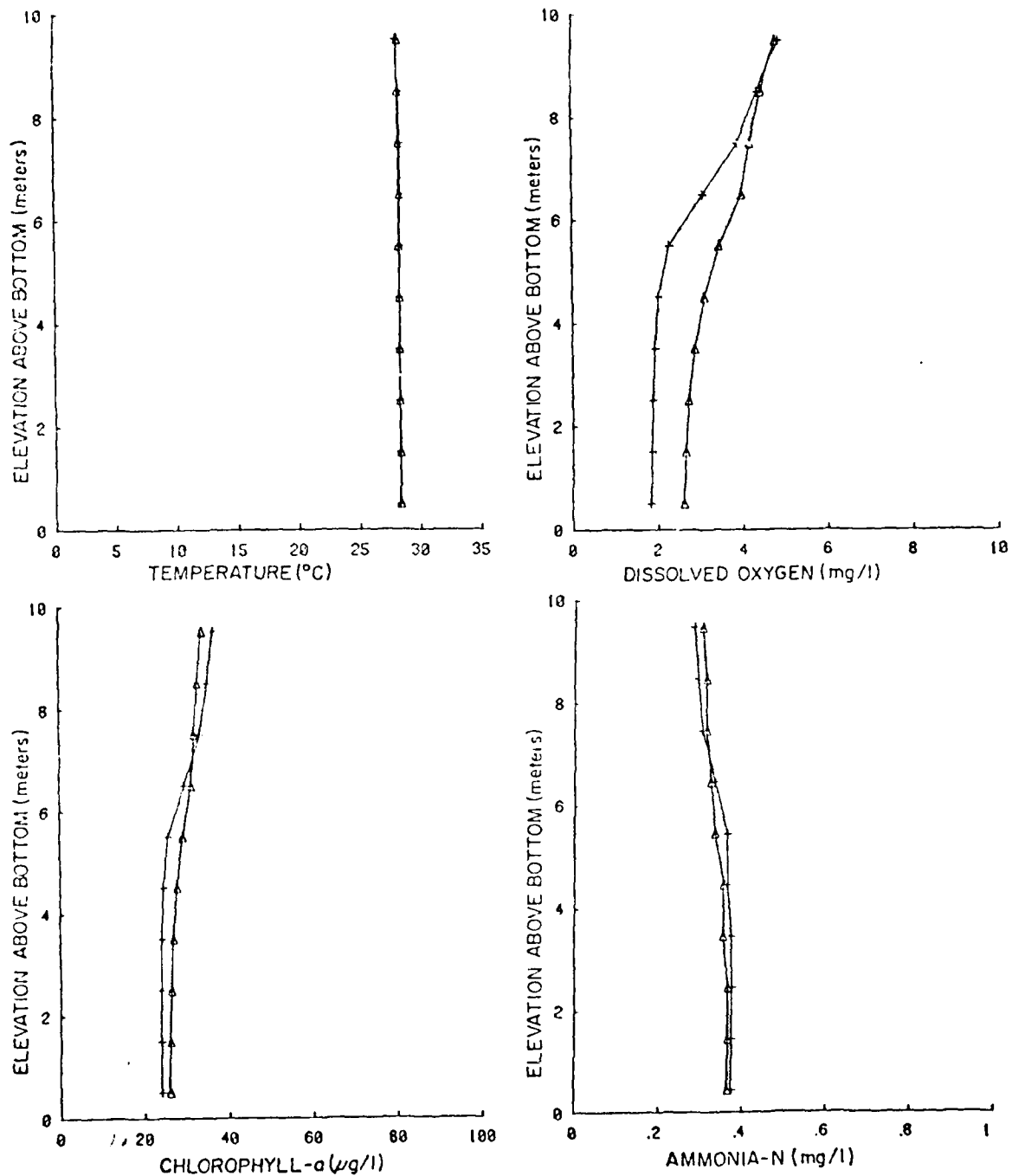


Figure F-23 (Cont'd)

Systemwide Post-Project Quality for 60Q10 Flow Condition

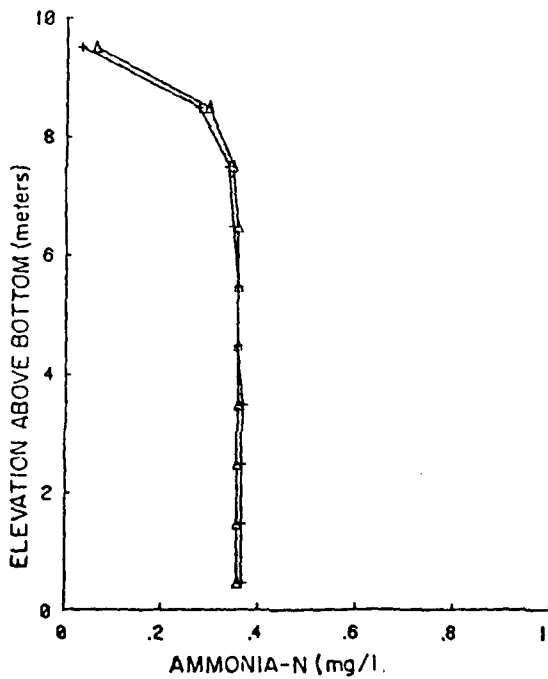
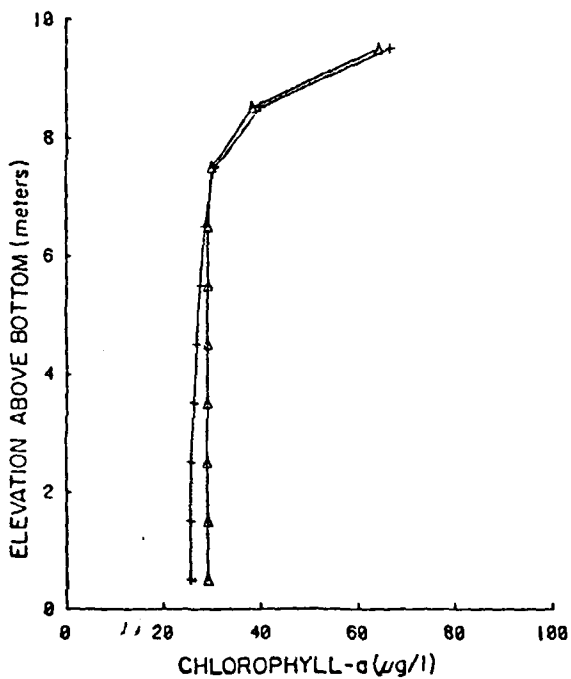
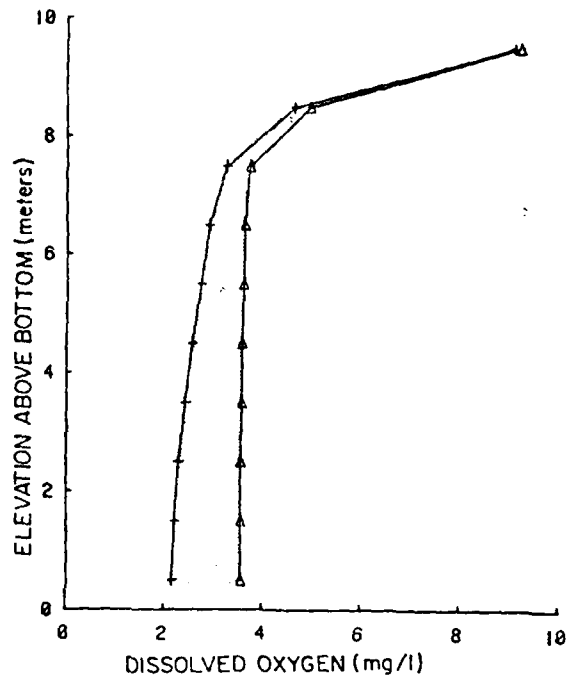
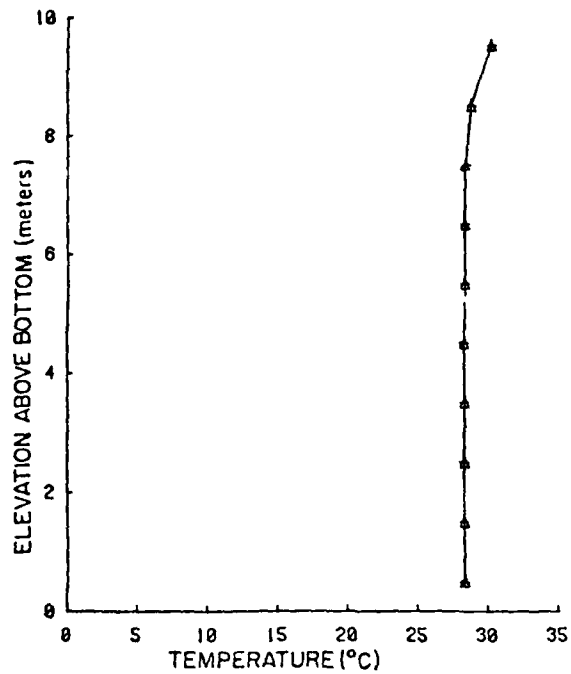


Pool #1 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

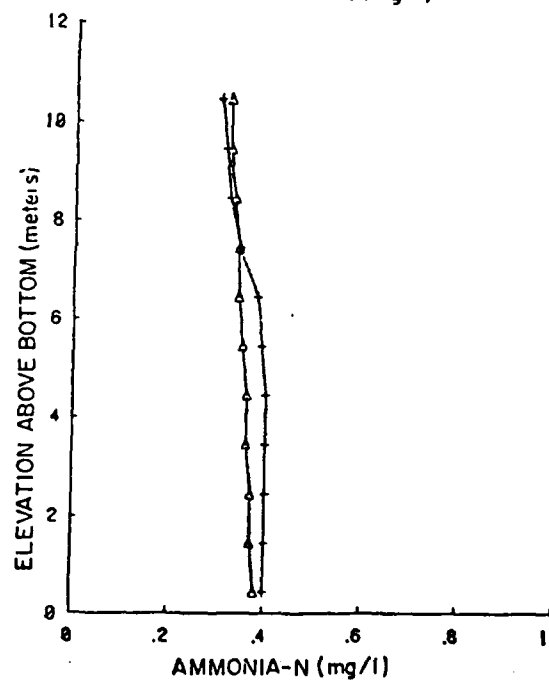
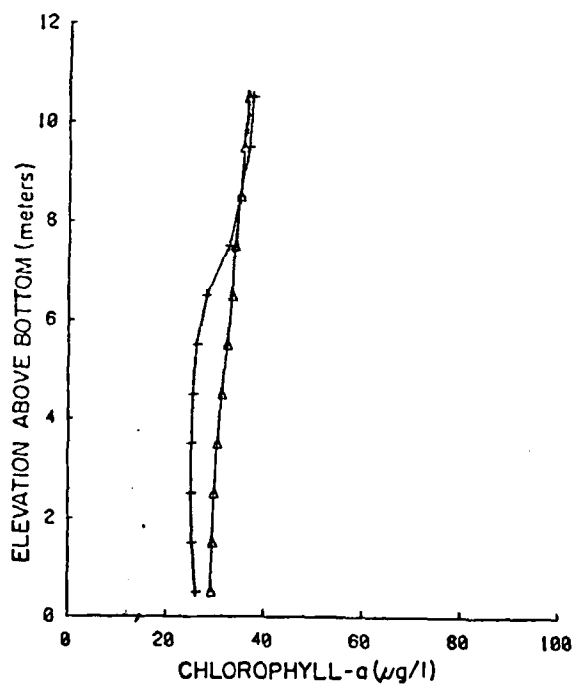
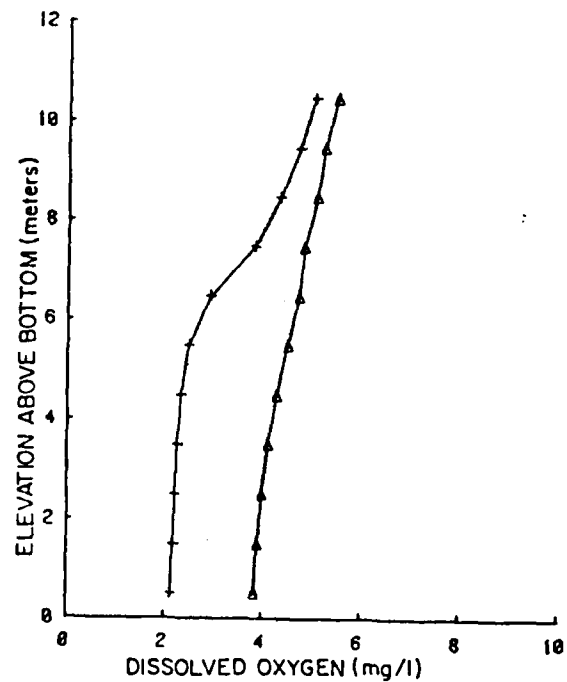
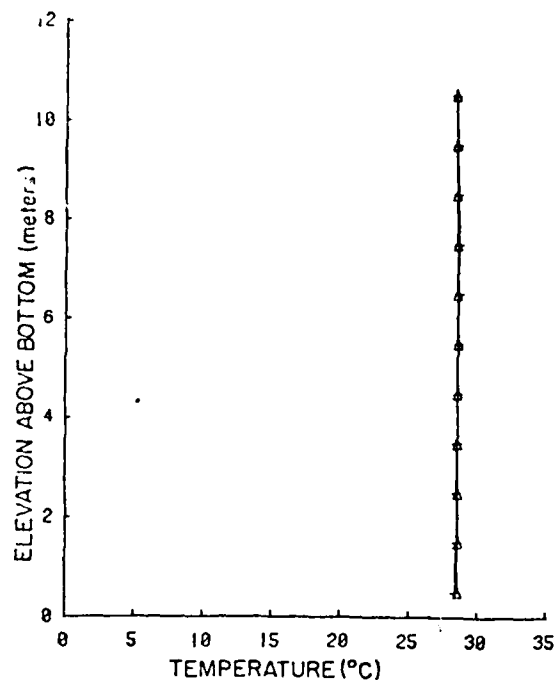
Figure F-24
Post-Project Pool No. 1 Quality for 60Q10 Flow Condition



Pool #1 at 6:00 P.M.

▲ High Diffusion
+ Low Diffusion

Figure F-24 (Cont'd)
Post-Project Pool No. 1 Quality for 60Q10 Flow Condition

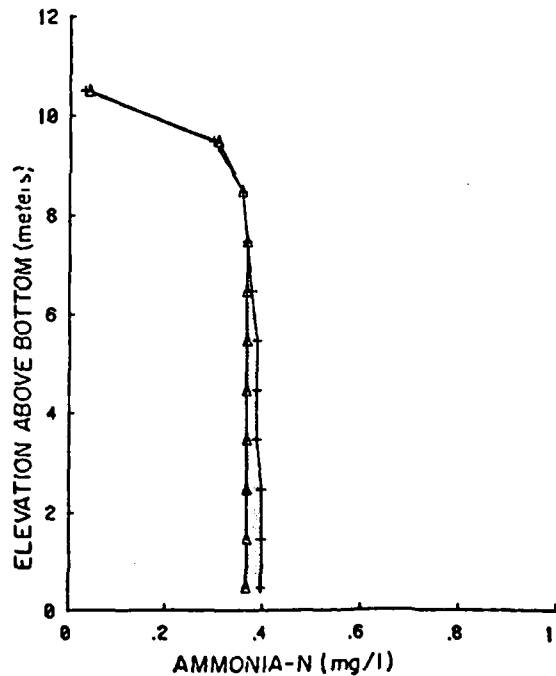
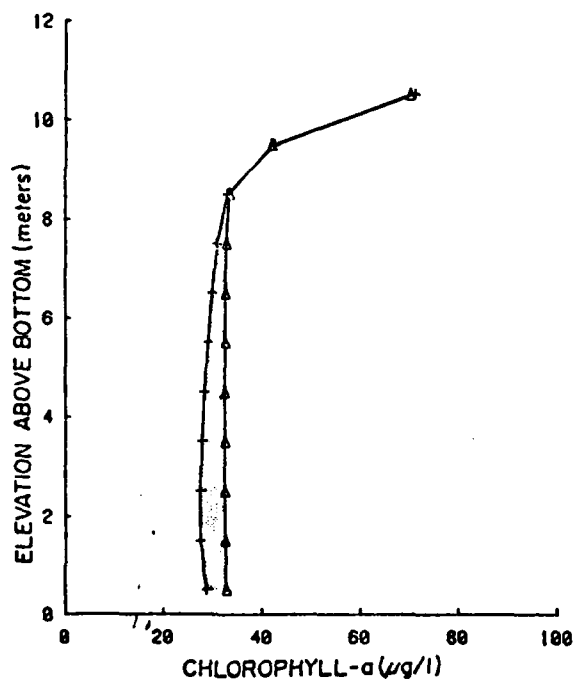
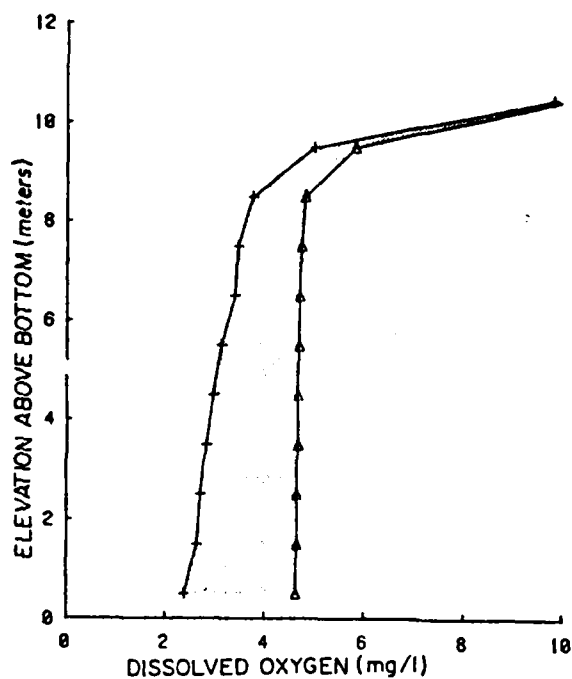
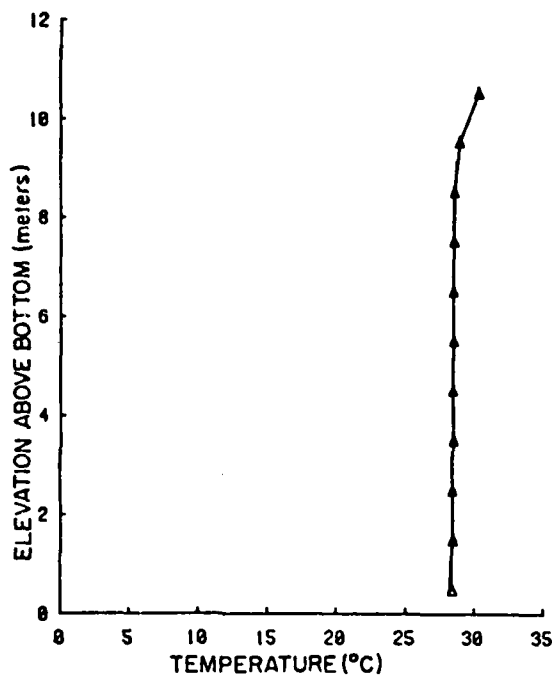


Pool # 2 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-25
Post-Project Pool No. 2 Quality for 60Q10 Flow Condition

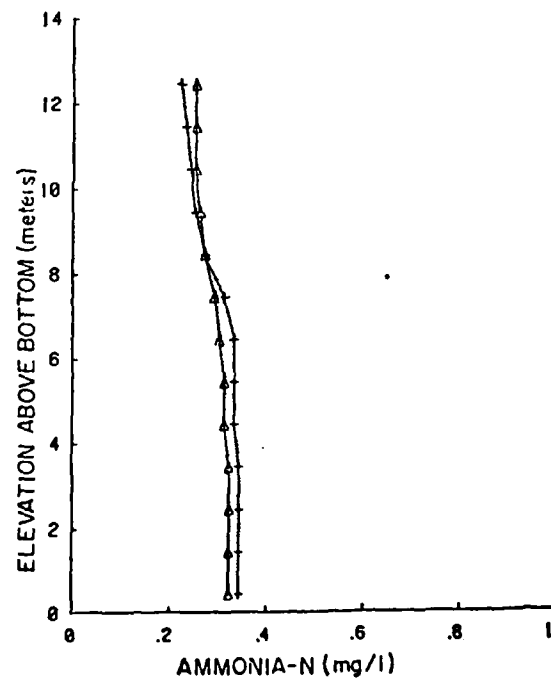
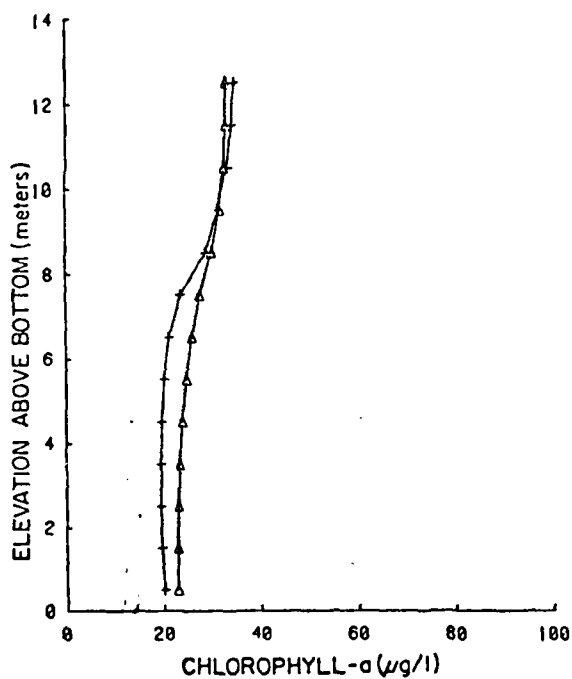
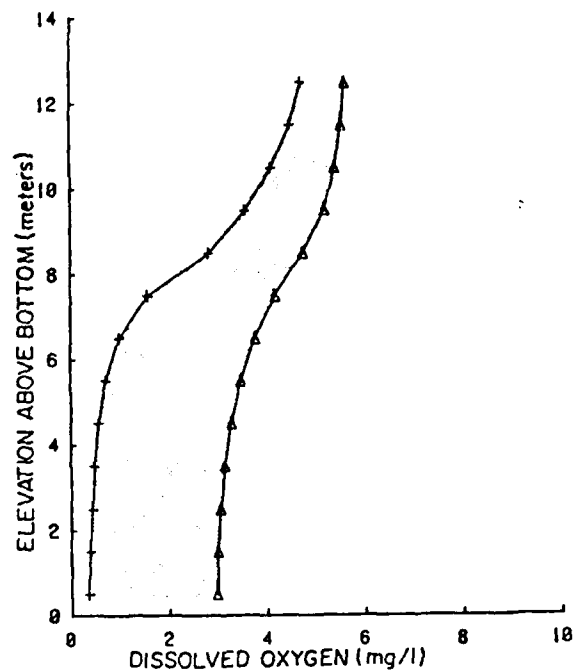
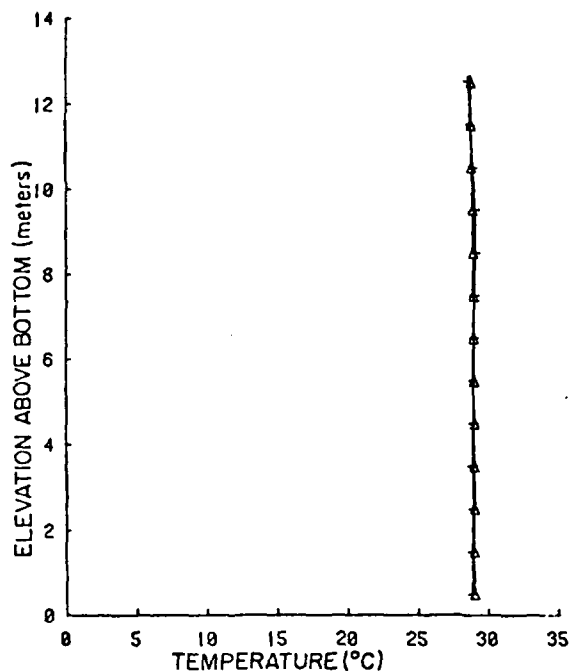


Pool # 2 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-25 (Cont'd)
Post-Project Pool No. 2 Quality for 60Q10 Flow Condition

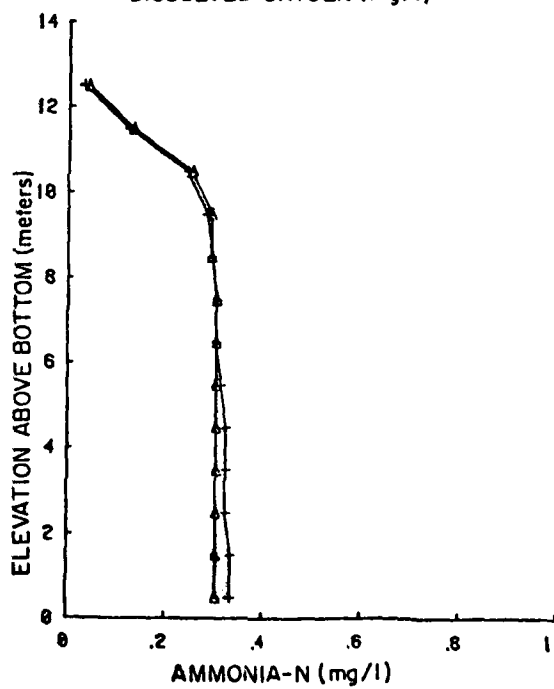
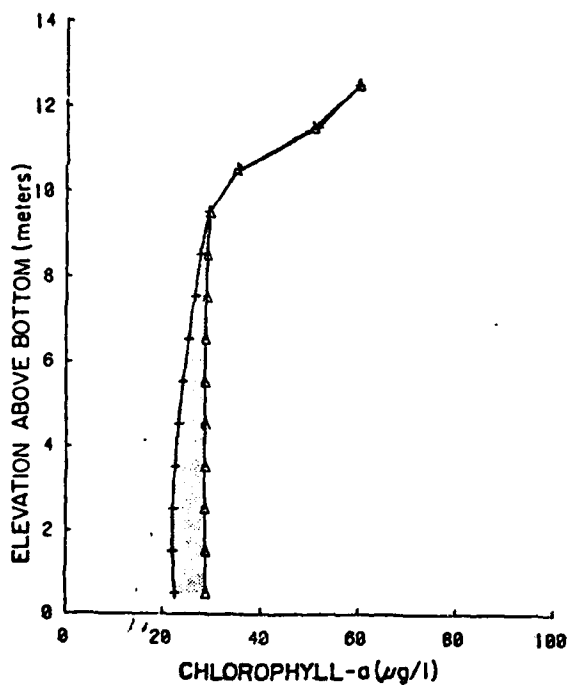
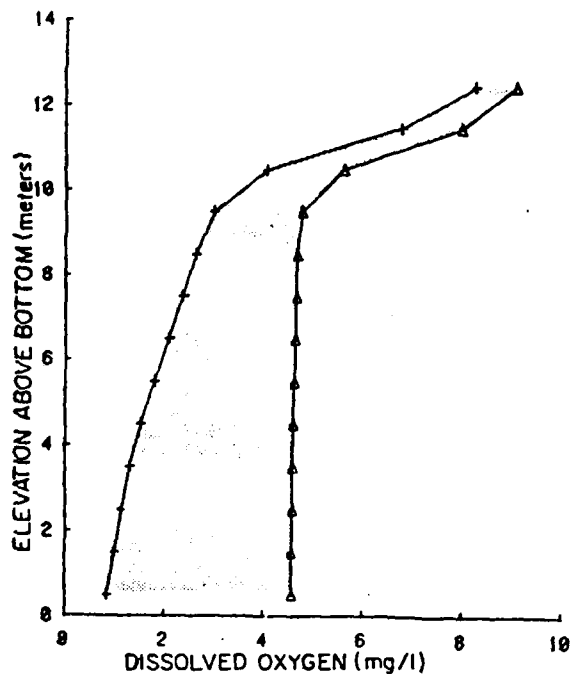
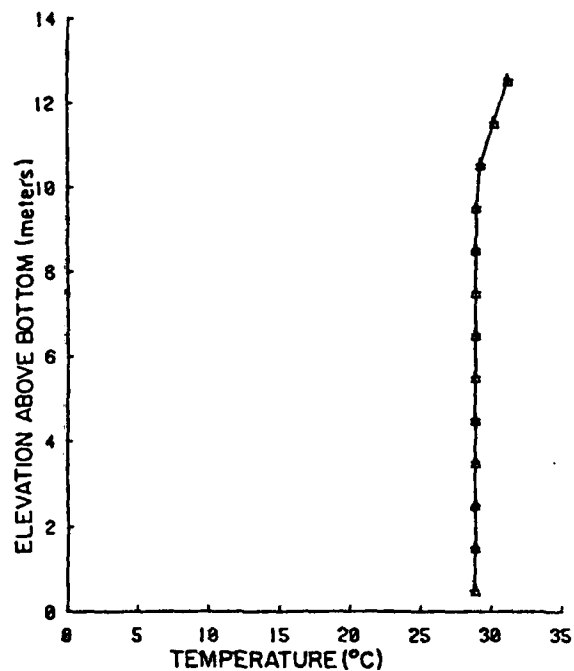


Pool # 3 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-26
Post-Project Pool No. 3 Quality for 60Q10 Flow Condition

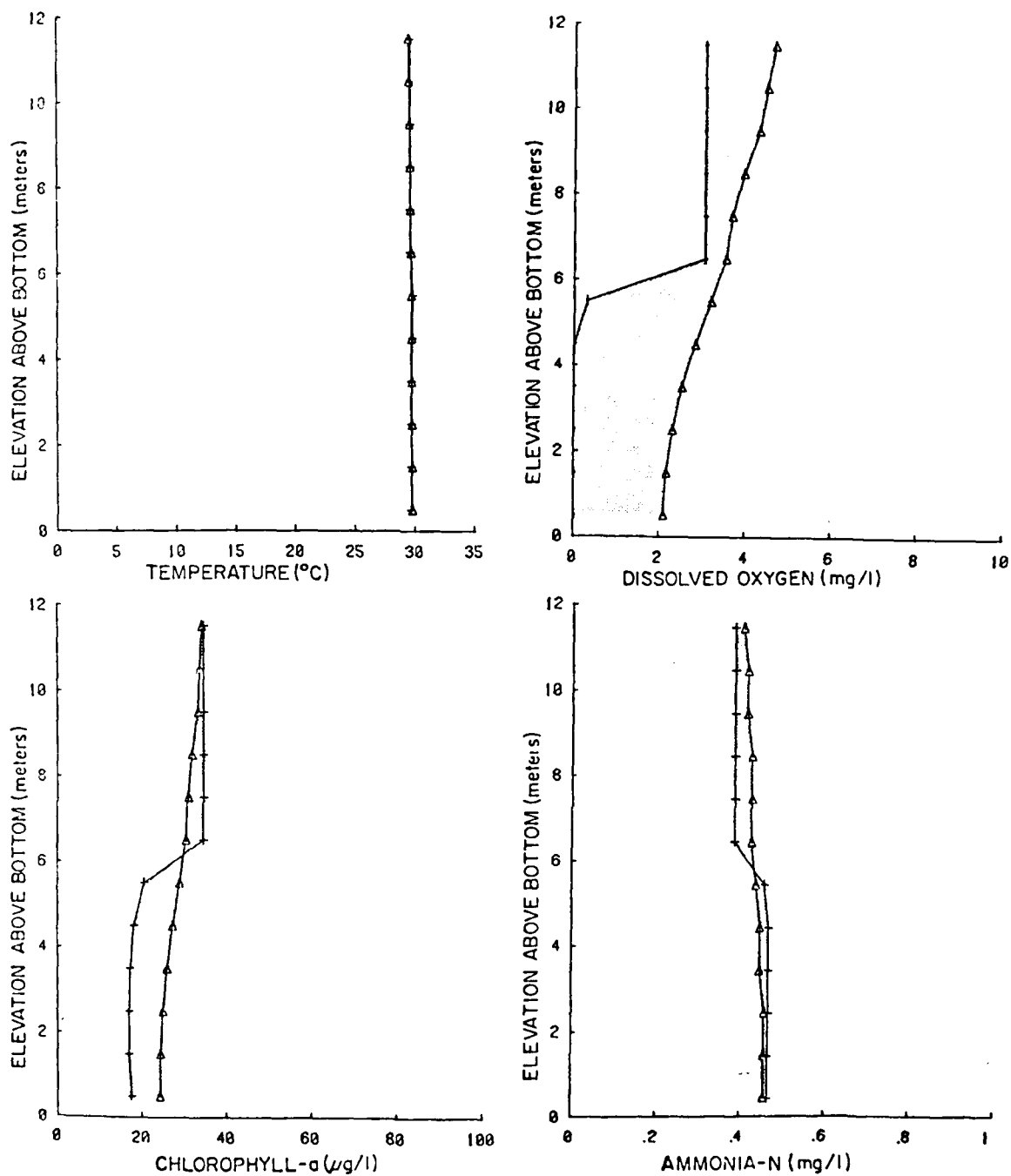


Pool # 3 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-26 (Cont'd)
Post-Project Pool No. 3 Quality for 60Q10 Flow Condition

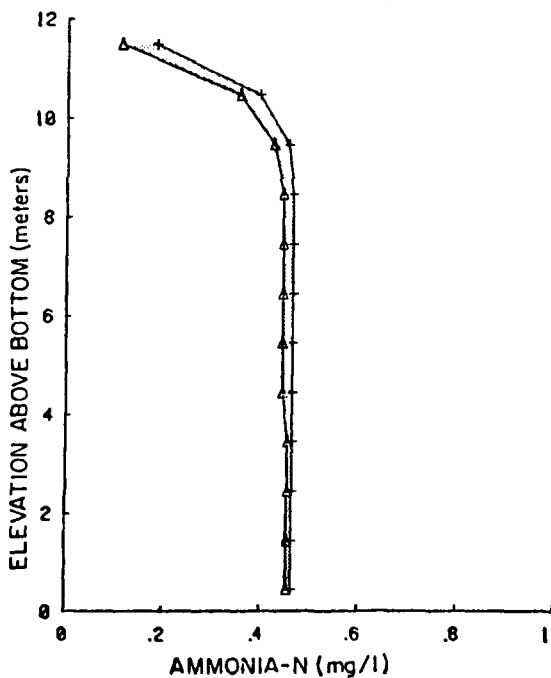
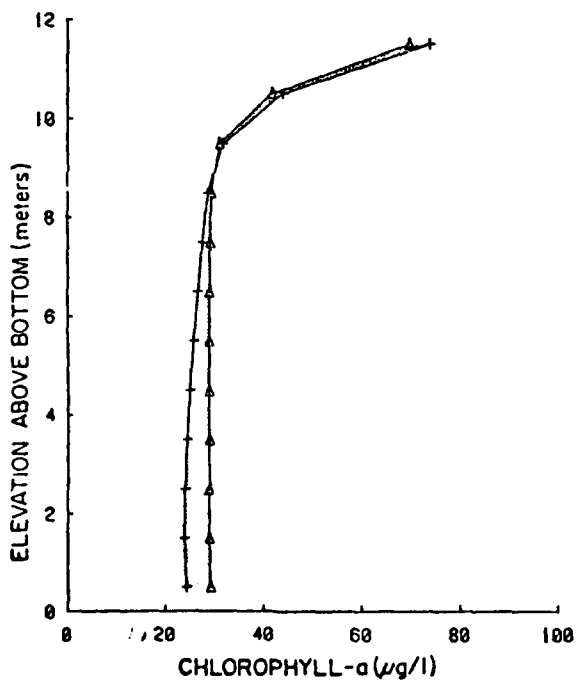
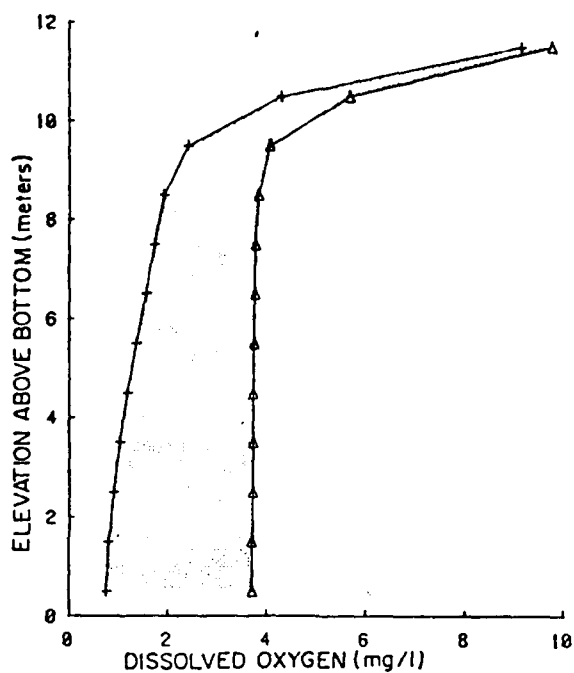
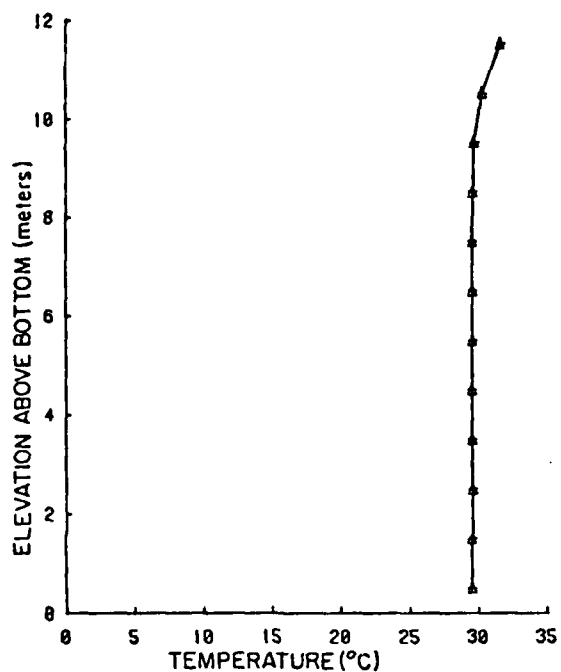


Pool # 4 at 6:00 A.M.

- ▲ High Diffusion - Kanwisher Reaeration
- + Low Diffusion - Banks Reaeration

Figure F-27

Post-Project Pool No. 4 Quality for 60Q10 Flow Condition

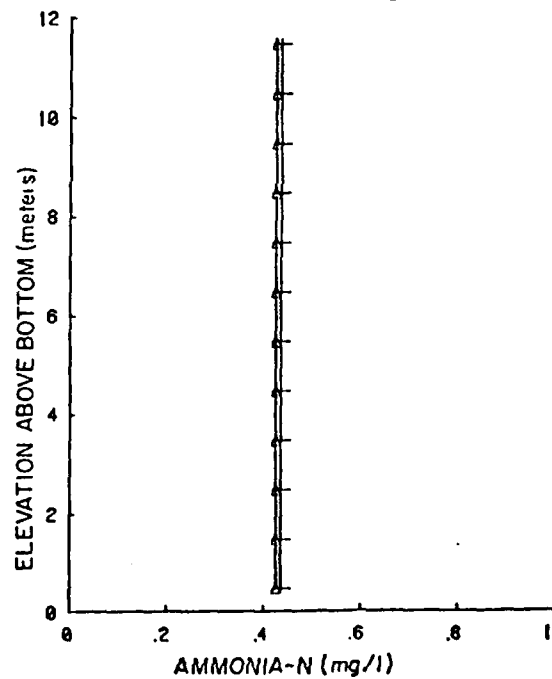
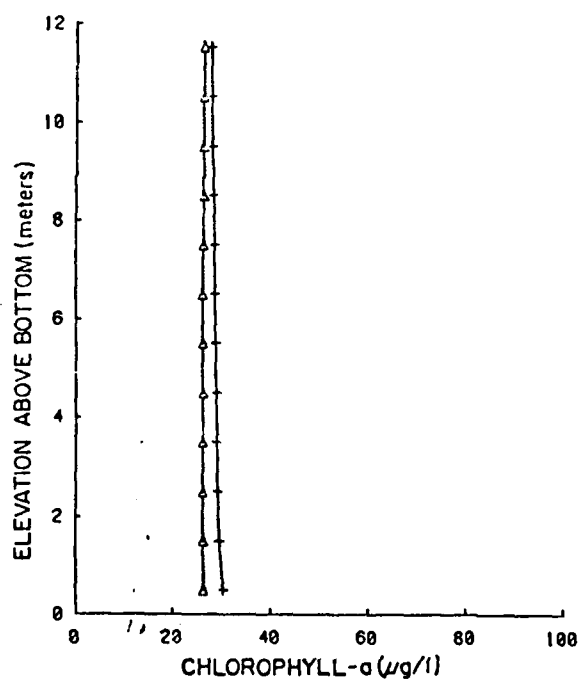
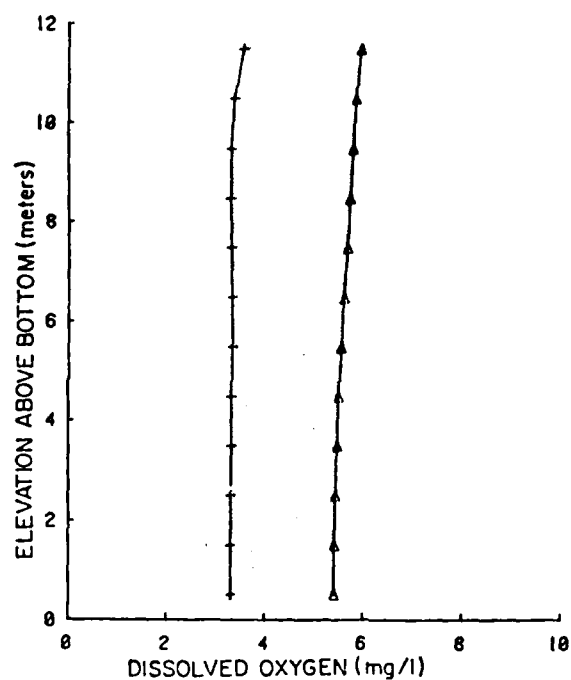
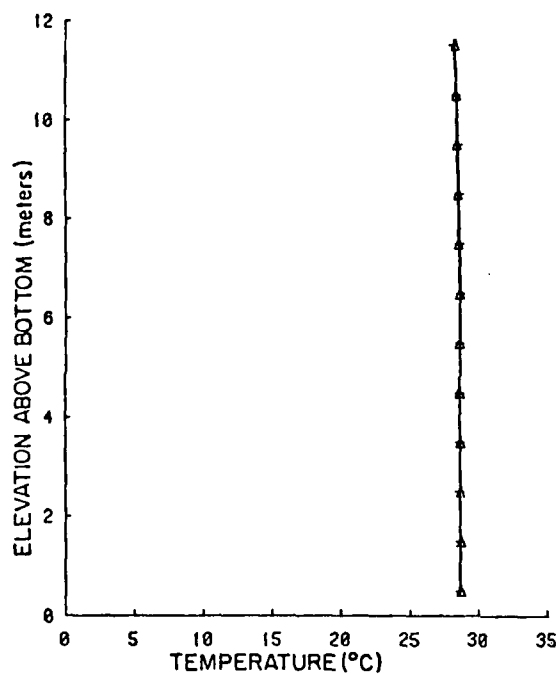


Pool # 4 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-27 (Cont'd)
Post-Project Pool No. 4 Quality for 60Q10 Flow Condition

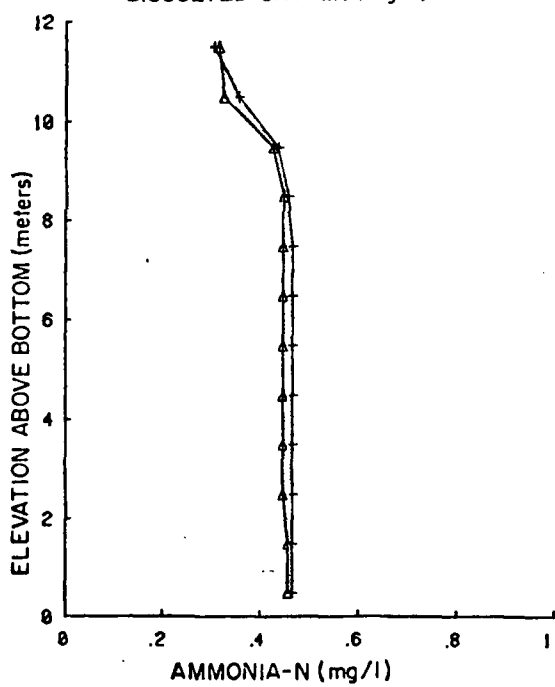
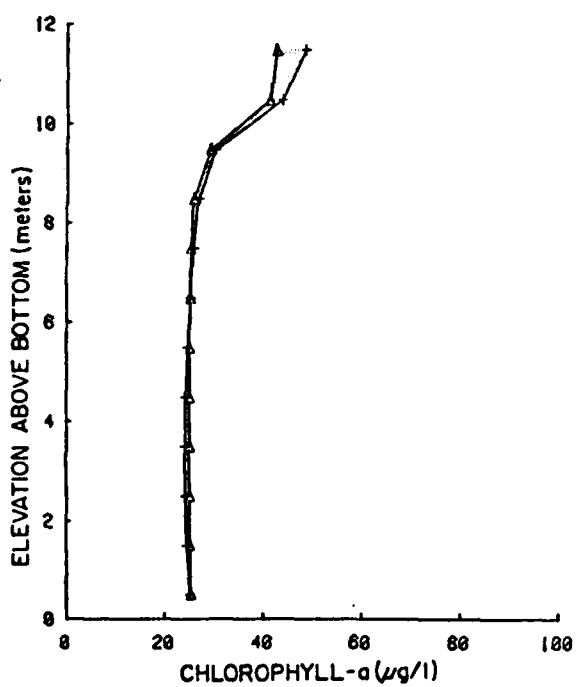
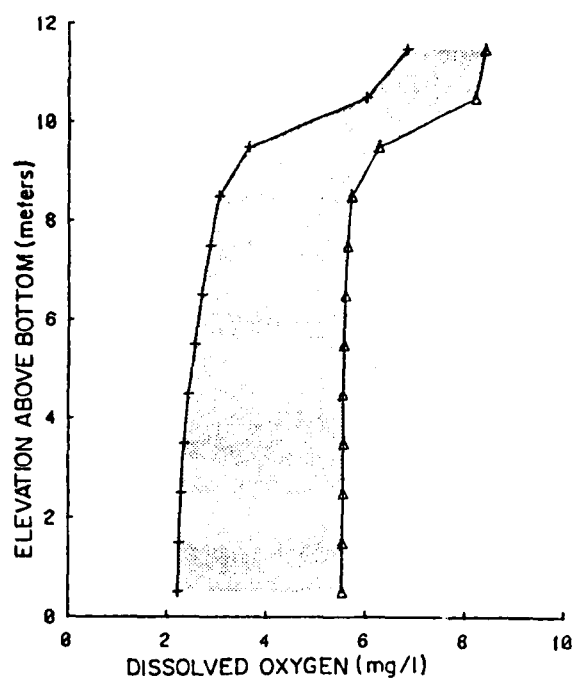
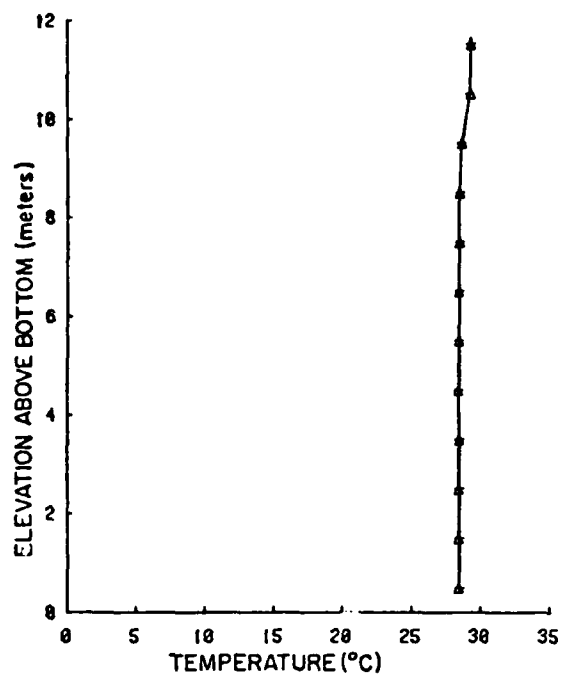


Pool # 5 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

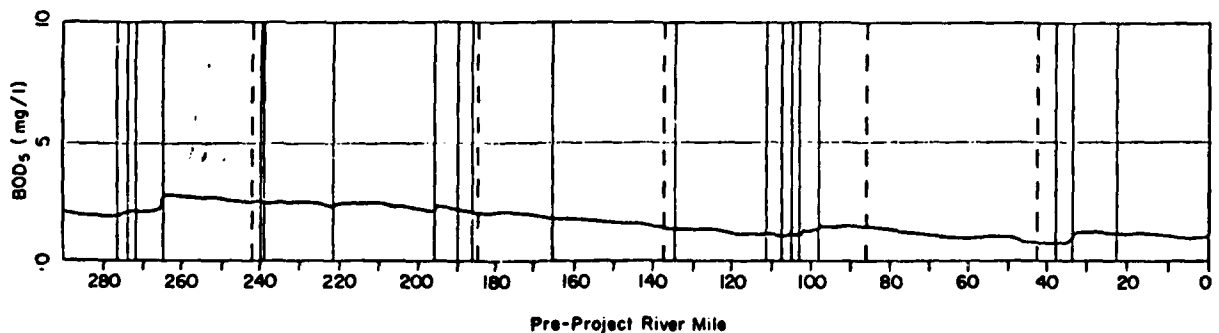
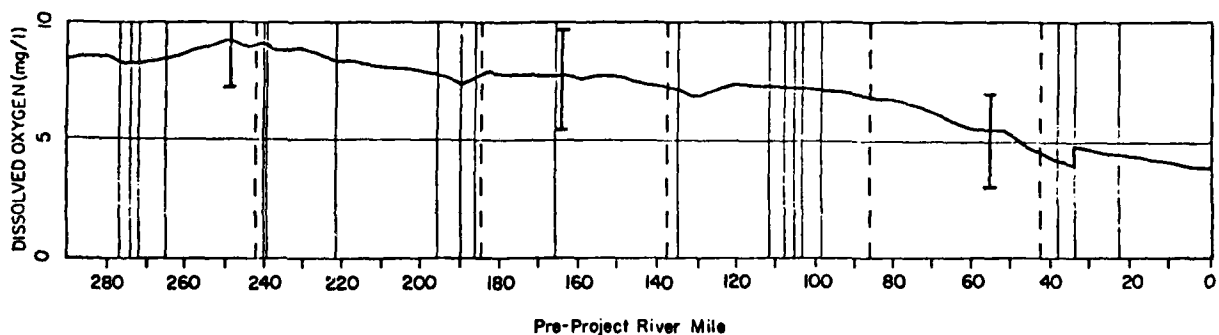
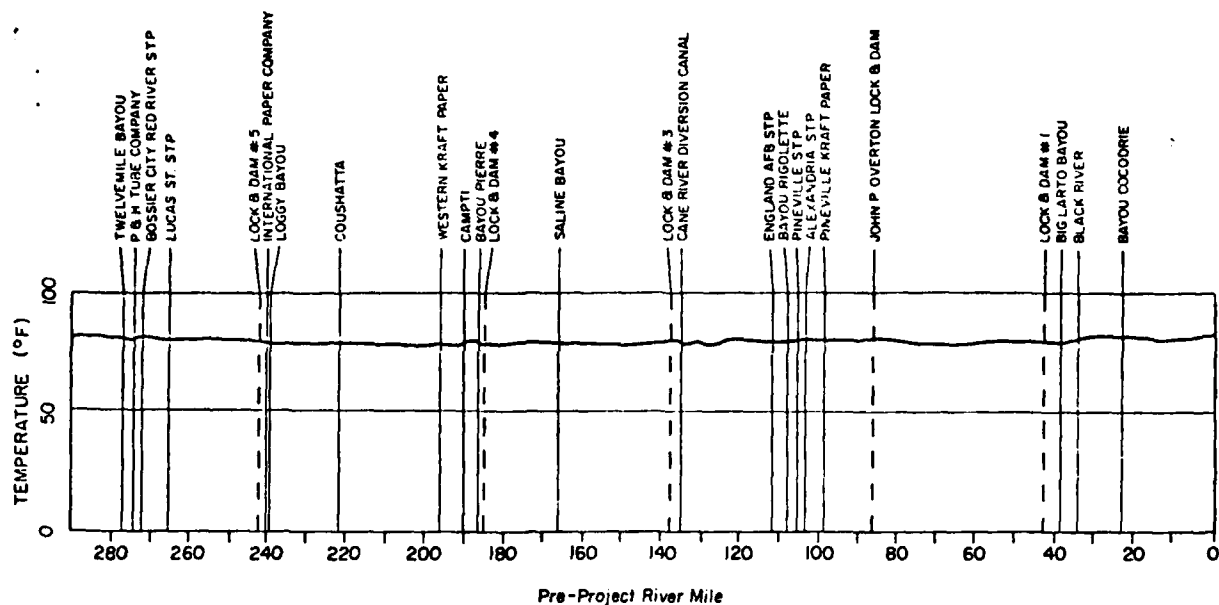
Figure F-28
Post-Project Pool No. 5 Quality for 60Q10 Flow Condition



Pool # 5 at 6:00 P.M.

- ▲ High Diffusion
- ♦ Low Diffusion

Figure F-28 (Cont'd)
Post-Project Pool No. 5 Quality for 60Q10 Flow Condition

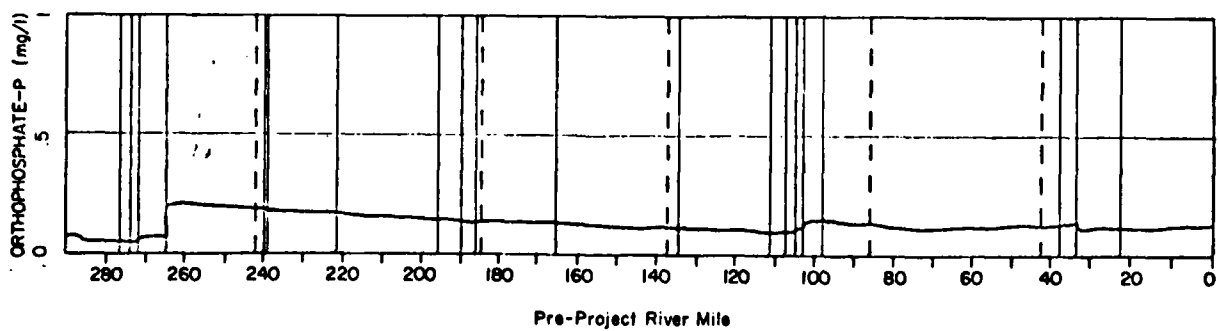
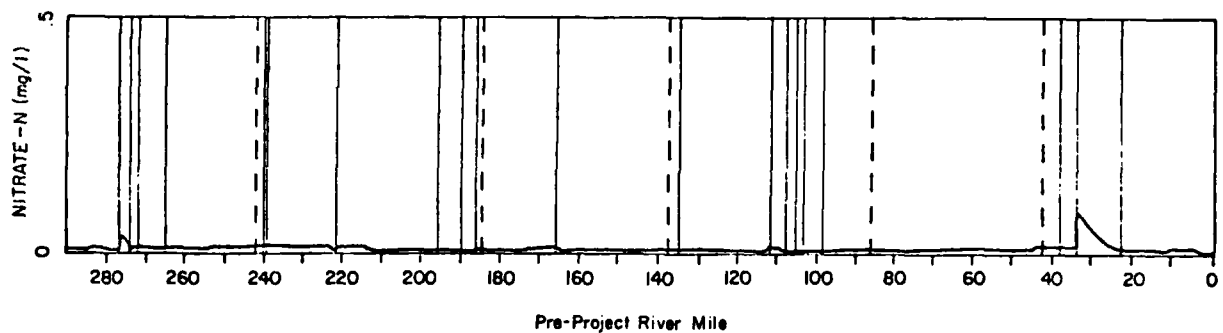
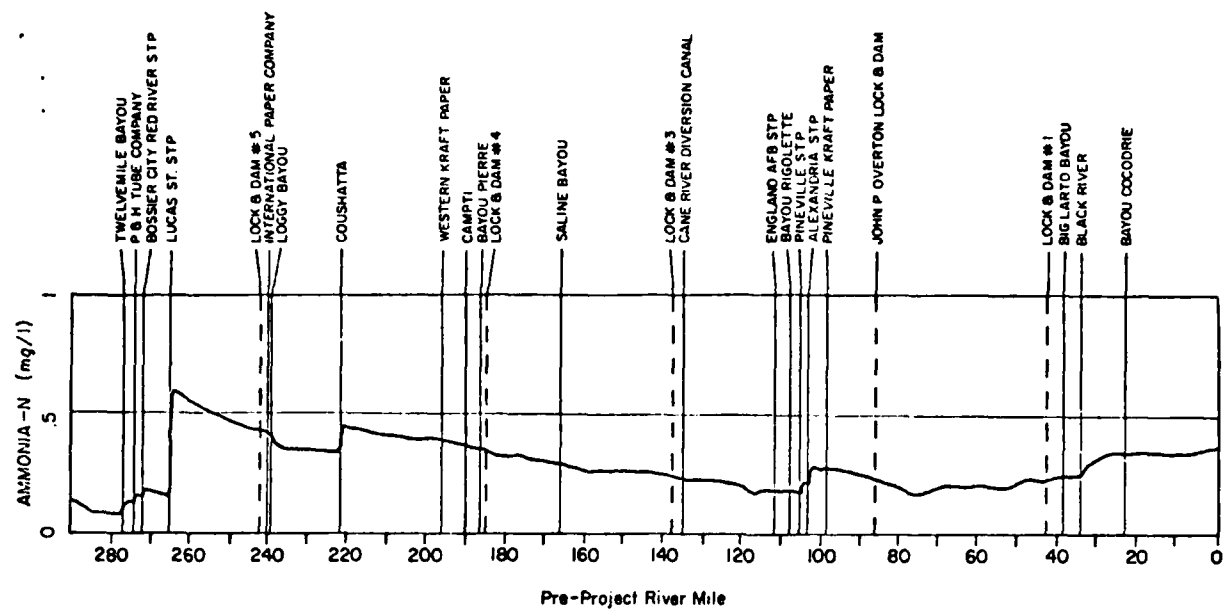


— Simulated values
at 12:00 noon

I Diurnal range

Figure P-29

Systemwide Pre-Project Quality for 7Q10 Flow Condition



— Simulated values
at 12:00 noon

Figure F-29 (Cont'd)

Systemwide Pre-Project Quality for 7Q10 Flow Condition

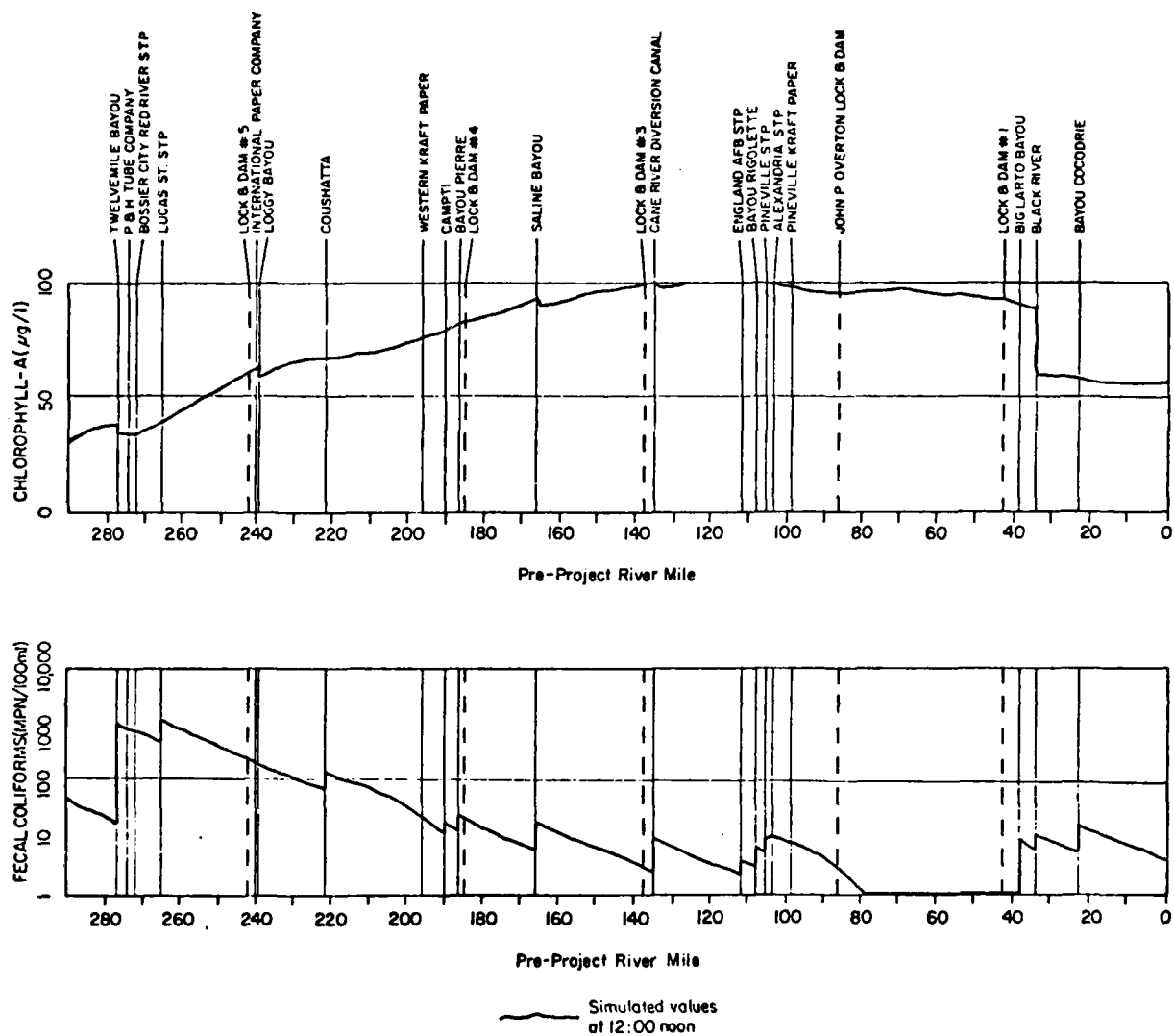
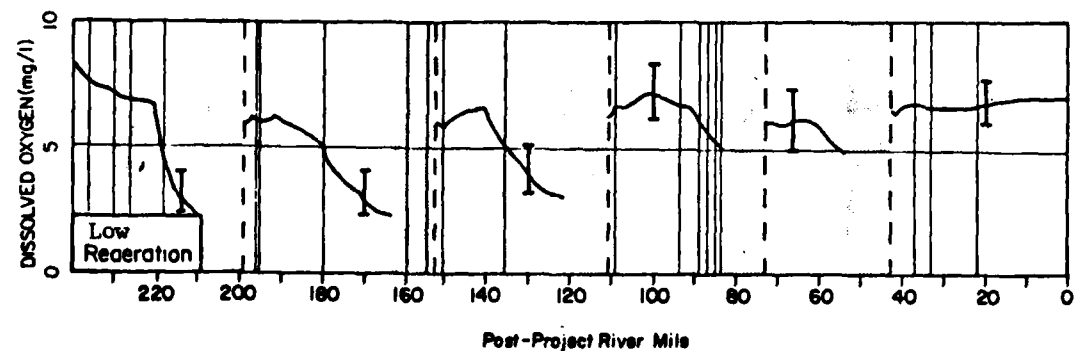
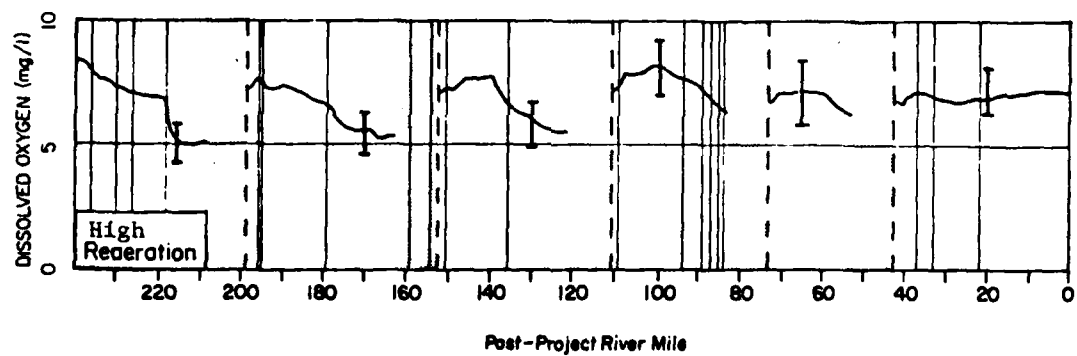
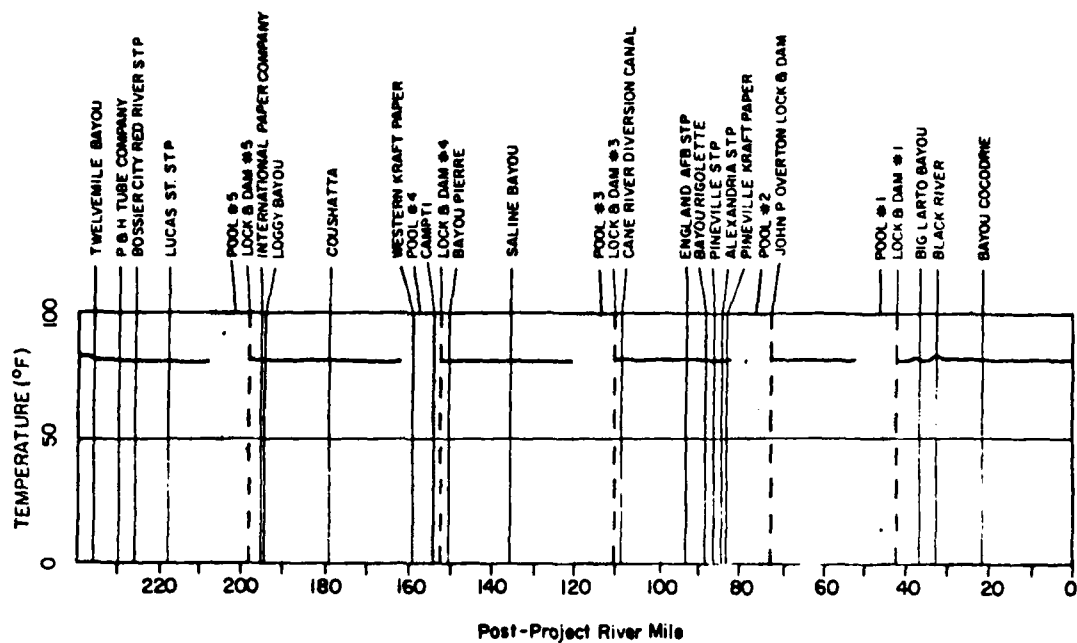


Figure F-29 (Cont'd)
Systemwide Pre-Project Quality for 7Q10 Flow Condition



— Simulated values at 12:00 noon

I Diurnal range

Pool

Figure F-30
Systemwide Post-Project Quality for 7Q10 Flow Condition

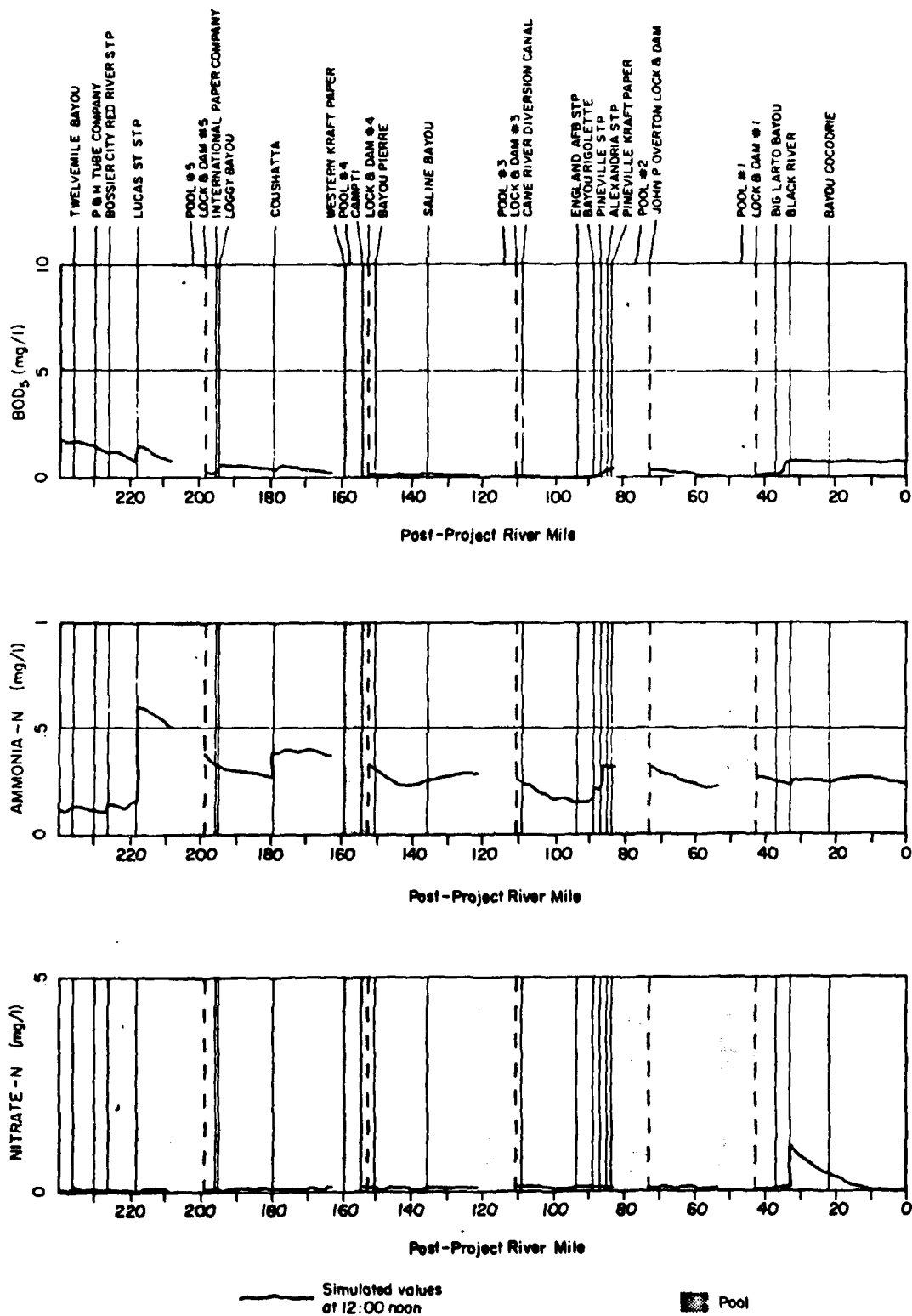


Figure F-30 (Cont'd)
Systemwide Post-Project Quality for 7Q10 Flow Condition

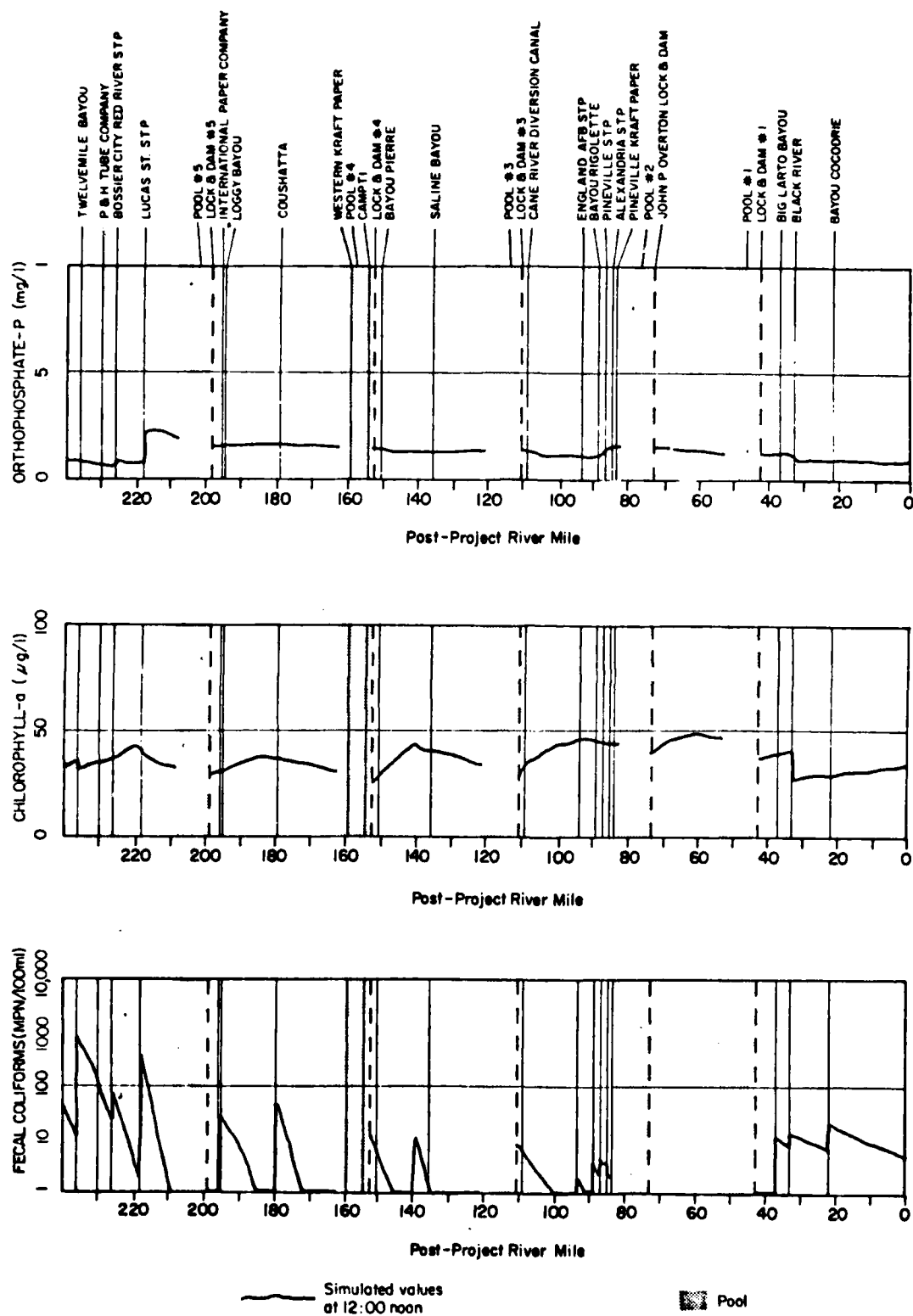
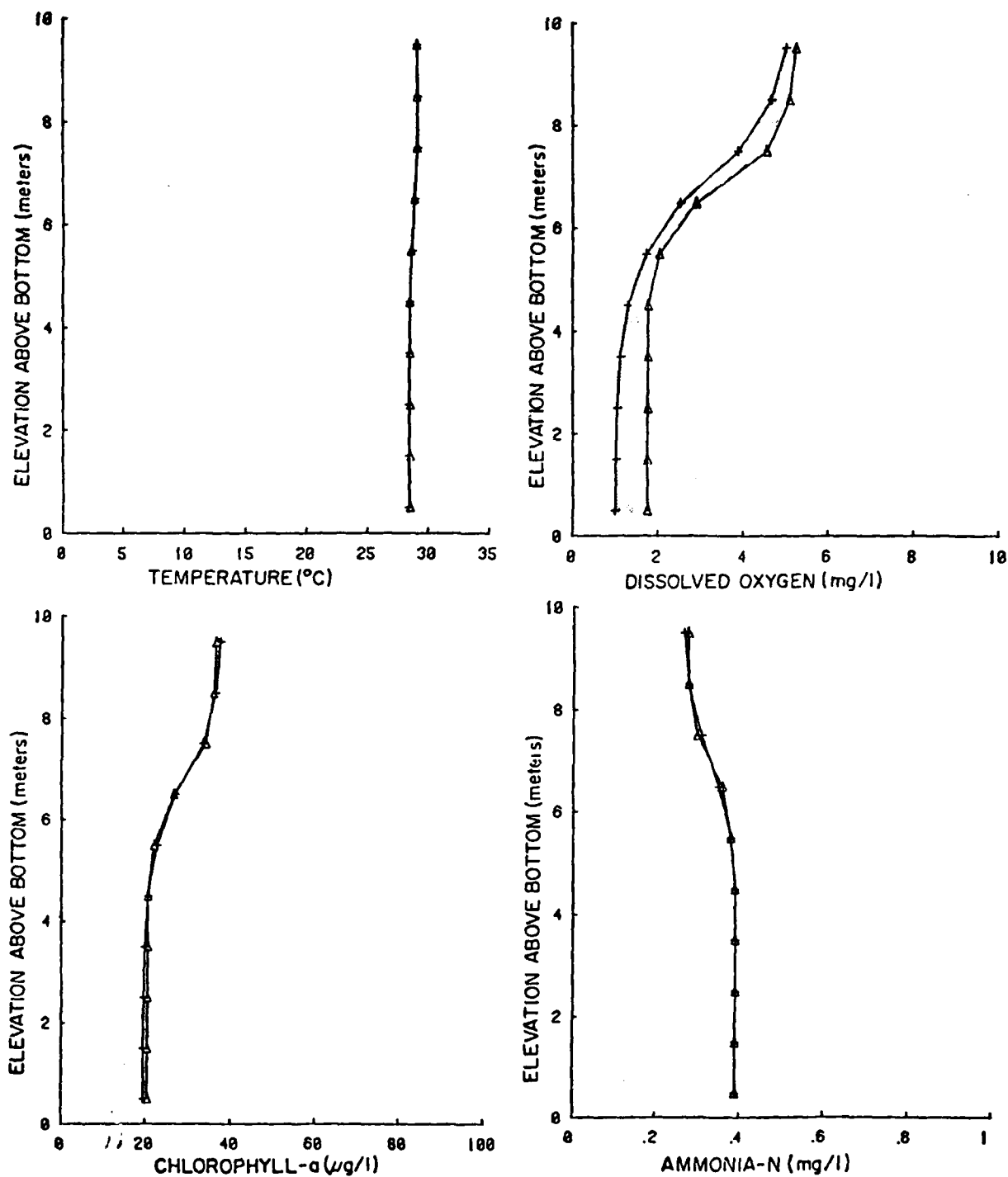


Figure F-30 (Cont'd)
Systemwide Post-Project Quality for 7Q10 Flow Condition

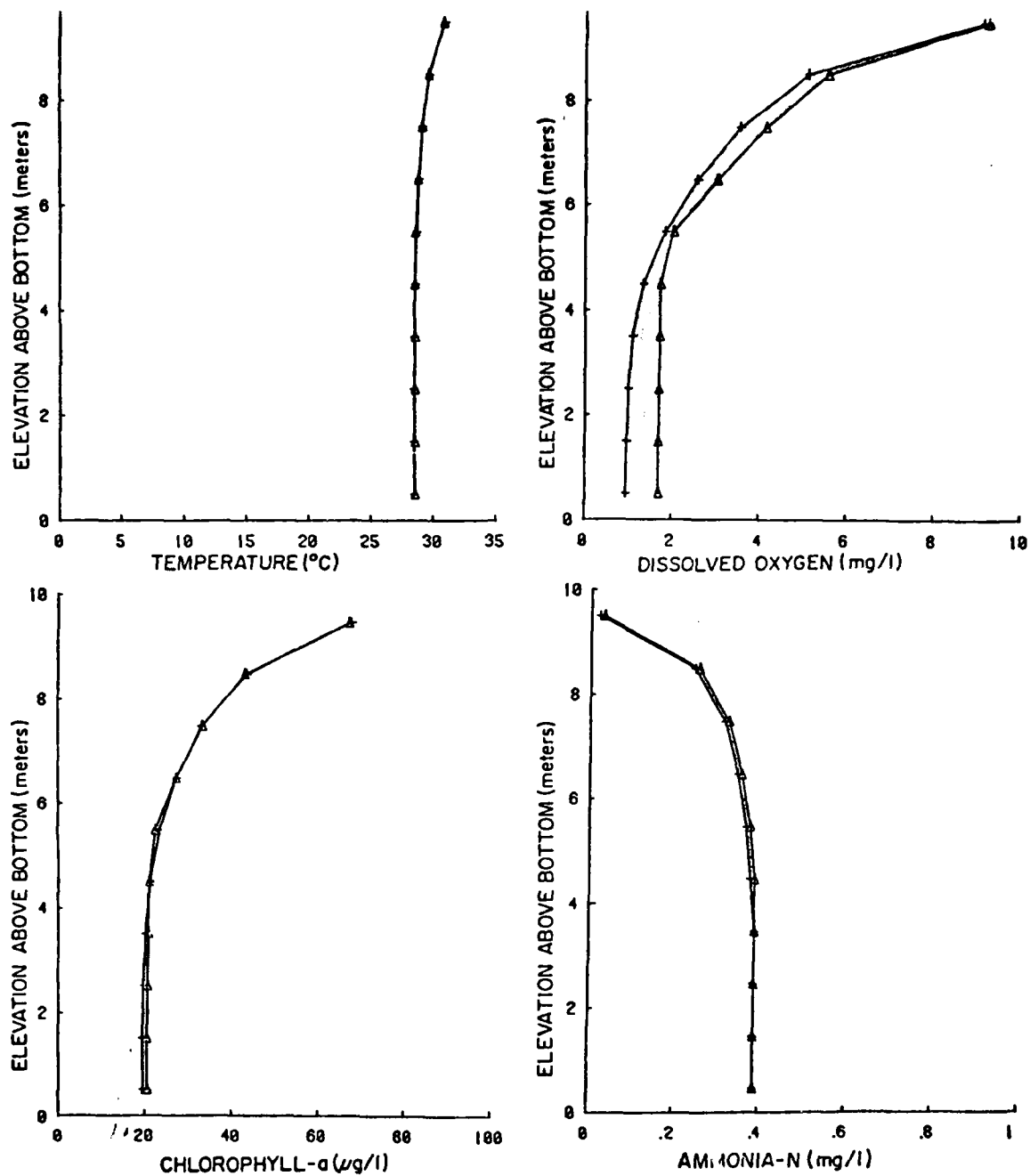


Pool #1 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

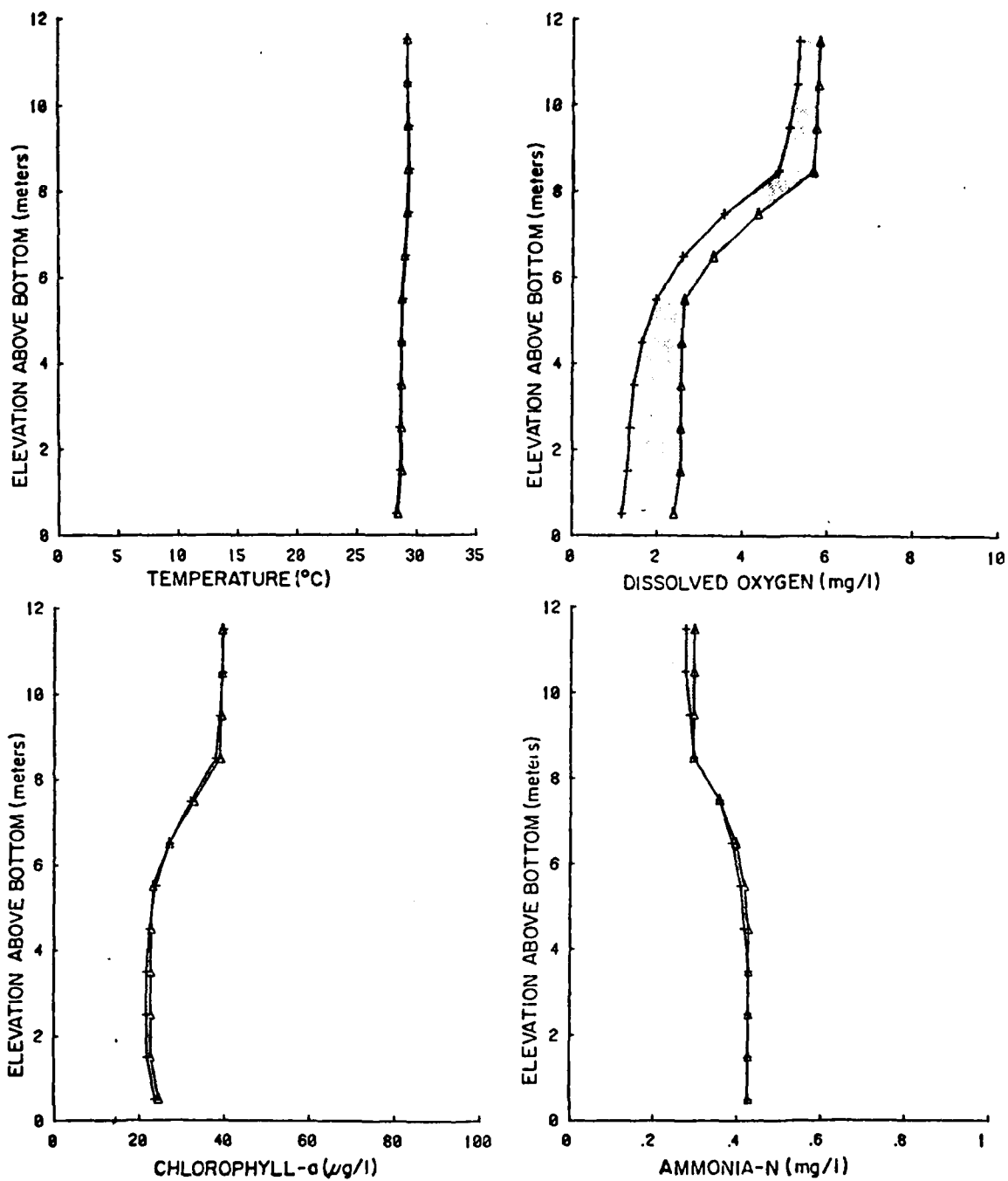
Figure F-31
Post-Project Pool No. 1 Quality for 7Q10 Flow Condition



Pool #1 at 6:00 P.M.

▲ High Diffusion
+ Low Diffusion

Figure F-31 (Cont'd)
Post-Project Pool No. 1 Quality for 7Q10 Flow Condition



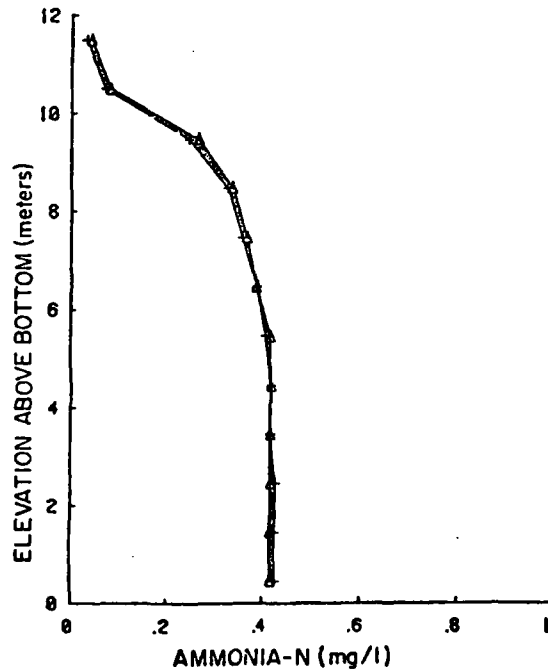
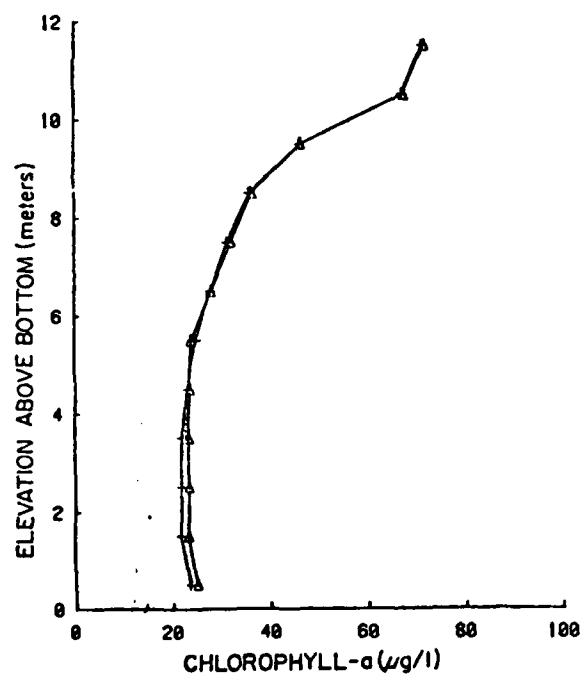
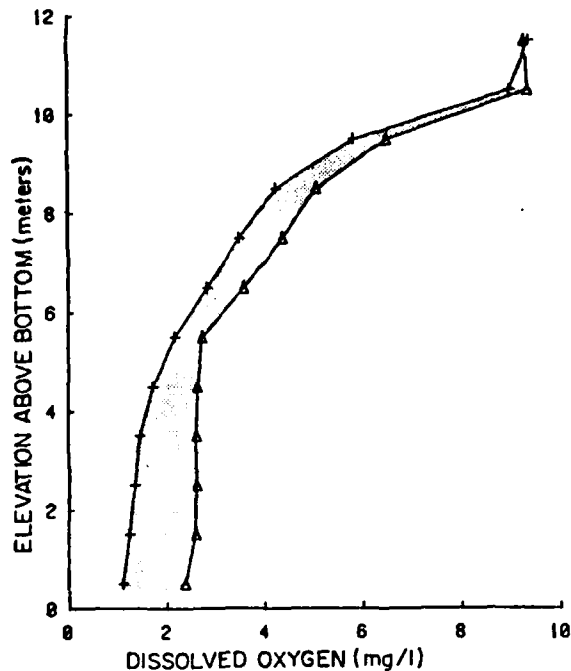
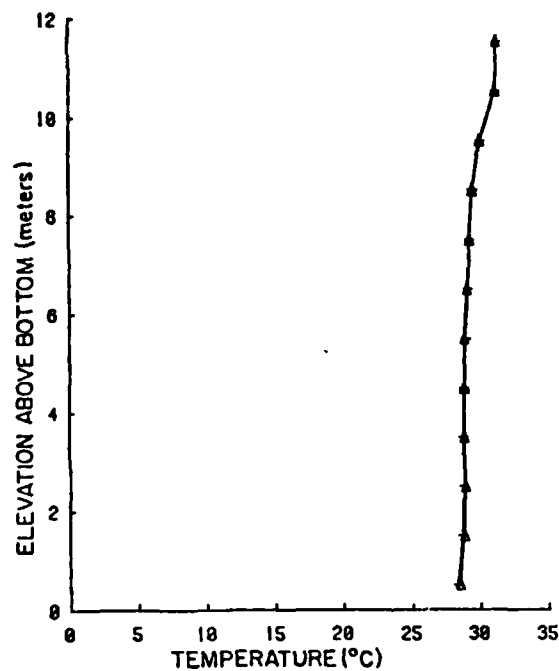
Pool #2 at 6:00 A.M.

▲ High Diffusion

+ Low Diffusion

Figure F-32

Post-Project Pool No. 2 Quality for 7Q10 Flow Condition

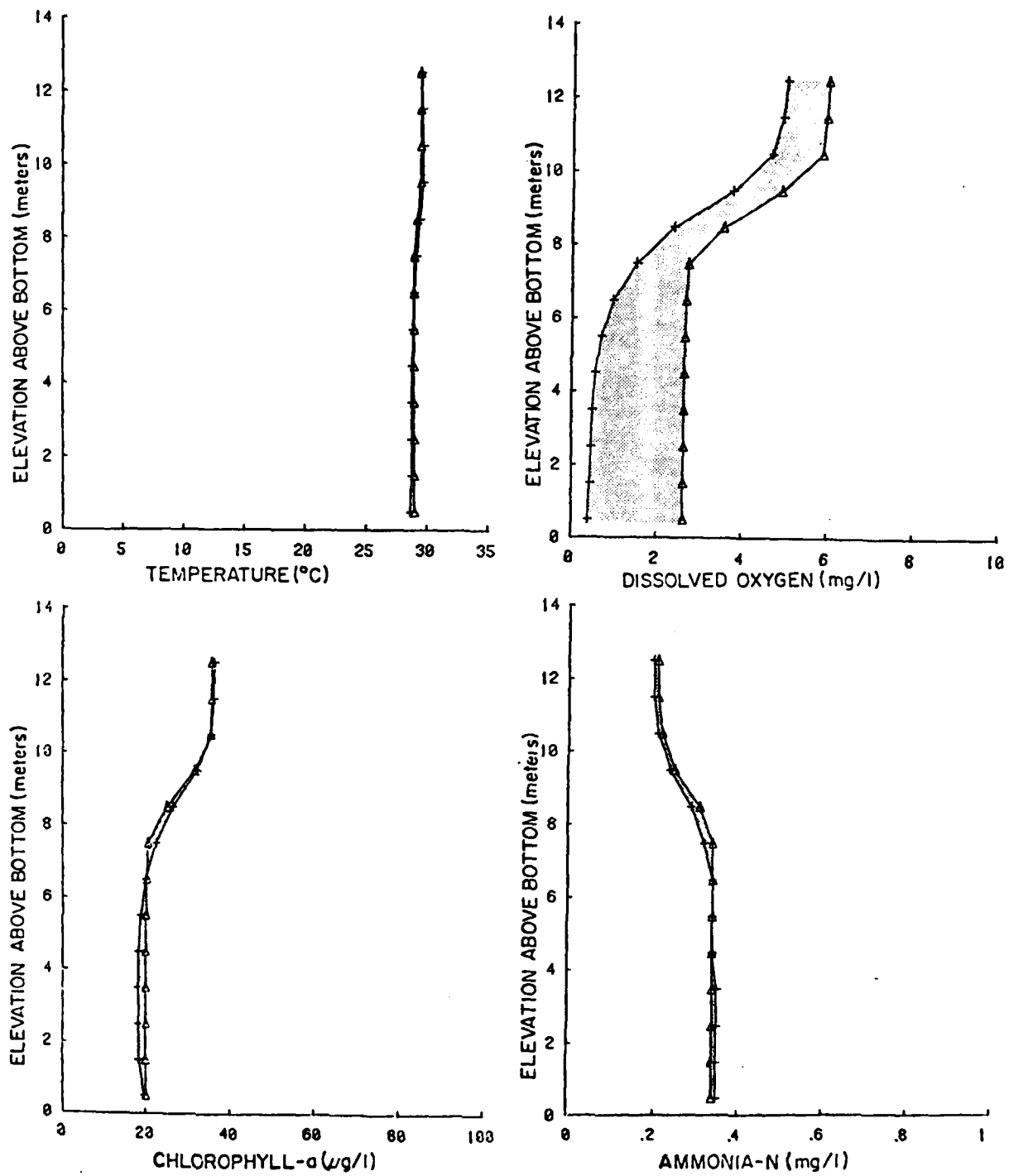


Pool #2 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

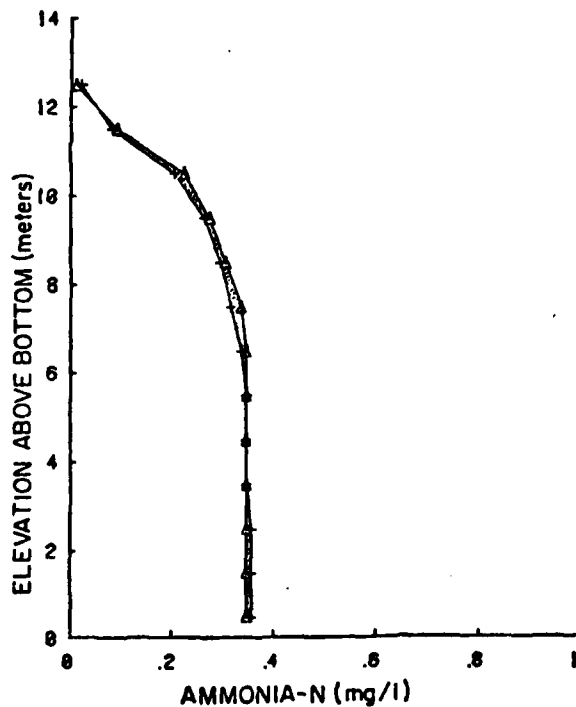
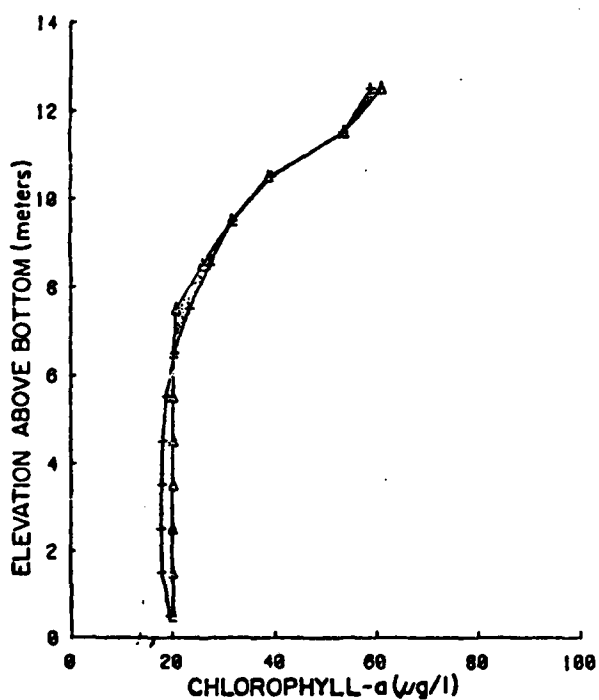
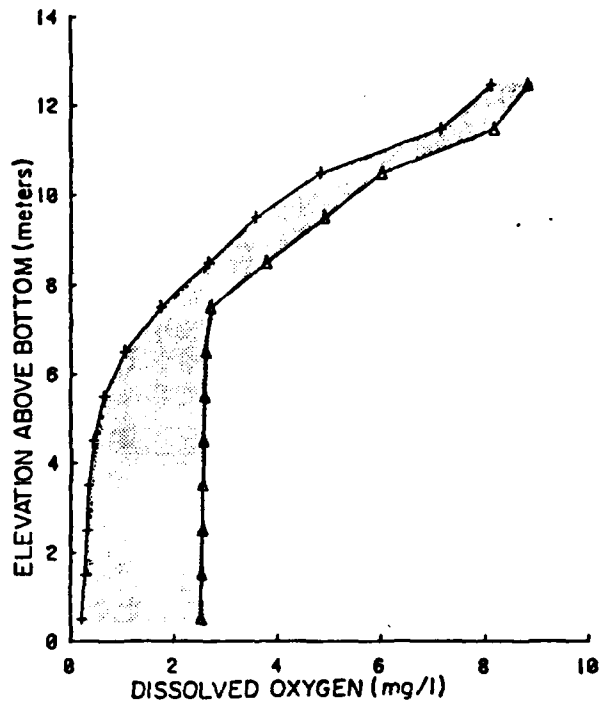
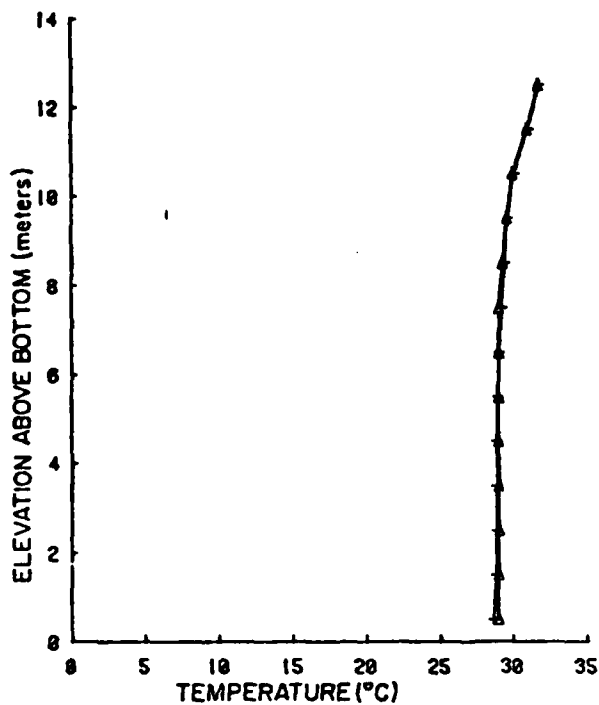
Figure F-32 (Cont'd)
Post-Project Pool No. 2 Quality for 7Q10 Flow Condition



Pool # 3 at 6:00 A.M.

- ▲ High Diffusion - Kanwisher Reaeration
- + Low Diffusion - Banks Reaeration

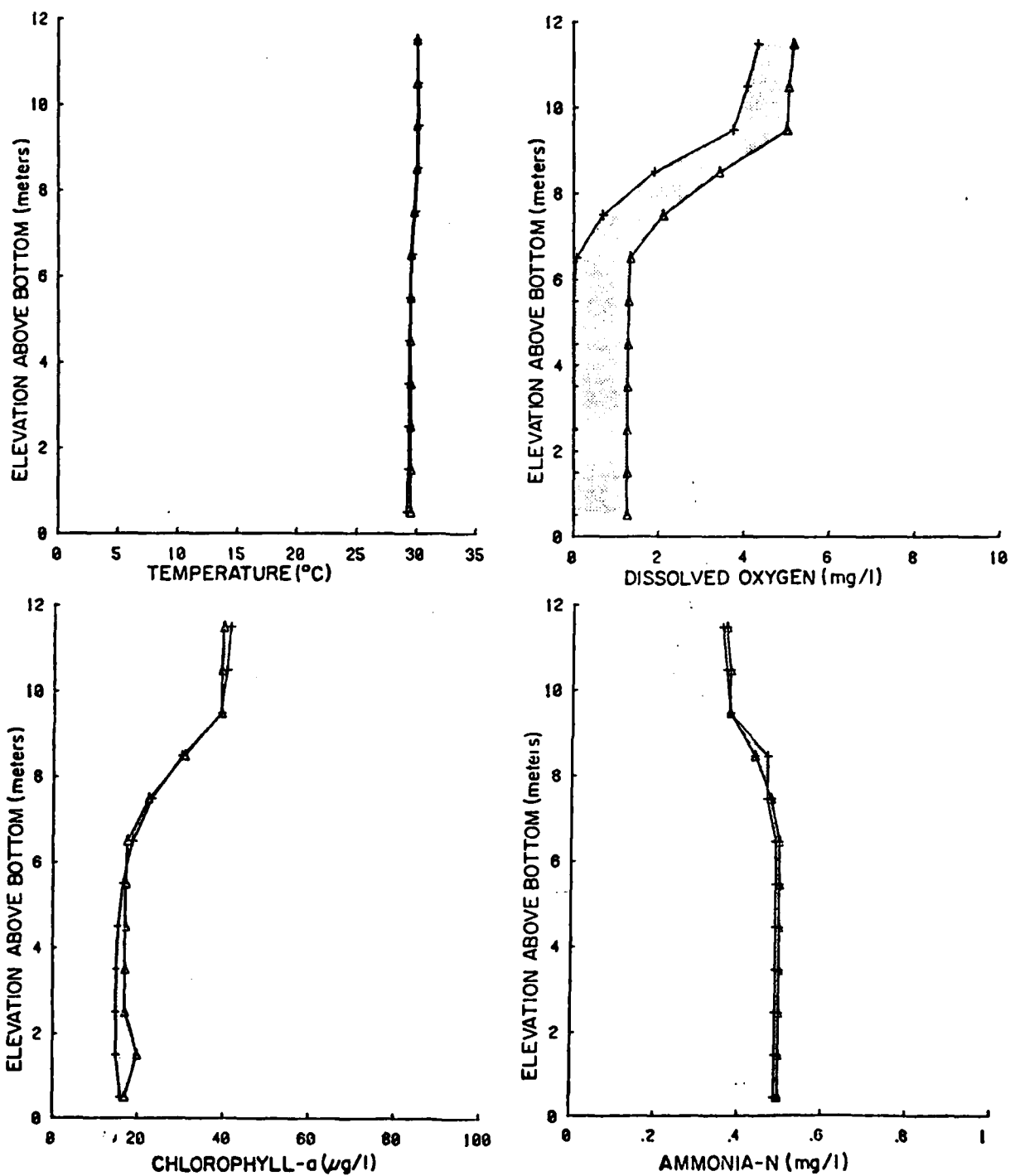
Figure F-33
Post-Project Pool No. 3 Quality for 7Q10 Flow Condition



Pool # 3 at 6:00 P.M.

- ▲ High Diffusion
- + Low Diffusion

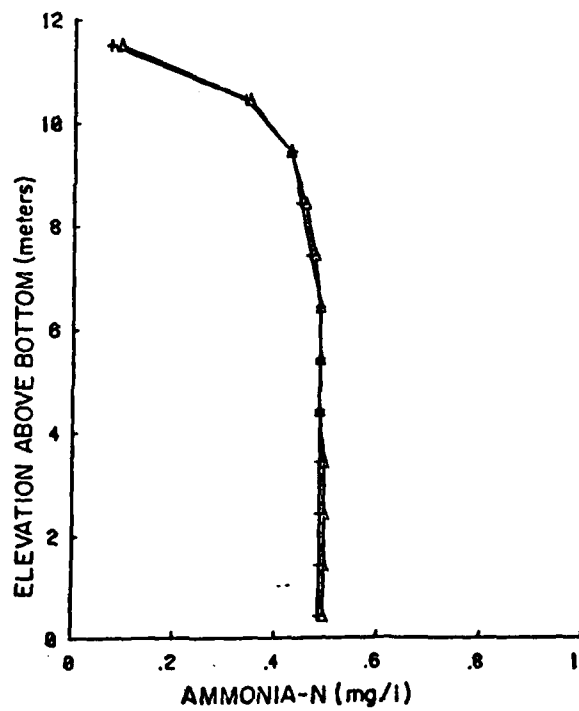
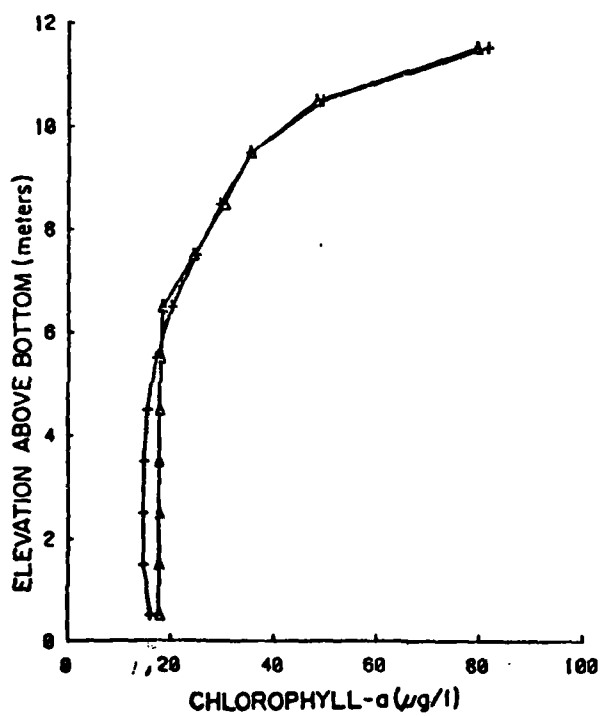
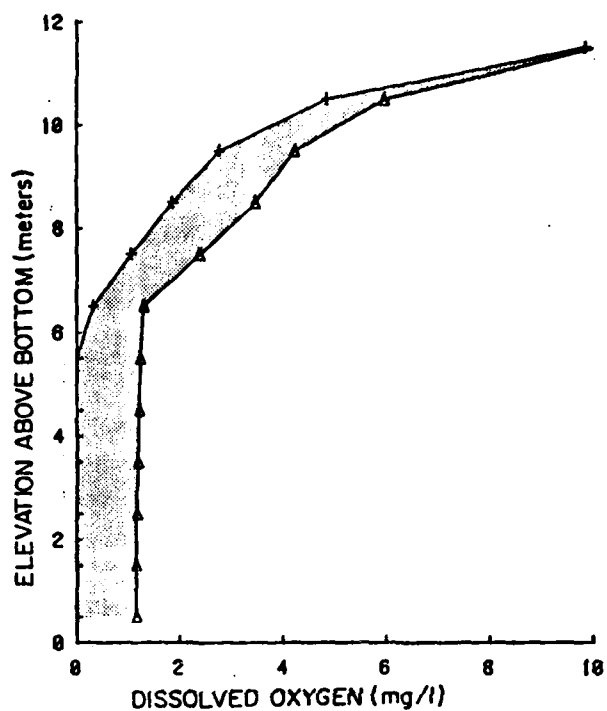
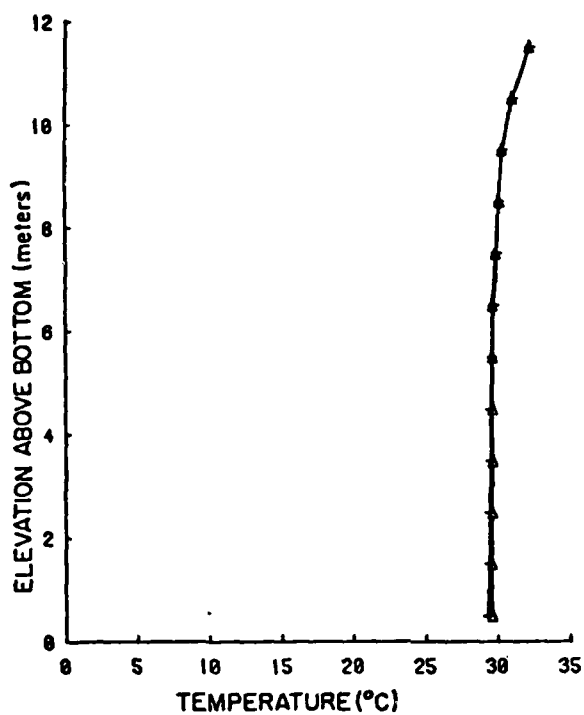
Figure F-33 (Cont'd)
Post-Project Pool No. 3 Quality for 7Q10 Flow Condition



Pool # 4 at 6:00 A.M.

▲ High Diffusion -
+ Low Diffusion

Figure F-34
Post-Project Pool No. 4 Quality for 7Q10 Flow Condition

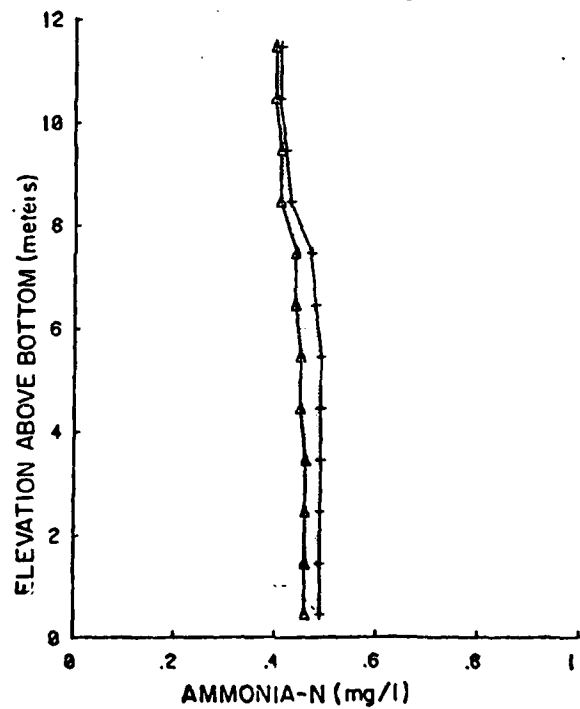
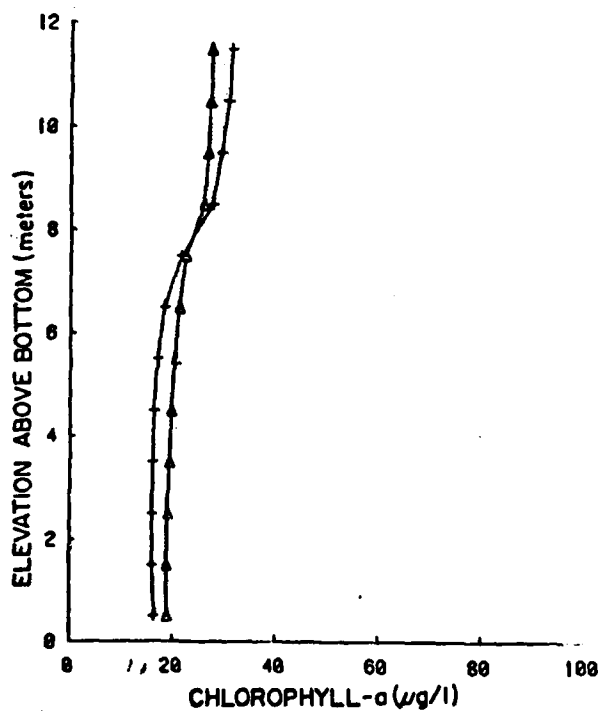
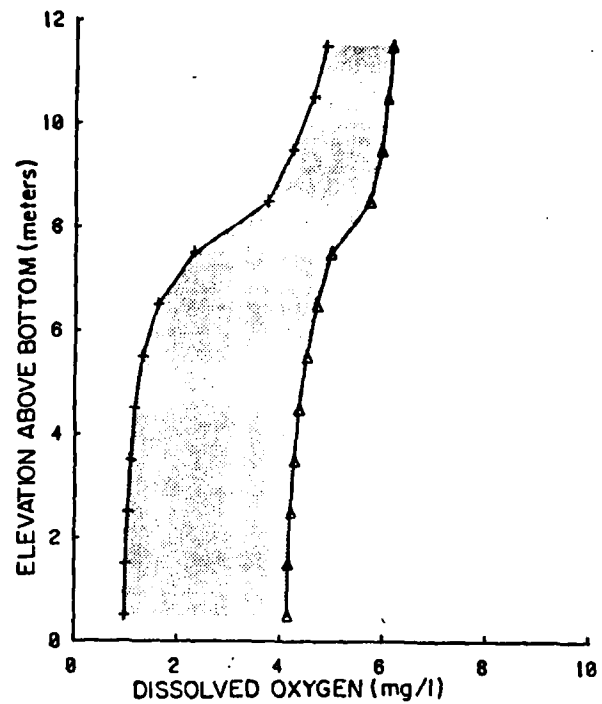
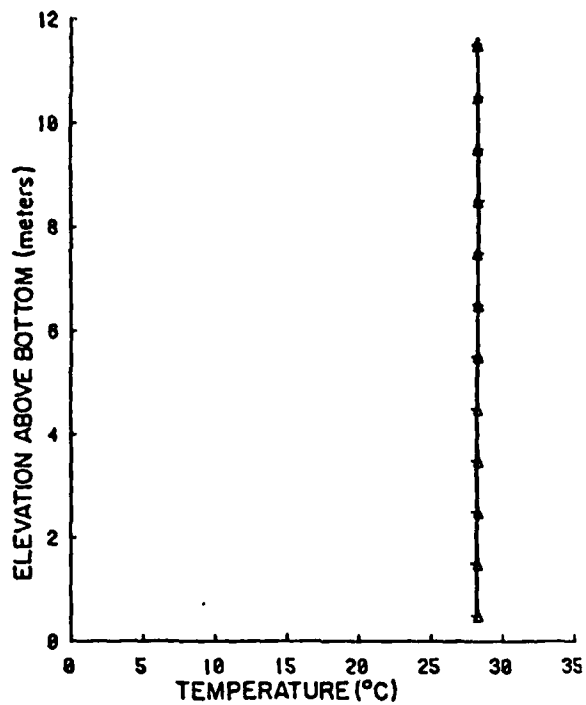


Pool # 4 at 6:00 P.M.

- ▲ High Diffusion
- + Low Diffusion

Figure F-34 (Cont'd)

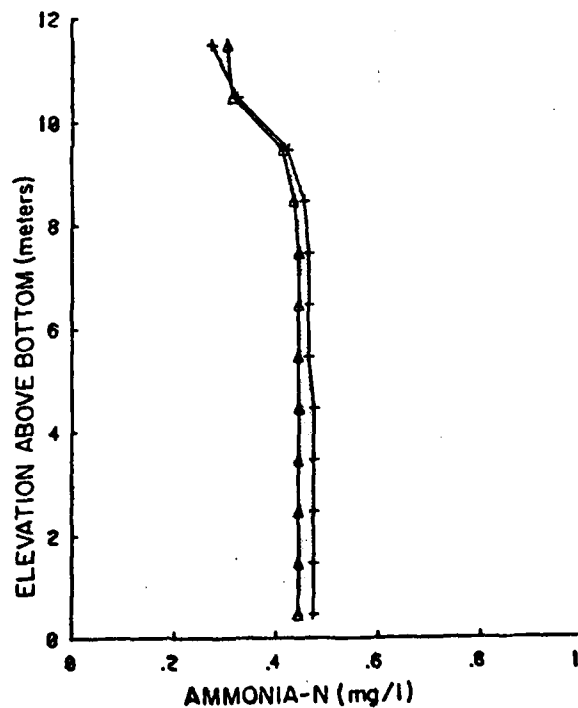
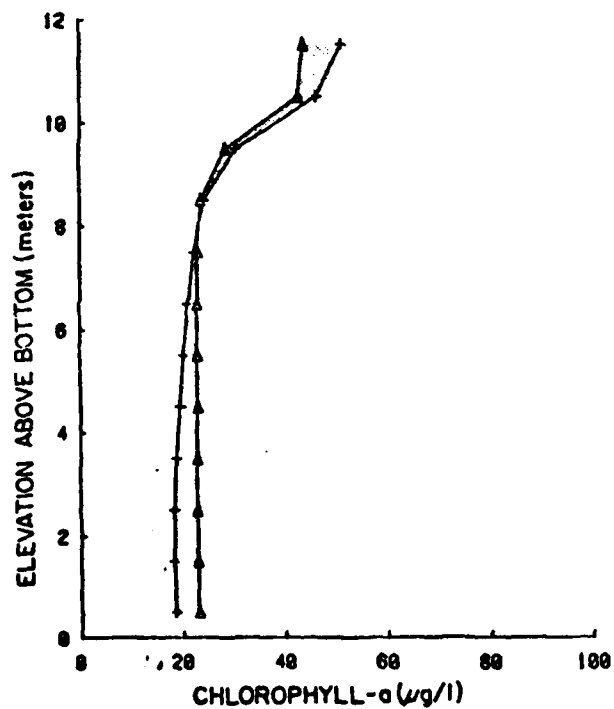
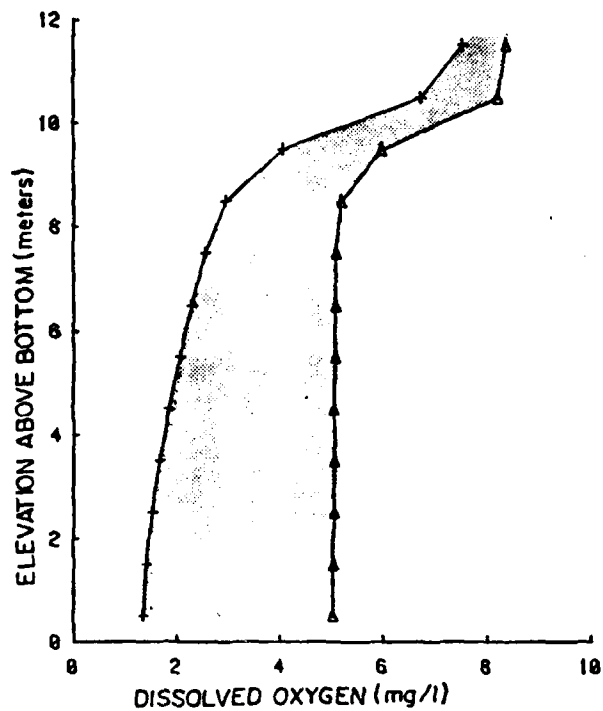
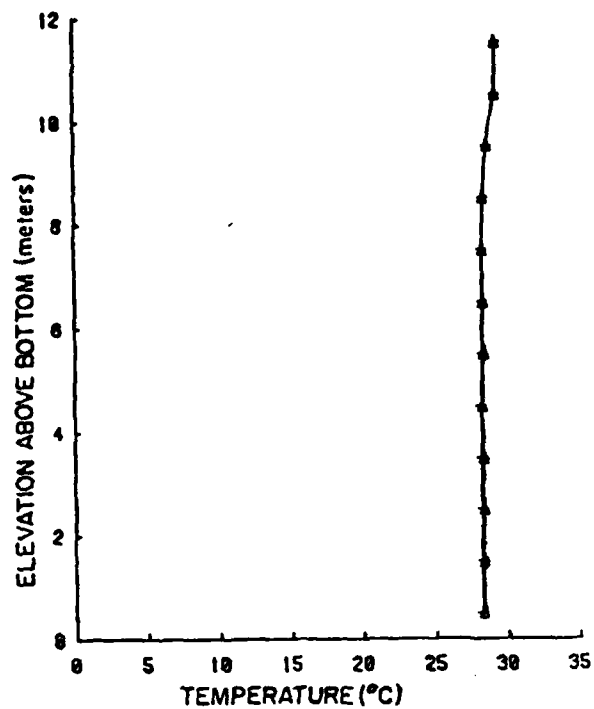
Post-Project Pool No. 4 Quality for 7Q10 Flow Condition



Pool # 5 at 6:00 A.M.

▲ High Diffusion
+ Low Diffusion

Figure F-35
Post-Project Pool No. 5 Quality for 7Q10 Flow Condition



Pool # 5 at 6:00 P.M.

▲ High Diffusion

+ Low Diffusion

Figure F-35 (Cont'd)
Post-Project Pool No. 5 Quality for 7Q10 Flow Condition

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX G
ECONOMICS

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
ECONOMIC ANALYSIS

SECTION I - SUMMARY

1. General.

a. The Red River Waterway, Louisiana, Texas, Arkansas, and Oklahoma, was authorized by Congress under Public Law 90-483, approved 13 August 1968 (H.D. 304, 90th Congress, 2nd Secession).

b. The primary purposes of the project are navigation and bank stabilization. The project comprises four generally independent elements, each of which also incorporates features contributing to water-oriented outdoor recreation and fish and wildlife enhancement. These elements are:

- (1) Navigation and complementary bank stabilization-Mississippi River to Shreveport, La.
- (2) Navigation - Shreveport, La. to Daingerfield, Tex.
- (3) Bank Stabilization - Shreveport, La. to Index, Ark.
- (4) Bank Stabilization - Index, Ark. to Denison Dam, Okla.

Only the first element, which is currently under construction, is addressed in this analysis.

2. Studies conducted for the reevaluation report.

a. Detailed analyses of beneficial project outputs were conducted during the Phase I - GDM (DM No. 2) studies published in May 1976. These studies addressed the plan designated as B-3M, which at that time featured water surface elevations of 58' NGVD in pool 2 and 145' in pool 5. Updated benefits and costs for the B3M plan as currently designed, as well as five other alternatives were developed for this document. These plans are the B-3M with a pool 2 elevation of 64', and alternative pool 5 elevations of 135', 137', and 145'; and a plan designated as B1 which also features a pool 2 elevation of 64' and pool 5 elevations of 135', 137', and 145'. Among the plans, there are also differences in location for certain project features. Detailed physical descriptions of each of the plans are contained in other sections of this document.

b. Economic studies conducted for this publication were confined to estimating the adjustments necessary to reflect any major impacts on benefits previously reported to Congress which would attend selection of any of the plans described. In addition, annualized remaining benefits and costs were brought to base year values in 1996 using present worth methods.

c. Projected land use differences among the alternatives were deemed to be the only new benefit-related plan features of significance. These differences are comprised of varying land requirements for construction of the plans, and of various levels of flooding and freeboard allowances associated with each plan. Three classes of benefits attributed to the bank stabilization feature--prevention of destruction of land, intensification, and inundation reduction are impacted by the various land use aspects of each alternative, and the appropriate adjustment to those items has been made. In addition, revised Fish and Wildlife benefits and losses based on detail studies by the US Fish and Wildlife Service conducted subsequent to the GDM have been included. Revised recreation benefits have also been included. Area Redevelopment benefits, which are a function of project costs, have been revised based on cost estimates for each alternative. Groundwater losses, a cost, also have been revised based on detailed studies completed since the GDM was published. The net effect of these revisions is minor and results in no significant differences among plans based on B/C ratios. Tables G-1, G-2, G-3 present a comparison of the six alternatives. Basis for selection of the B1/145' plan is discussed in Appendix A, along with a presentation of hydropower benefits attributable to increasingly deeper pool 5 elevations.

d. In addition, to the quantified benefit and cost data discussed above, additional studies were conducted in an effort to identify specific levels of benefits to potential waterborne commerce which could be expected to result from the varying heads of navigation associated with each of the three pool 5 elevations, 135', 137', and 145'. In the GDM analysis (May 1976) described in subsequent sections, commerce that was expected to move via the waterway was determined by comparing the transportation charges for movement by the prevailing mode of transportation with charges via the waterway. The port area for Shreveport, Louisiana, at that time was undetermined; therefore, for purposes of analysis the water movements were routed to or from a central point near the railroad bridge in Shreveport. The estimated transportation charges include an allowance for switching and trucking between a port terminal and shipping plants located off the waterway in Shreveport. These charges were obtained from tariffs which showed a flat rate within a 20 miles radius of Shreveport. All shippers that were determined to be project users were located at a distance from the waterway that required the switching or trucking charge. Since this charge would be required for all analyzed heads of navigation, calculated navigation benefits are the same for each of the three heads of navigation investigated.

e. It is recognized, however, that a considerable potential exists for reduction in cost of switching as the transfer point from water to

TABLE G-1
 Remaining Annual Benefits (\$ x 1000)
 Red River Waterway Project
 Mississippi River to Shreveport, LA

Benefit Category	Plan ^{1/}					
	B1			B3M		
	Pool15@135'	Pool15@137'	Pool15@145'	Pool15@135'	Pool15@137'	Pool15@145'
1. Navigation	\$61,821	\$61,821	\$61,821	\$61,821	\$61,821	\$61,821
2. Damages prevented by bank stabilization						
a. Levees	1,586	1,587	1,613	1,612	1,615	1,620
b. Utility and transportation facilities	4,386	4,390	4,465	4,458	4,468	4,483
c. Cropland	1,672	1,588	1,113	1,482	1,376	745
3. Intensification	664	632	507	586	541	294
4. Inundation reduction	151	139	69	122	107	16
5. Reduced maintenance on revetments	2,143	2,145	2,182	2,179	2,183	2,190
6. Security against levee crevasses	197	197	201	201	201	202
7. Irrigation	20	20	20	20	20	20
8. Reduced cost of M&I Water Supply	28	28	28	28	28	28
9. Reduced sedimentation	115	115	117	117	117	117
10. Fish and Wildlife	599	611	658	620	637	704
11. Recreation	6,300	6,300	6,300	6,300	6,300	6,300
12. Employment (ARA)	12,482	12,808	12,974	12,918	13,041	13,169
13. Wildlife mitigation ^{2/}	--	--	--	--	--	--
TOTAL ANNUAL BENEFITS:	\$92,164	\$92,381	\$92,068	\$92,464	\$92,455	\$91,709

^{1/} All plans feature a Pool 2 elevation of 64' N.G.V.D.

^{2/} Not authorized-

TABLE G-2
 Remaining Annual Charges (\$ x 1000)
 Red River Waterway Project
 Mississippi River to Shreveport, LA

Item	PLAN			
	B1		B3M	
	Pool5@135'	Pool5@137'	Pool5@145'	Pool5@145'
Gross Investment ^{1/}	\$1,500,074	\$1,505,459	\$1,527,235	\$1,518,357
				\$1,532,923
				\$1,555,598
<u>Annual Charges</u>				
Interest	48,753	48,927	43,634	49,346
Amortization	10,107	10,142	10,288	10,230
Operation and maintenance	10,392	10,392	10,531	10,475
Replacements	224	224	224	224
Fish and Wildlife losses	33	34	39	33
Groundwater losses	330	831	923	903
				41
				1,085
TOTAL charges:	\$70,339	\$70,550	\$71,639	\$71,211
				\$71,937
				\$72,992

^{1/} Gross investment reflects the present worth of all construction costs at the base year, 1996.

TABLE G-3
 Remaining Benefit - Cost Ratios
 Red River Waterway Project
 Mississippi River to Shreveport, LA

	PLAN					
	B1		B3M		B3M	
	Pool15@135'	Pool15@137'	Pool15@145'	Pool15@135'	Pool15@137'	Pool15@145'
Annual benefits:	\$92,164,000	\$92,381,000	\$92,068,000	\$92,464,000	\$92,455,000	\$91,709,000
Annual costs:	70,339,000	70,550,000	71,639,000	71,211,000	71,937,000	72,992,000
B/C Ratio:	1.3	1.3	1.3	1.3	1.3	1.2
Excess benefits: overcosts	\$21,825,000	\$21,831,000	\$20,429,000	\$21,253,000	\$20,518,000	\$18,717,000

land mode moves closer to specific plant sites. Accordingly, a field survey was conducted in 1981 to determine if any plants had located waterside since the survey performed for the 1976 GDM analysis. Such plants would require little or no switching charge for shipping or receiving waterborne cargo. This savings could represent incremental benefits for a head of navigation at mile 283.6 over others further downstream. No such plants were found; however, as the project becomes a reality, no doubt industry will tend to locate along Shreveport area riverfront sites as has nearly always been the case wherever navigation has been provided. Inability to accurately estimate the savings related thereto makes such savings no less real than the NED benefits which have been quantified.

SECTION II - NAVIGATION BENEFITS

1. Base year savings.

a. A comprehensive field canvass of local industries and prospective users of the waterway was conducted over the period November 1971 through June 1972. The area canvassed for potential traffic encompassed 10 parishes in Louisiana, 5 counties in Arkansas, and 22 counties in Texas. Estimates of traffic expected to move via the authorized waterway were based on a thorough analysis of the existing traffic movements in the tributary area via other modes of transportation. Those commodities that were not susceptible to movement on the waterway were eliminated by the following techniques: excluded were (1) those movements of insufficient annual volume; (2) movements to shippers and receivers unable to handle barge-lot sized shipments; (3) those requiring shorter time in transit; (4) shipments not adaptable to barge transportation; and (5) commodities moving to or from destinations extremely remote from the project service area.

b. Transportation rates for those commodities which were determined to be suited to barge movement were determined for the existing land mode of shipment and the expected waterborne mode. Commodity movements which appeared to generate adequate savings via water were determined to comprise the base year commerce. This resulted in 981,380 tons (see table G-4) of acceptable movements for the Mississippi-Shreveport reach.

2. Future growth.

a. Commodities comprising the 1971 base-year commerce were grouped and related to economic growth indicators deemed most likely to influence their movement. These groups are shown in table G-5.

b. In projecting the annual commerce that would move over the authorized waterway during the 50-year economic life of the navigation project, it was necessary to determine the magnitude of economic growth within the traffic area during the period.

TABLE G-4

MISSISSIPPI RIVER - SHREVEPORT REACH
ACCEPTED PROSPECTIVE COMMERCE - 1971

<u>Commodity</u>	<u>Upbound Traffic (Net Tons)</u>	<u>Downbound Traffic (Net Tons)</u>	<u>Total Traffic (Net Tons)</u>
Iron & steel articles	262,080	15,000	277,080
Iron & steel pipe	40,300	5,000	45,300
Scrap iron & steel	-	15,700	15,700
Ferro-maganese	-	-	-
Silico-maganese	-	-	-
Newsprint	6,200	-	6,200
Batites	20,000	-	20,000
Aluminum ingots	3,000	-	3,000
Carbon black	6,000	-	6,000
Linerboard	-	99,600	99,600
Carbon-activated	-	14,600	14,600
Superphosphate	6,000	-	6,000
Hydrochloric acid	6,000	-	6,000
Sulphuric acid	4,000	32,500	36,500
Formaldehyde	5,000	-	5,000
Chemicals (nec)	4,000	5,000	9,000
Caustic soda	5,000	-	5,000
Soda ash	4,300	-	4,300
Hexane	-	14,400	14,400
Naptha	-	40,800	40,800
Benzene	-	48,000	48,000
Creosote	17,000	-	17,000
Tar; tar products	10,200	3,000	13,200
Hardwood chips	-	15,000	15,000
Feed stock			
(Petro by-prod)	50,000	-	50,000
Fuel oil	5,100	-	5,100
Lubricating oil	-	116,000	116,000
Molasses	6,000	-	6,000
Soybeans	-	9,000	9,000
Coke	-	-	-
Iron ore	-	-	-
Coal	-	-	-
Cement	37,600	-	37,600
Sulphur	50,000	-	50,000
Total base year (1971)	547,780	433,600	981,380

TABLE G-5

MISSISSIPPI RIVER - SHREVEPORT REACH

COMMODITY GROUPINGS

Commodity Category	Commodities Included In Group
Iron & steel	Iron and steel articles; ingot stools and molds; iron and steel pipe; iron and steel scrap; iron and steel bars; skelp; cast iron pipe; iron and steel articles not elsewhere classified (nec)
Grain	Milo; corn; soybeans
Industrial chemicals	Creosote; tar; coal tar pitch; hydrochloric acid; sulphuric acid; basic chemicals; formaldehyde; caustic soda; carbon black; activated carbon; pine tar; hexane; naptha; benzene; feed stock; miscellaneous chemical products
Agricultural chemicals	Superphosphate; soda ash; nitro- genous chemicals fertilizers; phosphatic chemical fertilizers
Energy products	Residual fuel oil; transformer oil; lubricating oil
Sulphur	Liquid sulphur
Paper & allied products	Newsprint; linerboard; hardwood chips
Other metals & ores	Barites; aluminum ingots
Miscellaneous	Cement and molasses

The Bureau of Economic Analysis (BEA), US Department of Commerce developed projections of various economic parameters for the United States Water Resources Council. These data, which were published in 1972 OBERS Projections, Economic Activity in the United States by Economic Area, Water Areas, Historical and Projected - 1929-2020 (APRIL 1974), consist of Series E projections and were utilized for estimating the economic growth. As an analysis of the accepted base-year commerce revealed that the bulk of the commodity movements either originated or terminated within the Standard Metropolitan Statistical Areas of Shreveport and Alexandria, Louisiana, growth rates pertinent to those areas were used for projection purposes. Projected tonnages for the 9 categories are shown in table G-6 for the period 1985-2040.

3. Summary.

In the General Design Memorandum (GDM) dated May 1976 the base year tonnage and savings were projected over the 50-year period 1985-2035. The benefit stream was discounted, using an interest rate of 3 1/4 percent, and was annualized employing present worth methods. Since the publication of the GDM, the completion date for the project has been revised to 1996, shifting the 50-year economic life to 1996-2046.

SECTION III - BANK STABILIZATION BENEFITS

1. Bank caving problems.

The banks of Red River between the Mississippi River and Shreveport are highly vulnerable to river attack; the river flows in a bed of sand and the banks are composed mainly of highly erodible sand and silt. Development of the alluvial plain resulted from periodic overflows which occurred prior to the installation of flood control improvements along the main stem. In times of flooding, the coarser sandy sediments deposited as soon as flow passed over the banks where velocity suddenly slackened. By this process, the immediate banks of river were developed, sloping gently downward away from the river. Finer soil particles were deposited at a farther distance from the channel forming swampy and somewhat impermeable lowlands. Because of the natural drainage patterns and stiffer soils in the low areas, they are more difficult to drain and to till and are less productive than the higher sandy loam of the natural levees. Thus nature creates the choicest lands adjacent to the river, and immediately conspires to destroy them by bank recession. Improvements such as levees, buildings, railroads, highways, and utilities are subject to destruction.

2. Determination of land and structures destroyed.

Land which would be destroyed in the absence of the project was determined by projecting onto aerial photographs flown in 1971 the bank

TABLE G-6
MISSISSIPPI RIVER-SHREVEPORT REACH
PROJECTED TONNAGE
(1985-2035)

Year	Iron & Steel	Industrial Chemicals	Energy Products	Paper & Allied Products	Sulphur	Misc.	Grain	Other Metals & Ores	Agricultural Chemicals	Total Tonnage
<u>Thousands of Tons</u>										
1985	756	618	285	240	98	87	52	42	16	2,194
1990	926	751	349	310	118	99	55	49	17	2,674
1995	1,118	901	421	393	142	113	59	56	19	3,222
2000	1,347	1,080	507	495	171	130	64	64	20	3,878
2005	1,585	1,260	597	597	206	145	66	74	21	4,551
2010	1,856	1,461	699	712	247	162	69	85	22	5,313
2015	2,172	1,645	845	850	297	18	72	86	23	6,171
2020	2,543	1,964	958	1,015	357	201	75	87	24	7,224
2025	2,977	2,277	1,122	1,211	430	224	78	88	25	8,432
2030	3,596	2,139	1,313	1,445	516	250	81	89	26	9,955
2035	4,079	3,059	1,537	1,725	598	279	83	90	27	11,477
2040	4,562	3,479	1,761	2005	680	308	85	91	28	12,999

lines which would exist as far into the future as it was considered reasonable to project, the year 2000. Under an assumption of a uniform yearly caving rate, this total area when divided by the number of years in the period yielded an average annual rate of caving.

3. Damages on caving lands. The measurement and classification of lands and improvements located between the bank lines shown on the 1971 aerial photographs and the projected bank lines for year 2000 furnished a basis for calculating the benefits which would be realized by preventing bank recession.

a. Prevention of damages to levees. Costs of levee setbacks prevented as a result of the project were determined by assuming a uniform rate of bank recession between the 1971 bank lines and the projected bank lines for year 2000. For this 29-year period, it was estimated that 167 miles of levee setbacks would be required in the absence of bank stabilization. The period 1971 to 2000 was used solely as a basis for projecting future bank lines and determining average annual caving rates that could reasonably be anticipated over the 100-year project life. Credit was taken for the elimination of bank losses only during the period 1990 to 2090.

b. Prevention of damages to utility and transportation facilities. Utility and transportation improvements subject to damage in the absence of the project include railroads, highways, bridges, pipelines, powerlines, and telephone lines. No buildings are located in the bank caving areas under consideration. The estimated annual costs for relocation of utilities and transportation facilities were then adjusted for future conditions of growth. Average annual equivalent loss factors on future growth were computed by the use of present worth methods and a 3.25 percent interest rate. By applying these factors to costs of the appropriate base year developments, losses were calculated on future incremental developments.

c. Prevention of destruction of land. Based on the area projected to cave by year 2000 in the absence of the project and assuming uniform yearly caving rates, an annual acreage loss was computed, and is shown below.

LAND LOST BY CAVING

Land Use	Acres Lost (1971-2000)	Annual Acres caved
Cotton	2,660	91.7
Corn	60	2.1
Soybeans	1,200	41.4
Pasture	15,550	536.2
Woods	9,390	323.8
Sandbar	1,880	64.8
Total	30,740	1,060.0

Field investigations and surveys were made by Corps personnel to determine existing land uses within the area to be caved. The Department of Agriculture Soil Conservation Service, assisted in the determination of average crop yields and production costs, and land uses for the year 1985, 2005, and 2085. The net return from agricultural land that would be lost by caving in the absence of bank stabilization was computed over the 100-year project life 1990-2090. Net returns for each of these years computed, and then were discounted to present worth as of the base year of the project (1990). An annual equivalent value of these losses was determined by amortizing at a 3.25 percent interest rate over the 100-year project life.

The loss of annual revenue (net return) was adjusted for the amount of flood losses that would accrue on the lands caved under the present authorized conditions on Red River. This amount was also adjusted for the return on lands which accrete in the absence of the project. In order to estimate the return on accreted lands, it was necessary to determine the approximate lapse of time between loss of lands by caving and restoration of land and resumption of agricultural production. Both physical and economic factors affect the lag between loss and resumption of revenue. It has been concluded, based upon previous studies, that land accretion and restoration involved a lapse of about 30 years when utilized for pasture and a lapse of 15 years for use as woodland. The distribution of accreted lands, by classes, based on the above assumptions and the average annual recovery of revenue therefrom were determined as follows.

ANNUAL ACRES ACCRETED

Item	Acres in Floodway (1971)	Distribution ¹ (% 1971)	Distribution Adjusted for Projected Conditions (%)	Accretions Under Projected Conditions (Acres)
Improved Pasture	6,870	11.6	11.6	123
Unimproved Pasture	24,600	41.5	20.8	220
Woodland	22,200	37.4	58.1	616
Sandbar	5,640	9.5	9.5	101
Total	59,310	100.0	100.0	1,062 ²

¹ Unimproved pasture reduced in half and woodland increased by amount unimproved pasture reduced.

² Approximates average acres lost yearly by caving.

Computation of net return on accreted lands included adjustment for expenditures required for conversion and drainage.

4. Intensification benefits on floodway lands.

a. With bank recession no longer a threat, a higher land use within the floodway will be obtained. In 1972, personnel of the Corps of Engineers and the Soil Conservation Service inspected the floodway areas along the Red River. Based on data gathered during these inspections, projected changes in land use were made for years 1985, 2005, and 2085. It is anticipated that farm income will increase as a result of more efficient cropping patterns and minor increases in cotton yields. Woodland conversions are expected to occur on some 6,000 acres due to project construction.

b. Crop and pasture lands in floodway are subject to overflow; therefore, gross annual revenue from these lands under with- and without-project conditions is subject to reduction by the average annual flood damages sustained. Such flood damages were determined for each crop and pasture.

Investments by private interests for land conversion and drainage also would be required on lands put to higher use. Those costs incurred as a result of the project were deducted from the net income increases.

5. Inundation reduction.

The proposed project improvements will have a lowering effect on the stages of the Red River between the Mississippi River and Shreveport. This lowering effect will amount to as much as 2 feet for bankfull or lesser stages, whereas at the levee design stage a reduction of approximately 1.5 feet will obtain. Flood damages were computed based on stage hydrographs of damaging floods for the historical flood series since 1938; computations were based on individual crop damage curves. Protected land use and crop yields in the year 2005 were used as a basis for computing damages. Crop prices used were current normalized prices. Non-crop losses were based on October 1981 price levels. The difference between the average annual flood damages occurring without and with the project represented the average annual reduction in flood damages resulting from the lowering of flowlines by the proposed works.

6. Other stabilization benefits.

a. Reduced maintenance on revetment works. The expected maintenance cost of existing isolated revetment installation are estimated at 5 percent of construction cost, whereas with comprehensive stabilization offered by the project, it is about 1 1/2 percent. The latter figure has been used in estimating the maintenance cost savings on existing revetments.

b. Security against levee crevasses. An important benefit of bank stabilization is the security it affords against the threat of sudden disaster

by the breaching of a levee during a flood as the result of bank recession. The project, by reducing flood heights and preventing bank erosion, will increase the security of the levee systems, and its credited with preventing one major flood due to the crevasse during the 100-year economic life.

c. Reduced sedimentation. Harnessing of the bank erosion processes along the Red River will reduce the sediment load presently entering the Atchafalaya River Basin by about 13 percent, thereby reducing the dredging requirements in that area.

SECTION IV - OTHER BENEFITS

1. Irrigation benefits. Irrigation benefits which may be provided by navigation slack water pools were estimated by comparing differences in costs of lifting Red River water under natural conditions and under conditions with the pools in place, since all other components of the agricultural production costs are identical. Within Bossier and Caddo Parishes, Louisiana, 11,800 acres of highly permeable soils were considered suitable for irrigation. The benefits were computed based on a 75 percent participation rate, a uniform accumulation of benefits over the 50-year evaluation period of the navigation project, a discount rate of 3.25 percent, and an amortization period of 50 years.

2. Benefits from reduced treatment and pumping costs of municipal and industrial water.

a. Changes in channel width, depth, and flow characteristics to provide for navigation will result in water quality improvement by reducing turbidity and decreasing chemical quality variations. An improvement in physical convenience for the benefit of users will also result from maintaining the river stages at higher levels and reducing pumping heads.

b. With the improvement in water quality along the Red River between the Mississippi River and Shreveport it is expected that this segment of the Red River will serve municipal water needs throughout the life of the navigation feature of the project. Average annual benefits from reduced treatment costs were determined based on the population projections, per capita municipal water use, and a reduced water treatment cost with the proposed project.

c. In addition to the benefits obtained from reduced treatment costs, benefits also will result from reducing the pumping costs for both the volume of high quality water and an additional volume of industrial low quality water.

3. Recreation and fish and wildlife benefits. A detailed description of the projected recreational and fish and wildlife resources of the project area is contained in other appendixes.

4. Employment benefits. Labor costs are estimated to be approximately 35 percent of construction costs and otherwise underemployed labor will

account for 60 percent of total labor costs. The average annual benefits result from employment on project construction of otherwise underutilized labor resources. Benefits will also accrue from expenditures to operation and maintenance (O&M) labor. It is estimated that approximately 24 percent of all O&M expenditures will represent payments to otherwise underemployed labor.

5. Wildlife mitigation benefits. The project as authorized did not include any provisions for the purchase and/or management of additional land for wildlife mitigation.

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
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APPENDIX H
RECREATION

H-1

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

GENERAL REEVALUATION REPORT
AND
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MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

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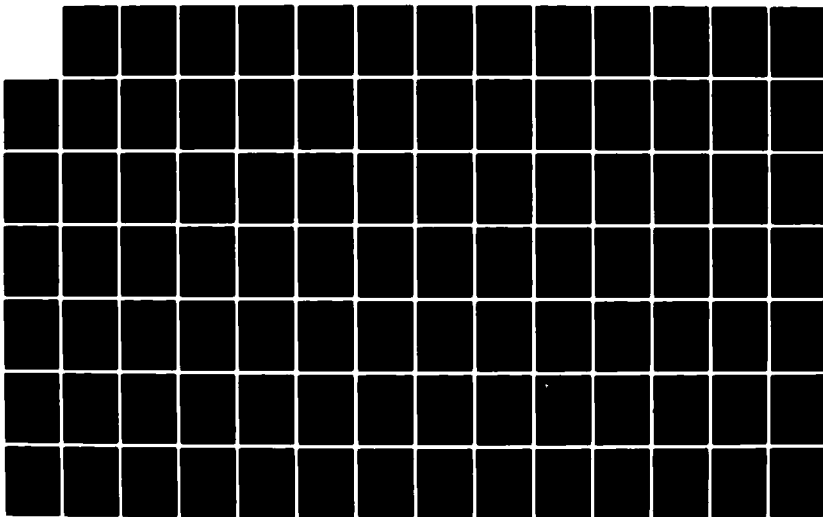
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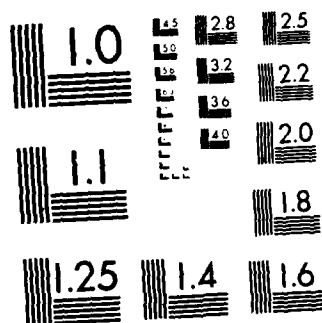
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RED RIVER WATERWAY
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MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
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PLAN FORMULATION
AND
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APPENDIX H
RECREATION

1. General. The Mississippi River to Shreveport, Louisiana reach of the Red River Waterway (RRWW) has the potential for satisfying a great portion of the recreational needs for the project market zone. Not only will additional public lands and facilities be provided by the project development, but an improved fishing resource, as well, will be created in this project reach. Due to the nature of the project and its strategic location and size, ultimate recreational development and use are limited primarily by the availability of funds and the willingness of local interests to develop recreation along the project on a cost-sharing basis. Upon completion of the project, anticipated, initial and future recreation needs of the market zone which are projected to be satisfied can be met by the RRWW project. This will be shown in the subsequent sections of this study. Without the proposed project, these needs will probably remain unfulfilled because of a shortage of state funds for this type of development.

The objectives of this study effort utilizing the US Army Institute for Water Resources techniques and the Louisiana State Comprehensive Outdoor Recreation Plan (SCORP) were to:

- a. Identify the Red River recreation market area;
- b. Estimate total recreation visitation of the Red River;
- c. Identify the needs of the primary user population;
- d. Estimate use levels for each activity type;
- e. Estimate the target facility numbers to be provided on the Red River for the identified principal activity usage levels.

2. Similar Projects Technique. The similar projects technique was adapted from the Plan Formulation and Evaluation Studies-Recreation, Volume II; US Army Engineer Institute for Water Resources, 1974. The similar project technique was designed to meet the first two objectives of the study - the identification of the recreation market area, and the estimation of the visitation to the Red River. The approach

compares the derived relationships between differing travel distances and frequencies of visitation at water-oriented recreation facilities. These distance-frequency relationships then, became a primary consideration in estimating visitation to the Red River. The method is outlined as follows:

- a. Select several existing projects similar in character to the Red River project, specifically one which have data records on travel and frequency of attendance for user of the recreational facilities;
- b. Determine the levels of visitation on a per capita basis from the similar projects for the population in zone presenting appropriate travel times;
- c. Determine present and future populations within the same travel zones for the Red River region as were used for the similar projects;
- d. Apply the per capita visitation rates derived from the similar project to the projected population levels of the Red River region to determine its initial and future visitations.

The zones of 0 to 25 miles and 25 to 50 miles were selected as significant to the Red River. Zones beyond 50 miles would decrease in per capita visitation rates to an immeasurable unit for practical planning use due to the dispersed lineal riverine system of the Red River project versus a more confined, single focus reservoir system. Zones beyond 50 miles will likely provide a significant total number of visitors to the project, but the origination of use is questionable. Larger population centers such as Baton Rouge, Ruston, Lake Charles, Texarkana, Carthage, Longview, and El Dorado are within a 100-mile radius of the project area. These and other locales contain potential visitors, but any quantifiable rates derived would be subject to numerous variables that would have no analytical value. Major water-oriented projects including Toledo Bend, Lake O' the Pines, Wright Patman, Millwood, and Sam Rayburn provide alternative and competitive recreation areas for most of the distances beyond the 50-mile zone, thus diminishing the visitor potential on the Red River. These alternative recreational water bodies have affected the 25 to 50-mile per capita visitation rates and largely explain the low per capita visitation rates and largely explain the low per capita rates registered beyond the 25-mile area. Based on the similar projects method, the annual per capita visitation was determined to be 5.3 for the 0 to 25-mile population, and 1.3 for the 25 to 50-mile population with additional undetermined use from beyond the 50-mile zone.

3. Market Area. The project technique also postulates that the area which contributes 80 percent or more of the day use visitation is defined as the market area. In most cases, the rates used in the Institute's study for the day use reservoirs conformed to this market area definition. Of the five similar projects used for comparative purposes, two reservoirs, Belton and

Garza-Little Elm, had defined market areas of 50 miles, while the other three, Bull Shoals, Whitney, and Norfolk had market areas which extended up to 100 miles. The 50-mile limitation for the Red River was selected as the market area subsequent to the analysis of the zones beyond 50 miles.

4. Visitation Refinement. Due to the dated material used for the similar projects technique, the nonreservoir character of the Red River, and the uncorroborated determination of the market area, it was necessary to make a further refinement of the estimated visitation technique. The visitation estimate technique was compared with a project with known visitation to indicate the degree by which estimated would vary from actual visitation. The area selected was the lower portion of the McClellan-Kerr Arkansas River System - specifically the lower reaches of the Arkansas River Waterway (ARWW) from the Norrell Lock and Dam 1 to and including the David Terry Lock and Dam 6. Similarities between this portion of the Arkansas River and the Red River project are such that the Arkansas River presented an opportunity to determine the required adjustment to raw visitation estimates in order to arrive at an actual or final visitation estimate. This portion of the Arkansas River is slightly less than 100 miles in length, and its 50-mile zone of influence has a 1977 population of 828,548. The RRWW will be some 200 miles long and its 50-mile zone of influence had a 1977 population of 905,214. No major impoundments with large surface water areas will exist on the Red River after construction of the navigation project, as is the condition of the lower Arkansas River. Both rivers have similar backwater lakes where the oxbows have been cut off in the process of rechannelizing the river for navigation. Both rivers have comparable recreational environments. Both systems have urbanized areas within, but not dominating, their area of influence (Little Rock and Pine Bluff on the lower reaches of the Arkansas River, and Alexandria, Shreveport, and Natchitoches on the Red River). Both navigation systems have other similar types of land use, including industrial use and port development with the resulting implications, if any, upon recreational use. Both systems have similar limitations such as the effects of high water on visitor attendance at recreation facilities. Analysis of use on the Arkansas River indicated that 80 to 83 percent of the total use of the lower Arkansas River for years 1969 to 1971 was from within 50 miles. This pattern conforms to the 50-mile market area determined for the Red River. The per capita attendance rates derived for the Red River were applied to the population in each of the travel distances associated with the Arkansas River to indicate a raw estimate of visitation for the lower portion of the ARWW. Actual visitation at recreation sites along the lower Arkansas River was reported at 2,698,000 in 1977, which is a difference of 62 percent from the estimated current raw day use visitation. This 62 percent factor was then used to adjust the raw visitation estimates for the Red River.

5. Final Totals. The final population totals for the demographic analysis are shown for the five pools in summary form:

Pool	Primary Market Zone		Secondary Market Zone		Total	
	Area (0-25 Mi)		Area (25-50 mi)			
	1990	2040	1990	2040	1990	2040
1	76,378	116,427	85,755	138,170	162,133	254,597
2	138,869	219,627	70,477	103,132	209,346	322,759
3	56,416	99,991	52,225	85,444	108,641	185,435
4	36,771	73,941	24,312	44,820	61,083	118,761
5	403,181	792,592	138,792	253,674	541,973	1,046,266
TOTALS	711,615	1,302,578	371,561	625,240	1,083,176	1,927,818

6. Recreation Visitation Estimates. The calculation of visitation estimates for 1990 for the Red River is as follows:

Market Zone	1990 Population	Per Capita Visitation Rate	Projected Visitation
0-25 miles	711,615	5.3	3,771,560
25-50 miles	371,561	1.3	483,209
Estimated recreation days from within 50 miles			4,254,589

Since only 80 percent of the visitation is from within 50 miles,

$$4,254,589 \div 0.8 = 5,318,237 = \text{Unadjusted total.}$$

Applying the .62 percent adjustment factor, $5,318,237 \times .62 = 3,297,307$, round to 3,300,000.

Therefore, 3,300,000 annual recreation days are anticipated at the RRWW project during 1990.

The visitation estimates for the year 2040 are as follows:

Market Zone	1990 Population	Per Capita Visitation Rate	Projected Visitation in Rec/Days
0-25 miles	1,302,578	5.3	6,903,663
25-50 miles	625,240	1.3	812,812
Estimated recreation day within 50 miles			7,716,475

Following the same procedure,

$$7,716,475 \div 0.8 = 9,645,594 = \text{Unadjusted total;}$$

$$9,645,594 \times .62 = 5,980,268, \text{ round to } 6,000,000.$$

Therefore, 6,000,000 annual recreation days are anticipated at the RRWW project for the year 2040.

7. SCORP/Recreation Participation. The demand-supply comparison as contained in the 1974 Louisiana SCORP was used to meet the third objective - the identification of the recreation needs of the primary use population. The SCORP, through a statewide demand survey measured high quarter recreation preferences by regions and compared these expressions with the known supply of activities in order to determine need by activity type. Essential to this study effort was the high quarter per capita visitation rates for each activity, the use standards which convert demand expressed in activity occasions to demand expressed in unit measurements of activities (sites, acres, square feet, etc), and the existing supply. These measurements were modified through extensive consultation and concurrence with the Louisiana Department of Culture, Recreation, and Tourism, through its Office of Program Development, and with US Army Corps of Engineer recreation personnel.

8. Base Participation Rates. With the 50-mile market area as a boundary, different Louisiana state planning regions are transected. A high quarter participation rate has been developed from the 1974 SCORP survey for each region for different recreational activities. The market area includes most, but not all of regions 6 and 7 of the state planning regions. In addition, portions of all but two of the remaining six planning regions are within the 50-mile boundary. A weighted rate was calculated using the two primary regions (regions 6 and 7) to constitute 80 percent of the total rates (40 percent each) with the additional 20 percent being provided by the state average. The resulting base rates more accurately reflect 1974 usage rates of the 50-mile market area population.

9. Standards of Use. Some standards of use contained in the 1974 SCORP were not felt to accurately reflect use patterns in the Red River region. In consultation and agreement between the Louisiana Department of Culture, Recreation, and Tourism, and the US Army Corps of Engineers, the standards were altered to more nearly reflect the type of facility developments which could be expected along the Red River. The US Army Corps of Engineers' guidelines, Bureau of Outdoor Recreation (BOR), Heritage Conservation and Recreation Service (HCERS) Outdoor Recreation Space Standards, and the Texas and Arkansas SCORP standards provided sources of comparison in the derivation of the modified standards.

10. Calculation of Recreation Needs Based on SCORP. Using the modified standards and zonal populations of the 50-mile recreation area, the needs by activity were calculated for the region for 1990 and projected to 2040. A breakdown of these needs are shown in tables H-1 and H-2. The comprehensive steps undertaken in the RRWW planning process ultimately resulted in the formulation of criteria for site selection and in the delimitation of recreation sites. The criteria were the outgrowth of analyses of the natural and social resource bases and their implications for the needs and potential of the Red River region. The implications were structured as concept and use objectives and these in turn served as the respective frameworks for two types of site criteria - general and specific. Criteria which primarily focused on a larger scale locational contexts were developed for the identification of general or concept area. Locational

TABLE H-1
1990 RED RIVER WATERWAY MARKET AREA FACILITY NEEDS

ACTIVITY	HIGH QUARTER PARTICIPATION RATE	(1990) POPULATION	HIGH QUARTER ACTIVITY OCCASIONS	NO. ACTIVITY OCCASIONS, AVERAGE HIGH QUARTER DAY	FACILITY STANDARD	PROJECTED MARKET AREA CROSS FACILITY NEEDS		EXISTING MARKET AREA FACILITY SUPPLY		PROJECTED MARKET AREA NEW FACILITY NEEDS	
Boat Fishing	3.09	1,083,176	3,347,014	36,579	50 UD/LN	732 LN		129 LN		603 LN	
Water Skiing	4.30	"	4,657,657	50,903	64 UD/LN	795 LN		108 LN		687 LN	
Non Power Boating	.67	"	725,728	7,931	36 UD/LN	220 LN		288 LN		(68) LN	
Power Boating	7.08	"	7,668,886	83,813	64 UD/LN	1,310 LN		19 LN		1,291 LN	
Swimming (Lake)	5.89	"	6,379,907	69,726	20UD/9SY/W + 9 SY/L	313,767 SY/L 313,767 SY/W		161,696 SY		152,071 SY/L 152,071 SY/W	
Picnicking	4.46	"	4,830,965	52,797	7.7 UD/TBL	6,857 TBL		2,621 TBL		4,236 TBL	
Tent Camping	1.34	"	1,451,456	15,863	4 UD/ST	3,966 ST		2,086 ST		1,880 ST	
Trailer Camping	3.59	"	3,888,602	42,498	4 UD/ST	10,625 ST		2,515 ST		8,110 ST	
Horseback Riding	3.39	"	3,671,967	40,131	20 UD/TR	2,007 TR		7 TR		2,000 TR	
Bicycling	16.24	"	17,590,778	192,249	30 UD/TR	6,408 TR		5 TR		6,403 TR	
Hiking	2.05	"	2,220,511	24,268	20 UD/TR	1,213 TR		7 TR		1,206 TR	
Nature Walk	3.10	"	3,357,846	36,698	40 UD/TR	917 TR		56 TR		861 TR	
Hunting	9.54	"	10,333,499	112,934	1 UD/26 AC	2,936,284 AC		1,038,101 AC		1,898,183 AC	
Playfields	7.55	"	8,177,979	89,377	30 UD/FLD	2,483 FLD		240 FLD		2,243 FLD	
Multi-Purpose Courts	4.56	"	4,939,283	53,981	20 UD/CT	2,699 CT		62 CT		2,637 CT	
Playing Volleyball	2.99	"	3,238,696	35,396	30 UD/CT	1,180 CT		66 CT		1,114 CT	
Children's Playgrounds	2	"	2,166,352	23,676	31 UD/PLGR	764 PLGR		0		764 PLGR	

TABLE H-2
2040 RED RIVER WATERWAY MARKET AREA FACILITY NEEDS

ACTIVITY	HIGH QUARTER PARTICIPATION RATE	(1990) POPULATION	HIGH QUARTER ACTIVITY OCCASIONS	NO. ACTIVITY OCCASIONS, AVERAGE HIGH QUARTER DAY	FACILITY STANDARD	PROJECTED MARKET		EXISTING		PROJECTED MARKET AREA NEW FACILITY NEEDS
						AREA GROSS FACILITY NEEDS	AREA GROSS FACILITY NEEDS	MARKET AREA FACILITY SUPPLY	MARKET AREA FACILITY SUPPLY	
Boat Fishing	3.09	1,927,818	5,956,958	65,103	50 UD/LN	1,302 LN	1,302 LN	129 LN	129 LN	1,173 LN
Water Skiing	4.30	"	8,289,617	90,597	64 UD/LN	1,416 LN	1,416 LN	108 LN	108 LN	1,308 LN
Non Power Boating	.67	"	1,291,638	14,116	36 UD/LN	392 LN	392 LN	288 LN	288 LN	104 LN
Power Boating	7.08	"	13,648,951	149,169	64 UD/LN	2,331 LN	2,331 LN	19 LN	19 LN	2,312 LN
Swimming (Lake)	5.89	"	11,354,848	124,097	2UD/9SY/W + 9 SY/L	558,435 SY/L 558,435 SY/W	558,435 SY/L 558,435 SY/W	161,696 SY	161,696 SY	396,739 SY/L 396,739 SY/W
Picnicking	4.46	"	8,598,068	93,968	7.7 UD/TBL	12,204 TBL	12,204 TBL	2,621 TBL	2,621 TBL	9,583 TBL
Tent Camping	1.34	"	2,583,276	28,233	4 UD/ST	7,058 ST	7,058 ST	2,086 ST	2,086 ST	4,972 ST
Trailer Camping	3.59	"	6,920,867	75,638	4 UD/ST	18,909 ST	18,909 ST	2,515 ST	2,515 ST	16,394 ST
Horseback Riding	3.39	"	6,535,303	71,424	20 UD/TR	3,571 TR	3,571 TR	7 TR	7 TR	3,564 TR
Bicycling	16.24	"	31,307,764	342,161	30 UD/TR	11,405 TR	11,405 TR	5 TR	5 TR	11,400 TR
Hiking	2.05	"	3,952,027	43,192	20 UD/TR	2,160 TR	2,160 TR	7 TR	7 TR	2,153 TR
Nature Walk	3.10	"	5,976,236	65,314	40 UD/TR	1,633 TR	1,633 TR	56 TR	56 TR	1,577 TR
Hunting	9.54	"	18,391,383	200,999	1 UD/26 AC	5,225,967 AC	5,225,967 AC	1,038,101 AC	1,038,101 AC	4,187,866 AC
Playfields	7.55	"	14,555,025	159,071	30 UD/FLD	4,419 FLD	4,419 FLD	240 FLD	240 FLD	4,179 FLD
Multi-Purpose Courts	4.56	"	8,790,850	96,075	20 UD/CT	4,804 CT	4,804 CT	62 CT	62 CT	4,742 CT
Playing Volleyball	2.99	"	5,764,176	62,996	30 UD/CT	2,100 CT	2,100 CT	66 CT	66 CT	2,034 CT
Children's Playgrounds	2	"	3,855,636	42,138	31 UD/PLGR	1,359 PLGR	1,359 PLGR	0	0	1,359 PLGR

contexts included situations such as proximity to urban areas and vehicular access. In order to maintain the overall objectives of the RRWW project, a decision was made not to utilize undeveloped areas which had high industrial use potential for recreational purposes. Therefore, criteria was developed for two types of areas - industrial and recreational. The concept objectives of effecting an equitable distribution of benefits and of enhancing recreational assets all along the waterway figured prominently in the identification of general recreation areas. Thus, the areas would have to provide a balance or recreation opportunities in urban, semiurban, and rural locational situations as well as meet the anticipated recreation demands in each pool. Within this broader context, four major factors were assessed in determining significant potential recreational areas: access, locational context, building condition, and recreational environment.

a. Access. Potential recreational areas were evaluated for reasonable vehicular access. Areas which would require lengthy road extensions or major rebuilding as well as bridging would be prohibitively costly to develop. Such problems occur along the lower reaches of the waterway.

b. Locational Context. Urban, suburban, and rural sites were sought to provide a full range of recreation facilities and experiences along the Red River while maximizing convenience to the user population.

(1) Urban sites provide community oriented open space and day use facilities (i. e., picnic tables, playgrounds, gamecourts, etc.) for the people in cities and towns near the river. Seven urban site developments consisting of 783 acres are proposed for the reach.

(a) Cane's Landing, a 192-acre site and Twelve Mile/Cross Bayous, a 260-acre site, both in Shreveport, Louisiana;

(b) Bennet's Bluff, a 71-acre site 2 miles south of Shreveport, Louisiana;

(c) Coushatta, a 46-acre site in Coushatta, Louisiana;

(d) Campti, a 42-acre site in Campti, Louisiana;

(e) Colfax, a 74-acre site in Colfax, Louisiana;

(f) Alexandria Riverside, a 98-acre site in Alexandria, Louisiana.

(2) Suburban locations provide larger sites and consequently increased numbers of day use facilities as well as a slightly broader range of facilities (i.e., hiking and nature trails). Three suburban site developments consisting of 1,523 acres are proposed for the reach.

(a) Sunflower Point, a 757-acre site 8 river miles downstream from Shreveport, Louisiana.

(b) Boyce, a 417-acre site at Boyce, Louisiana.

(c) Fort Buhlow, a 349-acre site one-half mile upstream from Pineville, Louisiana.

(3) Rural locations provide greater locational flexibility, greater emphasis on the natural environment, and overnight facilities in addition to supportive day use facilities. Regardless of locational context, specific sites also offer unique resource-related activities (i.e., tailwater fishing, swimming beaches, interpretive exhibits, wildlife enhancement) ten rural site developments consisting of 5,128 acres are proposed for the reach.

(a) La Chute, a 1,030-acre site at LaChute, Louisiana, downstream of Lock and Dam No. 5;

(b) Howard Cutoff, a 1,155-acre site at Howard, Louisiana;

(c) Nicholos Cutoff, a 52-acre site at Nicholos, Louisiana;

(d) Bayou Pierre/Grand Ecore, a 477-acre site, located at Ecore, Louisiana;

(e) Cane River, a 1,424-acre site, located directly across the river from Colfax, Louisiana;

(f) Grand Bend, a 19-acre site, located 10 river miles downstream of Alexandria, Louisiana;

(g) Lock and Dam No. 2, a 281-acre site, located 10 river miles downstream of Alexandria, Louisiana;

(h) Ben Routh, a 70-acre site, located across the river from Moncla, Louisiana;

(i) Hadden Fort Derussy Cutoff, a 15-acre site, located 5 river miles downstream of Moncla, Louisiana;

(j) Lock and Dam No. 1, a 605-acre site, located 15 river miles downstream of Moncla, Louisiana.

(4) Wildlife Management lands provide for limited recreational facilities. These lands are acquired for recreation and allocated as habitat for fish and wildlife or for propagation of such species. Such lands will be continuously available for low density recreational

activities, i.e. boat ramps. Six wildlife/minimal recreation areas consisting of 5,667 acres are proposed for the reach.

(a) Wilkerson Point, a 596-acre site located 10 river miles downstream from Shreveport, Louisiana;

(b) Gahagan, a 760-acre site at Gahagan, Louisiana;

(c) Porters Island, a 2,031-acre site, located 10 river miles downstream of Coushatta, Louisiana. In proximity to this wildlife site a recreational development is proposed.

(d) Clarence, a 1,029-acre site at Clarence, Louisiana;

(e) St. Maurice, 548-acre site, located at St. Maurice, Louisiana;

(f) Once More, a 703-acre site, located in the vicinity of Echo, Louisiana.

c. Building Conditions. Extensive low-lying and large swampy tracts were avoided for potential recreational areas. Zones that might prove difficult for utility extensions or which possessed widespread, very poor soil conditions were similarly avoided.

d. Recreation Environment. The primary factor of this type was the presence of suitable tree cover. Masses of trees near the river are generally scarce, and much of what exists is either scrubby or swampy. Locations with a variety of existing or potential water bodies were considered major attractors. Similarly, the better potential fishing and boating areas were also considered. Several of the most interesting or prominent archeologic/historic features were considered to offer significant recreation potentials. Natural interpretive possibilities, however, are generally uniform along the river.

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
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APPENDIX I
CULTURAL RESOURCES

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

GENERAL REEVALUATION REPORT
AND
EIS SUPPLEMENT NO. 2

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

APPENDIX I
CULTURAL RESOURCES

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RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
DESIGN MEMORANDUM NO. 2 - SUPPLEMENT NO. 1
PHASE I - SUPPLEMENT NO. 1
PLAN FORMULATION
AND
SITE SELECTION

APPENDIX I
Cultural Resources

1. Geomorphology.

a. Introduction. General knowledge of the geomorphic history of any river system is essential for understanding and predicting human settlement patterns in a given region. By first identifying the variety of formations available for human habitation through time, patterns of occupation specific to cultural periods, and the present location of specific formations, predictive statements can be made regarding site location. Conversely, relative dates from cultural strata can be applied to physical formations, bracketing either the time of their formation or burial. The geomorphological history of the Red River is a complex subject not yet fully studied or understood. The following discussion summarizes the major geomorphic and cultural events which affect locating sites and reconstructing the history of settlement in the Red River Valley over the last 10,000 years.

b. Background Literature. Fisk (1938), Murray (1948), Kolb (1949) and Russ (1975) used geomorphic criteria to determine relative chronologies for meander belts in several sections of the valley. Additional portions of the alluvial valley have been described for Winn, Grant and Rapides Parishes (Huner 1939; Fisk 1938, 1940). Smith and Russ (1974) published profiles and interpretive U.S.G.S. 15 minute quadrangle maps for the lower alluvial valley. Abington (1973) described meander morphology and hydraulics. In association with multiple archeological investigations, Lenzer (1977; Dickson 1979; Newkirk and Mueller 1980; Thomas and Campbell 1978; Thomas et al. 1978; Thomas and Wright et al. 1978) conducted much of the recent fieldwork interpreting the relationship of specific sites to specific physical features. Lenzer's work and interpretations are the bases for much of the data presented in this portion of the appendix.

c. Aggrading Phase. Prior to the late Wisconsin glacial stage (approximately 19,000 years B.P.) sea level fell and the ancestral Red and Mississippi Rivers cut downward into Pleistocene and Tertiary shelf sediments. Broad entrenched valleys were created. When sea level then rose during the last glacial stage, the ancestral Red River also rose, filling its valley with the sand and gravel which is the substratum of

the present river. Eventually, sand deposition gave way to topstratum deposition and a meandering regime. A date of 20,000 to 12,000 years B.P. is hypothesized for this event based upon Saucier's (1974) relative dating of contemporary strata in the Mississippi River Valley. During this period (approximately 13,000 years B.P.) man migrated into the Southeast. The earliest cultural sites in the valley would therefore be associated with formations dating from this or earlier time periods. The process of topstratum deposition continued until approximately 3,500 years B.P. when sea level stabilized and the alluvial valley aggraded to its present elevation. During the deposition of the top stratum, the Red River constructed as many as five discrete meander belts, as in the section between Colfax and St. Maurice. In the Montgomery vicinity, meander belt and backswamp deposits are approximately 15 meters thick (Smith and Russ 1974). North of Shreveport, two or three meander belts developed, and the backswamp deposits (at least 40 meters thick) are more extensive and continuous than in the middle and lower valley (Smith and Russ 1974).

d. Diversions. Approximately 1,100 years B.P. the Red River cut through low areas of its eastern alluvial wall at Evergreen Gap and began to drain into the Mississippi alluvial valley (Fisk 1944). Bayou des Glaisses flows along a remnant of the resulting meander belt which was occupied by the Red River until approximately 600 years B.P. It is hypothesized (Thomas and Wright et al. 1978:30) that the change in gradient resulted in the transition from aggradation to degradation upriver from Evergreen Gap. This first diversion was followed by a second diversion down the Boeuf-Red River meander belt, and a third more dramatic diversion through Moncla Gap. Associated with this last event are entrenchment of the channel, course straightening, exposure of levee clays, bank slumping, and eventual creation of extensive obstructions in the form of log rafts (Abington 1973). These rafts, which at one time extended as far south as Alexandria, diverted floodwaters into multiple channels through crevasses in the natural levee. Alternate flow channels through neighboring bayous (probably relict Red River channels) were used by historic boat traffic but passages were navigable only at high water. Nineteenth century accounts of the rafts describe blockages 25 feet thick which supported the growth of willow trees 12 feet in diameter (Hardin 1935:769-773). Sedimentation along the rafts' edges contributed to the creation of large lakes in the adjacent backswamp and rimswamp basins (Harriss and Veatch 1899).

e. Historic Intervention. Between 1833 and 1873, the log rafts north of Alexandria were removed by the US Army Corps of Engineers. The river was restricted to a single navigation channel and the huge lakes were drained by the 1890's (Harriss and Veatch 1899). An artificial levee construction program was initiated to maintain this single channel. In 1893 the final impediment to navigation -- the siltstone rapids in the vicinity of Alexandria -- was also removed. These events, associated with historic settlement in the area, caused channel entrenchment and lowering water levels. Annual high and low water stages are now partially controlled

by Denison Dam. The presently exposed upper point bar and natural levee deposits are associated with the post-1830 meander belt (Weinstein et al. 1979; Dickson 1979; Thomas and Wright et al. 1978).

f. Affects on Cultural Resources. Over time, these geomorphological changes have dramatically affected archeological sites and the methods used to locate them. During the river's aggrading phase, most early floodplain sites would have been quickly silted over and possibly scoured away during a succeeding meander entrenchment. In some places the river reoccupied portions of older meander belts and the associated deposits have been reworked multiple times (Lenzer 1977). This building of serial point bars and natural levees with each meander shift created a continually altered living surface. In terms of the archeological record, there is a probability that deeply buried sites exist all along the river on old natural levees. Such locations are exceedingly difficult to predict. Additional deposition of silt over large areas would have been a direct result of the nineteenth century rafts and associated water impoundment. The historic settlement pattern above Alexandria should reflect the restriction of navigation to distributary channels up until the time the main channel was restored. Newkirk and Mueller (1980:30-34) review problems encountered by large scale reconstructions of the pre-1830 alluvial valley and point out interpretational inconsistencies between those reconstructions already attempted. Nineteenth century engineering changes have substantially altered the river regime, masking pre-1830 conditions. In the uplands, the dominant geomorphic process has been erosion, exposing sites rather than burying them (Gagliano et al. 1979).

g. Field Methodology. Cultural resources surveys conducted since the mid-1970's have depended on geomorphological reconstructions to interpret archeological deposits. Prediction and location of buried sites, however, is still an experimental process. In association with the comprehensive Newkirk and Mueller survey (1980:34), Lenzer sampled selected locations in colluvial soils and relict meander belts in the Red Oak Lake-Porters Island area and in the Kisatchie Wold constriction near Colfax, Louisiana. A series of twenty-five trenches, one to two meters deep, located only one possible buried occupation surface. The technique has been used successfully in other alluvial valleys and will require additional refinement to succeed along the Red. To date, the alternative techniques of coring and examining available cutbank profiles are equally hit-or-miss locational tools.

2. Culture History.

a. General. The chronological record (see Table I-1) of the Red River Valley has been repeatedly summarized in archeological reports and Federal agency planning documents (Davis 1968, 1970; GSRI 1975). This appendix focuses on broad changes in settlement pattern and the relationship of these changes to the physical environment affected by the present project.

TABLE I-1

CULTURAL COMPLEXES IN THE RED RIVER - LOWER MISSISSIPPI ALLUVIAL VALLEY

		SHREVEPORT	ALEXANDRIA	LOWER MOUTH
2000 AD	HISTORIC			
		Kadohadacho Confederacy	CADDO V	Natchitoches Confederacy
1500 AD	MISSISSIPPIAN			Natchez
Late Miss.		Belcher/Bossier	CADDO IV	
			CADDO III	Caddoan/Plaquemine
Middle Miss.		Haley		Mississippi
1000 AD			CADDO II	
Early Miss.				
		Alto/Coles Creek	CADDO I	Coles Creek
500 AD	WOODLAND			Coles Creek
				Baytown
Middle Woodland		Bellevue	Troyville	
AD BC		Marksville	Marksville	Marksville
				Tchula
500 BC		Fourche Maline/Tchefuncte	Tchefuncte	Tchefuncte
Early Woodland			(Ellis) (Gary)	
1000 BC	ARCHAIC		Poverty Point	
Late Archaic			(Motley/Gary) (Ellis)	
3000 BC				
5000 BC			(Evans)	
Middle Archaic				
7000 BC			(Kirk)	
Early Archaic	PALEO-INDIAN		(Dalton/Meserve/San Patrice/Scottsbluff)	
9000 BC				
		From Newkirk and Mueller (1980:96)		

b. Earliest Occupation The valley was first exploited some 12,000 to 8,000 years B.P. by Early Paleo-Indian big-game hunters. Their appearance in the Southeast coincided with the end of the Wisconsin glacial era. The period was one of adaptation to relatively rapid environmental changes. The transition from the Pleistocene to the Holocene was marked by a warming climate, rising sea and river levels, the extinction of Pleistocene megafauna, and their replacement by modern faunal and floral species. No early Paleo-Indian occupation sites are recorded in Louisiana. However, in the northwest portion of the state surface finds of Clovis and Scottsbluff projectile points have been made on Pleistocene or older terraces (Dickson 1979). Because the land surface of the lower valley is less than 6,000 years old, the frequency of such surface finds decreases sharply south of Moncla Gap. In the upper valley there is abundant evidence to hypothesize changes in subsistence and settlement strategies by the time of the Late Paleo-Indian, San Patrice focus. There are at least twenty-four known San Patrice sites in Caddo Parish (Webb et al. 1971) and another twenty in Natchitoches Parish (Gregory and Curry 1978). Several authors (Webb et al. 1971; Gagliano and Gregory 1965; Gregory and Curry 1978) suggest that Late Paleo-Indian groups occupied a series of small camps or established small semi-sedentary base camps. Two settings appear to have been utilized repeatedly: 1) the margin of upland terraces overlooking a river valley, large lakes or lateral streams flowing into a valley, and 2) along small upland streams away from major river valleys (Thomas and Campbell 1978). Gregory and Curry (1978) note an additional preference for remnants of old terraces in the alluvial valley, particularly those adjacent to late Pleistocene or early Holocene lakes. Settlement in similar small camps and a preference for occupation of terrace edges overlooking major tributaries, such as Cane River (Campbell et al. 1978), continued into the early Archaic period (8,000 - 6,000 B.C.).

c. Cultural Diversification. The Archaic period, however, was a time of dynamic expansion which spanned several thousand years (8,000 - 500 B.C.). It was a time of population growth, increased sedentism, and cultural diversification in response to local environmental niches. This expansion is evident in the archeological record from the increase in numbers of surviving sites, and an increase in numbers and types of stone tools manufactured, suggesting a diversification of tasks. In the lower valley, the impressive size and complex pattern of earthen mounds which form the Late Archaic, Poverty Point site (circa 2,000 years B.C.) attest to the development of a complex social system, a sedentary population, and stable subsistence base. The site appears to have been the focal point of a widespread exchange network with outlying sites and related cultures distributed throughout the lower Mississippi River alluvial valley (Webb 1977). In the lower Red River valley, Poverty Point complex sites are located on terraces overlooking rivers, on natural levees, and at the juncture

of rivers and lakes (relict river channels) (Weinstein et al. 1979:3-5). It is significant to note that similar sites have not been found in the middle and upper reaches of the Red River.

d. Sedentary Growth. Following the decline of the Poverty Point influence, the lower alluvial valley was occupied by several Woodland period cultures -- the Tchefuncte, Marksville, and Troyville/Baytown foci. Throughout the Southeast, the Woodland Period is characterized by the increased use of ceramic vessels, construction of burial mounds, ever increasing sedentism, and the expansion of the Archaic Period seasonal round subsistence strategy to include cultivation of squash and possibly bottle gourd (Byrd 1976). In the upper alluvial valley, sites are present which yield ceramics from these three Woodland complexes, but elaborate population/ceremonial centers with burial mounds, such as those found along the lower Red and in the lower Mississippi alluvial valley, are absent. In the upper valley, the settlement pattern and artifact assemblages differ little from those of the preceding Archaic period (Weinstein et al. 1979:3-6; Newkirk and Mueller 1980:101). The Tchefuncte complex does not appear to have spread north of lower Natchitoches Parish (Dickson 1979). The succeeding Marksville complex (100 B.C. - A.D. 300) was a southern expression of the Ohio Valley Hopewellian Interaction Sphere. The term interaction sphere was chosen to describe a previously unprecedented cross-cultural network which linked Woodland groups from the Upper Great Lakes to the Gulf, and from the Eastern Coast to the Mississippi River. The network fostered the exchange of raw materials (such as copper, marine shell, Rocky Mountain obsidian), exotic finished goods (carved bear teeth, human figurines, copper pan pipes and earspools) and ideological concepts (class structure, burial ceremony). Marksville burial mound and associated village sites have been reported as far north as Clear Lake, Black Lake and Black Lake Bayou in Natchitoches Parish (Campbell et al. 1978).

e. Period of Transition. The final Woodland focus, the Baytown complex, is identified archeologically by distinctive ceramic types but is extremely hard to define as a culture. Baytown occupation in both the upper and lower Red River Valley echoes the Marksville and Tchefuncte settlement pattern choices, often reoccupying the same sites. The Baytown focus appears to have been a transitional era between the decidedly Woodland period adaptation of the Marksville phase and the appearance of the new ideas, social organization and subsistence practises introduced during the following Mississippian Period.

f. Cultural Florescence. By A.D. 700 - 900, similar political and social units populated the Southeast. Unlike the Hopewellian Interaction Sphere, which linked diverse cultural groups by a sophisticated trade network, the Mississippian culture embodied a set of religious, political and social concepts held in common by the population of the Gulf Coastal Plain physiographic province. The populations of major alluvial valleys were organized by chiefdom. Archeologically, these spheres of influence are recognizable as large population and ceremonial centers surrounded by smaller settlements and farming hamlets. The chiefdoms were interrelated by trade, warfare, and population exchange through slavery and intermarriage (Hudson 1976). The

Mississippian culture can also be described as an adaptive response which maximized the exploitive potential of the food resource array present in a riverine environment. Settlement locations have been found to correlate directly with areas of tillable alluvial soils. A significant portion of the year was devoted to cultivating corn, beans and squash, the Mississippian dietary staples.

g. Coles Creek Complex. The local expression of the Mississippian culture was the Coles Creek complex (A.D. 700 - 1,200). Coles Creek ceramics and other traits appear at sites throughout the valley, but large village sites with multiple mounds are common only to the lower valley. One example is the Greenhouse site (16AV2) which may have been a regional center surrounded by associated smaller villages or seasonally occupied camps (Belmont 1967; Weinstein et al. 1979:3-8). By A.D. 1,000, the upper and lower valleys were inhabited by two distinct cultures. In the south, the Coles Creek complex flowered into the Plaquemine focus (A.D. 1,200 - 1,700). Many of the same sites continued to be used throughout the Mississippian Period (Weinstein et al. 1979:3-10). In the upper valley, Coles Creek influence diminished with the appearance (circa A.D. 800) of a western people, the Caddo.

h. The Caddo Complex. The Caddo appear to have utilized all portions of the alluvial valley and surrounding terraces. There is some disagreement, however, in the definition of the settlement pattern for the entire cultural sequence. During the earliest, Alto focus (A.D. 800-1,200) the Caddo appear to have lived in floodplain villages located on natural levees. For the following Bossier focus (A.D. 1,200 - 1,400) Webb (1948) noted a movement away from the floodplain to higher terraces. Thomas et al. (1978) recorded sites in both locales and suggested that site function determined site location. By the Belcher focus (A.D. 1,400 - 1,700) the total settlement system included camps, saltworks, single family farming hamlets, villages of multiple hamlets, and single truncate mounds with associated villages (Thomas et al. 1978). While the sequence in the extreme upper valley developed from the Alto into Bossier then Belcher foci, the Caddo occupying the middle valley between Montgomery and Natchitoches, maintained the Alto-Bossier life-style up until A.D. 1,500. At that time, the Caddo in the upper and middle valley appear to have united into a single society, described as the Glendora complex. The large burial mound and ceremonial centers developed during the Bossier and Belcher foci lost favor. The population was distributed along natural levees in extended villages of multiple hamlets, each with its own small cemetery. During this period, the Southeastern Indians were introduced to European influence. Concurrent with increased trade came Old World diseases, population dispersal, internal warfare, and the disintegration of recognized political systems and boundaries. By the early 1800's many Indian groups were being assimilated into European culture.

Most were removed from their ancestral lands. Many groups moved through the Red River Valley following European settlement of Alabama, Mississippi and southern Louisiana (GSRI 1975:96). Following the Treaty of Doak's Stand in 1829, the Choctaw abandoned the Chickasawhay River in Mississippi and resettled near Alexandria and Catahoula Lake, Louisiana. The Tunica migrated throughout the 18th century, finally settling near Marksville, Louisiana. During this same period, the Caddo moved in unison down the Red River from the Great Bend region in Arkansas to northern Louisiana. In 1835 they signed a treaty with the United States selling some one million acres located between Texarkana, Arkansas and Desoto Parish, Louisiana (Webb and Gregory 1978:22). The Caddo eventually left Louisiana and settled along the Kiamichi River in Oklahoma.

i. Prehistoric Patterns. Southeastern prehistory is a record of slowly evolving responses to environmental change. The greatest adjustments occurred during the Paleo-Indian and Archaic Periods with the shift from migratory big game hunting to semi-sedentary exploitation of smaller regions. Exploitive changes are directly reflected in the settlement shift from upland terraces to the alluvial valley itself. Following the initial shift, subsequent subsistence and settlement changes represent refinements in the adaptation to the alluvial valley niche. Of major importance to cultural development were the concepts of scheduling plant and animal harvests and developing food storage techniques during the Archaic Period, followed by selecting and cultivating wild plants, creating ceramic vessels and the bow and arrow during the Woodland Period. All of these technological advances were further refined by the Mississippian culture to support the largest and most politically sophisticated of prehistoric populations in the Southeast.

j. Man-Land Relationships. The Moncla Gap divides the upper and lower valley geographically and culturally. The lower valley is synonymous with the combined valleys of the Red, Black and Mississippi Rivers. With the exception of the initial Paleo-Indian migration, which is assumed to have come from the north and west, most cultural influences prior to A.D. 800 traveled to the Red from the east and south through the Mississippi alluvial valley. The upper and lower Red River valleys share a similar culture history but the upper valley has frequently been only a conservative edge-area for more sophisticated social systems which developed to fuller extent in the lower valley.

k. French Settlement. As noted above, the appearance of European settlers abruptly altered aboriginal cultural development. The French claimed Louisiana as a colony in 1699. Historic settlement of the territory was directly linked to exploration of the Red River, the French incentive to trade, and the implacement of military installations which attracted settlers to their vicinity. In the late 1600's, Henri de Tonti explored the Red River as far north as the Shreveport vicinity. He established trade relations with the Indian groups met along his route. The chief commodity of interest was salt. The principle salt sources were 1) near

Natchitoches, 2) 15 leagues west of Los Adaes, and 3) west of Bayou Pierre (Gregory 1973). On a separate expedition, Sieur de Bienville traveled as far north as Natchitoches where he founded Fort St. Jean Baptiste in 1714. The fort was the most important military and trade center on the Red, linking river traffic from the Mississippi with the Camino Real Trail into the Texas Territory (Newkirk and Mueller 1980). By 1719 the French were actively trading cattle and hides in exchange for salt and Lipan Apache slaves (Gregory 1973). European settlement of the floodplain began in earnest during the 1720's. Indian uprisings occurred during the 1730's in response to the white frontier movement, but did little to halt the competition.

l. Spanish Rule. Louis XV of France ceded Louisiana to Spain in 1762. The practice of Indian slavery was halted but the French legal code and colonial administrations remained in force. Relevant to the proposed Red River Waterway are the settlement patterns introduced during this and the previous period. Early settlements, like the Caddo villages before them, were aligned with the sinuous crests of natural levees. There was a single rambling main street (Stokes 1964). The Catholic Church divided the colony into missionary parishes which are retained today as political and social units. The population increased in direct response to a land grant offer which attracted American, French Canadian and Acadian immigrants. River bottomland was divided then and has remained divided by the French arpent measurement system whereby the rich riverfront acreage and less desirable backswamp land were evenly apportioned to all grantees in narrow, assymmetrical strips. The land grants were the basis of a tobacco and indigo plantation economy which catered to the European market. By 1810, cotton replaced indigo as a major cash crop. In contrast to the bottomland, the adjacent pine hill acreage was eventually sold in small units to poorer individuals who worked the land with family labor rather than slaves. The upland terraces also served as a place of refuge for freed or runaway Blacks and Indians (Newkirk and Mueller 1980:156).

m. Statehood. The ceding of Louisiana from Spain back to France had little effect on area settlement. In 1803 France sold the Louisiana colony to the United States. The ensuing push for statehood made it necessary for the first time to establish a recognized and fortified western border between Louisiana and the Texas Territory. By 1815 the first steamboats plied the river to Natchitoches but could not proceed farther north because of the Great Raft. In 1833 the raft was 92 miles long, extending from Loggy Bayou north to the Hurricane Bluffs. The impediment of the Raft was not great enough to influence the rising number of immigrants intent on settling in Louisiana, however. President Jefferson had authorized a full survey of the Louisiana Territory in the

early 1800's. In 1828 the US Army Corps of Engineers initiated raft removal and in 1835 Capt. Shreve and others founded Shreveport. This new settlement replaced Natchitoches as the northern-most Red River port and trade center. River traffic was induced to travel farther upriver even though the raft was not completely removed. Shreveport was a gateway to Texas, which gained its independence in 1836. It was also a gateway to the one million acres of Red River bottomland which the Caddo sold by treaty in 1835. In sum, these events stimulated an immigration wave between 1830 and 1850 (Newkirk and Mueller 1980).

n. Twentieth Century. The post Civil War years brought reorganization and industrial growth. The previous plantation system was replaced by tenant farming on the same arpent parcels. Navigation was enhanced by the final clearing of the Great Raft in the 1870's, followed by removal of the rapids at Alexandria. By 1900, however, steamship commerce was partially replaced by railroad and overland road networks which fostered the development of small communities located away from the main river. The pine forests of the adjacent Pleistocene and Tertiary terraces were heavily exploited during the timber boom of 1910 to 1914. This industry declined when clearcutting was introduced and the virgin stands of pine disappeared (Newkirk and Mueller 1980). The first Red River oil field was discovered in 1913 (Nichols 1941). While the resultant petrochemical industry has added multiple sites of varying function to the future archeological record, it has not yet destroyed the rural disposition of the valley as a whole. Increased impact on geomorphic features, our three hundred year old land use pattern, and a 10,000 year old cultural record is inevitable in the evolution of exploitive adaptations. Prior to the twentieth century technological expansion, these impacts occurred in small stages. Over the next quarter century the surface environment may be subjected to massive change from the exploitation of additional fuel sources. Of particular import to the Red River Valley will be the development of the lignite industry.

3. Archeological Investigations Associated With Red River Waterway Plan Development.

a. Literature Searches. The Red River Waterway has been an active project for at least a decade. Project planning was initiated in the early to mid 1960's. Multiple revetments and channel realignments have already been constructed. The first cultural resources overviews were prepared for the US Army Corps of Engineers by the National Park Service (Davis 1968, 1970) and summarized what was known at that time of prehistoric occupation and cultural chronology. In 1974, Gulf South Research Institute (GSRI 1975) conducted a magnetometer survey of the river, locating approximately 200 anomalies. The GSRI team also conducted a terrestrial reconnaissance of the river's banks from its mouth to the Arkansas state line, and just to the north and west of Shreveport in the vicinity of Twelve Mile Bayou, Caddo Lake, and Cypress

Bayou as far as Daingerfield, Texas. The report of these investigations briefly discussed 74 sites in Louisiana and included recommendations for further testing.

b. Intensive Terrestrial Surveys. Initiation of the revetment and channel realignment construction program required intensive survey of specific project areas. The majority of cultural resources survey, impact assessment, site testing and data recovery was conducted on an item by item basis, determined by the construction schedule per fiscal year. Areas assessed have been limited to construction rights-of-way. The bulk of the constructed revetment and channel realignment items has been surveyed by Jon L. Gibson (1977a, 1977b, 1977c, 1977d, 1977e, 1977f, 1977g, 1977h, 1978a, 1978b, 1978c, 1978d), of the University of Southwestern Louisiana; Bert Rader (1978) of the US Army Corps of Engineers; Bruce Dickson (1979) of New World Research; Sherwood Gagliano et al. (1979) and Richard Weinstein et al. (1979), both from Coastal Environments Inc.; and most recently by Judith Newkirk (Newkirk and Mueller 1980) of Commonwealth Associates. Most of these investigations included evaluation of significance of located sites. New World Research (Thomas and Wright et al. 1978) conducted separate test excavations at site 16NA171 prior to construction of Cognac Revetment. The site, a Caddo village or hamlet, had been largely destroyed by erosion and was determined to be insignificant. The Commonwealth project was the first comprehensive study of the Waterway since the initial GSRI reconnaissance in 1974. The scope included intensive survey of all revetment, realignment, lock and dam, and disposal sites identified as of 1978 and was oriented toward examining the impacts of the B-3m plan. In selected areas spanning the length of the Waterway, Commonwealth located 47 new sites, relocated 13 known sites from GSRI's (1975) reconnaissance, and tested 16 sites. Further evaluation or data recovery has been recommended for 5 sites. Those sites not tested were twentieth century in origin. The report of these investigations is currently being coordinated with the Louisiana State Historic Preservation Officer and the Department of the Interior. Table I-2 lists the sites located within the proposed impact zone and indicates the expected project impact, the status of testing and determination of eligibility to the National Register of Historic Places. Of the some 102 sites reported to date, 65 are located within the proposed project impact zone.

c. Data Recovery. Of the sites located prior to the Commonwealth survey (Newkirk and Mueller 1980), 5 in the impact zone required testing and only one required additional data recovery. In 1977, New World Research tested, then excavated the Hanna site (16RR4), a buried Alto focus village of the Caddo period (Thomas et al. 1978). In 1980, Louisiana State University recovered a fossilized, Eocene era whale skeleton from Montgomery Landing. The find is the most complete Basilosaurus specimen ever recovered. The report of these investigations is expected by Fall 1981.

d. Magnetometer Surveys. Using GSRI's (1975) initial magnetometer survey results, Rone Engineering recently investigated six anomalies in the vicinity of Locks and Dams 2 and 3 to assess their eligibility to the National Register of Historic Places and to develop an appropriate mitigation plan, if necessary. The report of these investigations is not yet complete. Under the auspices of Towill Inc., Gulf South Research Institute (Saltus 1980) recently conducted a systematic baseline magnetometer reconnaissance of the channel between Simmesport (mile 7) and Shreveport (mile 274). The reconnaissance provides the District with a comprehensive data bank of over 900 anomaly locations. Also under subcontract to Towill Inc., Coastal Environments Inc. will conduct an intensive magnetometer survey of seventeen selected cut-offs to be impacted by planned channel realignments. The cutoffs are relict 19th century channels in which shipwrecks may have been buried over the last century as the channels filled in. Testing of any located anomalies will be conducted under a separate investigation. The initial data from Coastal Environment's survey is expected by late 1981. Apart from these large scale investigations, Gulf South Research Institute relocated and investigated three anomalies reported previously (GSRI 1975) in the Dunn Lake area prior to revetment construction. All three anomalies were determined to be outside the project impact area. Prior to construction of Coushatta Revetment eight additional anomalies originally reported by GSRI (1975) were investigated and determined to be remains of historic structures which had caved into the river in recent years.

e. Future work. Additional intensive surveys are scheduled for the remaining revetments, disposal areas, additional channel alignments, free-board, dam pools, mitigation acreage and recreation sites. Much of this work is associated with Locks and Dams 4 and 5 at the upper end of the Waterway and will include additional deep backhoe testing of selected locales in an effort to locate deeply buried sites. All newly recorded sites will be assessed and data recovery will be conducted where necessary. Mitigation plans will be required for the recovery of Bailey's Dam (16RA516/90), the Log Raft site (16AV62) and are expected to be necessary for several sites reported by Newkirk and Mueller (1980), dependent upon the selected plan of construction.

TABLE I-2
PROJECT IMPACT ON CULTURAL RESOURCES

Site	Pre-historic	Historic	Type of Impact	Impacting Plan	Pool	Survey	Testing	Significance	NRHP Status	Data Recovery
16AV42	X		R/D	Both	1	CSRI (1975)	None-nondiagnostic ceramic, lithic scatter	Unknown	-	-
16AV62		X	R/D	Both	1	Weinstein et al. (1979)	photographed	Historic log raft	Eligible	None-site destroyed
16CT148	X	X	R	Both	1	Weinstein et al. (1979)	Weinstein et al. (1979)	None-natural feature misidentified as mound; surface scatter	-	-
16RA13	X		C/D	Both	2	CSRI (1975) Gibson (1977b)	None-eroding surface scatter	Unknown	-	-
15RA40	X		C	Both	2	CSRI (1975) Gagliano et al. (1979)	shovel tested	None-surface lithic scatter	-	-
16RA41	X		C	Both	2	CSRI (1975) Gagliano et al. (1979)	Hartley (1980)	None-surface lithic scatter	-	-
16RA53	X	X	C	Both	1	Gibson (1978c)	None-eroded lithic and historic scatter; not <u>in situ</u>	None	-	-
16RA76		X	Pu	Both	2			Historic earth-work	Nominated	to be completed
16RA78		X	C	Both	2	Gagliano et al. (1979)	Gagliano et al. (1979)	None-19th c. surface scatter; no structural remains	-	-
16RA89		X	Pu	Both	2			Historic earth-work	Nominated	to be completed
16RA119		X	R/D	Both	2	Gibson (1977h)	None-20th c. cistern; no structural remains	None	-	-
16RA125		X	C	B-1 B-3M	2 3	Newkirk & Mueller (1980)	shovel tested	None-recent, disturbed surface scatter	-	-
16RA126	X		D	B-3M	3	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	None-nondiagnostic lithic scatter	-	-
16RA127	X		D	B-3M	3	Newkirk & Mueller (1980)	shovel tested	None-surface lithic scatter	-	-

TABLE I-2 continued

Site	Pre-historic	Historic	Type of Impact	Impacting Plan	Pool	Survey	Testing	Significance	NRHP Status	Data Recovery
16RA128	X		C/D	B-3M	3	Newkirk & Mueller (1980)	shovel tested	None-disturbed	-	-
16RA129	X	X	D	B-3M	3	Newkirk & Mueller (1980)	shovel tested	None-disturbed; historic dump	-	-
16RA130	X	X	C/D	B-3M	3	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	None-disturbed	-	-
16RA131	X	X	C	B-1 B-3M	2 3	Newkirk & Mueller (1980)	shovel tested	None-recent surface scatter	-	-
16RA132	X	X	D	B-3M	3	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	None-sparse, nondiagnostic occupation debris	-	-
16RA133	X		C/D	B-3M	3	Newkirk & Mueller (1980)	shovel tested	None-re-deposited	-	-
16RA134	X		C/D	B-3M	3	Newkirk & Mueller (1980)	shovel tested	None-disturbed; not in situ	-	-
16RA135	X		C/D	B-3M	3	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	Multi-component in situ occupation	to be determined	-
16RA503/79		X	C	Both	2	GSRI (1975) Weinstein et al. (1979)	shovel tested	Flint Plantation	to be determined	-
16RA504		X	R	Both	2	GSRI (1975)	None	None-19th c. surface scatter	-	-
16RA507/82		X	R R/D	B-1 B-3M	2 2	GSRI (1975) Newkirk & Mueller (1980)	No-recent abandoned settlement	None-surface scatter	-	-
16RA509/84		X	C D	B-1 B-3M	2 3	GSRI (1975) Newkirk & Mueller (1980)	No-GSRI site not relocated	None-destroyed by pond excavation (?)	-	-

TABLE I-2 continued

Site	Pre-historic	Historic	Type of Impact	Impacting Plan	Pool	Survey	Testing	Significance	NRHP Status	Data Recovery
16RA510/85		X	C D	B-1 B-3M	2 3	GSRI (1975) Newkirk & Mueller relocated (1980)	No-GSRI site not relocated	None-eroded into river (?)	-	-
16RA516/90		X	R	Both	2	GSRI (1975) Weinstein et al.	None	Bailey's Dam	Nominated	to be completed
16NA20/181	X	X	R D	B-1 B-3M	3 4	GSRI (1975) Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	None-disturbed; non-diagnostic occupation debris	-	-
16NA21/171	X	X	R	Both	3	GSRI (1975) Gibson (1977d)	Thomas & Wright et al. (1978)	None-eroded by river	-	-
16NA100		X	R/D D/C	B-1 B-3M	3 4	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	18th c. house site	to be determined	-
16NA224	X		R/D	B-1 B-3M	3 4	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	Multi-component in situ occupation	to be determined	-
16NA225		X	C D	B-1 B-3M	3 4	Newkirk & Mueller (1980)	None	None-recent surface scatter	-	-
16NA226		X	D	B-3M	4	Newkirk & Mueller (1980)	None	None-recent surface scatter	-	-
16NA229		X	R/D D	B-1 B-3M	3 4	Newkirk & Mueller (1980)	None	None-recent structure and debris	-	-
16NA230		X	D/C	B-3M	4	Newkirk & Mueller (1980)	None	None-recent structure and debris	-	-
16NA231		X	D D/C	B-1 B-3M	3 4	Newkirk & Mueller (1980)	None	None-recent structure and debris	-	-
16NA232		X	D D/C	B-1 B-3M	3 4	Newkirk & Mueller (1980)	None	None-recent structure and debris	-	-

TABLE 1-2 continued

Site	Pre historic	Historic	Type of Impact	Impacting Plan	Pool	Survey	Testing	Significance	NRHP Status	Data Recovery
16NA234	X		D	B-3M	4	Newkirk & Mueller (1980)	Newkirk & Mueller shovel tested	None-disturbed surface scatter	-	-
16NA236		X	D	B-1 B-3M	3 4	Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	Brick Klin	to be determined	-
16NA501		X	C/D	Both	3	GSRI (1975)	None- 19th c. surface scatter	Unknown	-	-
16NA502/180		X	P F	B-1 B-3M	3 3	GSRI (1975)	None-known site of 19th c. homes; site not located in field	Unknown-eroded into river (?)	-	-
16NA503/179		X	C	Both	3	GSRI (1975)	None-known site of 19th c. homes; site not located in field	Unknown-eroded into river (?)	-	-
16NA504/178		X	C	B-1 B-3M	3 4	GSRI (1975) Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	19th c. house site	to be determined	-
16NA505/177		X	R/D	B-1 B-3M	3 4	GSRI (1975) Newkirk & Mueller (1980)	Newkirk & Mueller (1980)	Ambrose Cox House	to be determined	-
16NA506/176		X	R/D C	B-1 B-3M	3 3	GSRI (1975) Newkirk & Mueller (1980)	shovel tested	None-disturbed surface scatter	-	-
16NA507/174		X	R/D	B-1 B-3M	3 4	GSRI (1975) Newkirk & Mueller (1980)	shovel tested	None-eroded; disturbed surface scatter	-	-
16GR504		X	D	B-1	3	GSRI (1975)	None-19th c. debris & cistern	Unknown	-	-
16GR505		X	F	B-1	3	GSRI (1975)	None-late 19th c. frame house	None	-	-
16GR507	X	X	R	Both	3	GSRI (1975) Newkirk & Mueller (1980)	shovel tested-GSRI site not relocated	None-eroded into river	-	-

TABLE I-2 continued

Site	Pre historic	Historic	Type of Impact	Impacting Plan	Pool	Survey	Testing	Significance	NRHP Status	Data Recovery
16RR4	X		P R	B-1 B-3M	4 4	US Army Corps of Engineers	Thomas et al. (1978)	Caddo occupation site	Eligible	Completed
16RR39		X	D	B-3M	5-all elev.	Newkirk & Mueller shovel tested (1980)		None-disturbed surface scatter	-	-
16RR40		X	D	B-1 B-3M	4 5-all elev.	Newkirk & Mueller shovel tested (1980)		None-disturbed surface scatter	-	-
16RR41		X	D/F D	B-1 B-3M	4 4	Newkirk & Mueller shovel tested (1980)		None-disturbed surface scatter	-	-
16RR42	X	X	C	B-1	4	Newkirk & Mueller Newkirk & Mueller (1980)		Coles Creek/Alto focus occupation	to be de-terminated	-
16RR43		X	C/D	B-1	4	Newkirk & Mueller shovel tested (1980)		None-surface scatter	-	-
16RR44		X	C	B-1	4	Newkirk & Mueller shovel tested (1980)		None-surface scatter	-	-
16RR46		X	C	B-1	4	Newkirk & Mueller shovel tested (1980)		None-disturbed surface scatter	-	-
16RR50		X	C	B-1 B-3M	4 5-all elev.	Newkirk & Mueller shovel tested (1980)		None-disturbed surface scatter	-	-
16RR501		X	C	B-1 B-3M	4 5-all elev.	GSRI (1975)	None-recent structure	None	-	-
16RR502		X	P R	B-1 B-3M	4 4	GSRI (1975)	None-house site, 3 cisterns	Unknown-eroded into river (?)	-	-
16RR504/10		X	D	B-1 B-3M	4 5-all elev.	GSRI (1975)	shovel tested	None-surface scatter	-	-

TABLE I-2 continued

Site	Pre-historic	Historic	Type of Impact	Impacting Plan	Pool Survey	Testing	Significance	NRHP Status	Data Recovery
16CD91		X	C	Both	5-all Newkirk & Mueller shovel tested elev. (1980)		to be determined	to be determined	-
16CD92		X	D	B-1	5-all Newkirk & Mueller shovel tested elev. (1980)		None-sparse, disturbed surface scatter	-	-
			F	B-3M	5-145'				
16CD95		X	F	Both	5-145' Newkirk & Mueller shovel tested (1980)		None-redeposited debris	-	-
16B014	X	X	F	Both	5-137' GSRI (1975)	None-Alto focus mound, historic cemetery	Unknown	-	-
16B035			P	B-3M	5-137' Newkirk & Mueller shovel tested		None-surface scatter	-	-
			F	B-3M	5-145' (1980)				
16B039		X	R/D	Both	5-all Newkirk & Mueller shovel tested elev. (1980)		None-isolated cistern	-	-

Key For Types of Impact:

R= Revetment Construction
 F = Freeboard
 P = Navigation Pool
 C = Channel Realignment
 D = Disposal of Dredged Material
 Pu= Public Use, Recreation Area

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1977c Cultural resources survey of Beaver revetment and Maria realignment, Red River Waterway, Rapides Parish, Central Louisiana. Ms. on file, US Army Corps of Engineers, New Orleans District.

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CULTURAL COMPLEXES IN THE RED RIVER - LOWER MISSISSIPPI ALLUVIAL VALLEY

		SHREVEPORT	ALEXANDRIA	LOWER MOUTH	
2000 AD	HISTORIC				
		Kadohadacho Confederacy	CADDO V	Natchitoches Confederacy	Natchez
1500 AD	MISSISSIPPIAN				
Late Miss.		Belcher/Bossier	CADDO IV		
Middle Miss.		Haley	CADDO III	Caddoan/Plaquemine	Mississippi
1000 AD	MISSISSIPPIAN				
Early Miss.			CADDO II		
		Alto/Coles Creek	CADDO I	Coles Creek	Coles Creek
Late Woodland					
500 AD	WOODLAND				
					Baytown
Middle Woodland		Bellevue		Troyville	
AD BC		Marksville		Marksville	Marksville
	WOODLAND				
					Tchula
500 BC		Fourche Maline/Tchefuncte		Tchefuncte	Tchefuncte
Early Woodland				(Ellis) (Gary)	
1000 BC	ARCHAIC				
				Poverty Point	
Late Archaic				(Motley/Gary) (Ellis)	
3000 BC	ARCHAIC				
Middle Archaic				(Evans)	
5000 BC	ARCHAIC				
7000 BC				(Kirk)	
Early Archaic	PALEO-INDIAN				
				(Dalton/Meserve/San Patrice/Scottsbluff)	
9000 BC	PALEO-INDIAN				

From Newkirk and Mueller (1980:96)

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
AND EIS SUPPLEMENT NO. 2

APPENDIX J
HYDROPOWER

J-1

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL EVALUATION REPORT AND
EIS SUPPLEMENT NO. 2
APPENDIX J
HYDROPOWER

1. General The current hydropower preliminary study effort is based on a Corps update of the Federal Energy Regulatory Commission (FERC) evaluations of hydropower potential at the project dam sites for both the B-1 and B-3M plans. The latest FERC report dated 5 May 1981, and a letter modifying the report dated 19 August 1982, are included in this appendix. Using these analyses from FERC, and discussions with the Commission staff, the calculations have been updated to reflect costs and benefits based on October 1981 prices and interest rates of 3 1/4% (project rate), and 7 5/8% (current rate). A summary of the updated results and computation sheets are shown on pages 4 through 17 of this appendix.

2. Assumptions. The following is a presentation of the basis data and assumptions used to update the FERC analysis.

a. General.

(1) The hydroelectric power benefits are estimated on the basis of a federal project; however, the cities of Alexandria, New Roads, Vidalia and Jonesboro, Louisiana, have been granted preliminary FERC permits for feasibility studies of the project's hydropower potential.

(2) In updating that portion of the analysis from 7 3/8% to 7 5/8% it was assumed that the optimal installed capacity would remain the same.

b. Hydrology and Hydraulic Considerations.

(1) Hydrologic data used in previous FERC reports were derived from design memorandum by the Corps' New Orleans District and were assumed to be valid. Assumptions from the previous FERC reports based on Corps data were also assumed to be valid. Pertinent assumptions included the assumption that the water resource available for the production of hydroelectric power is the average monthly gaged flows less total waterway system flows required continuously for other purposes, i.e., lockage, 104 cfs; infiltration, 12 cfs; evaporation, 195 cfs; and leakage, 100 cfs (total, 411 cfs). Hydropower was assumed to be an incidentally added feature to the dams. No attempt was made to make revisions with a view toward economically optimizing hydropower versus other project purposes. The effect hydropower releases may have on navigation tows or the effect they may have on sedimentation was considered, but not specifically addressed. Headwater elevations were assumed fixed at normal top of pool. No power drawdown was considered.

Head losses through powerhouses were estimated to be one foot. At normal pools, the static heads for the B-1 and B-3M plans, respectively, are: L&D No. 2 - 24.0 ft. for both plans; L&D No. 3 - 31 ft. and 23 ft.; L&D No. 4 - 25 ft. and 28 ft.; and L&D No. 5 - 25 ft. and 30 ft. Since the dams will have similar heads, much of the powerhouse machinery could be interchangeable from plant to plant which could result in considerable savings, both initially and in O&M costs. Dependable capacity assigned to the project in the previous FERC report is defined as that available 85 percent of the time during the peak power demand months of June, July, August, and September.

(2) Under the FERC definition of dependable capacity, the entire installed capacity was assumed to be dependable unless generation was constrained by adverse head conditions. Thus defined, the FERC estimate of dependable capacity included an increment of capacity that would not be hydrologically available when flows are inadequate for generation at installed capacity on a continuous basis. In the Corps update, dependable capacity was estimated using the Bickerstaff method. In applying this method, the FERC computed plant factors were found to correlate closely with the area under the flow-duration curves for the peak power demand months. The plant factors were therefore assumed to be representative of the hydrologic availability of the hydropower installation. These factors were adjusted by the ratio of mechanical availability of the hydropower and thermal alternatives (i.e., 98 percent hydropower availability vs 84 percent thermal availability, based on 540 mw thermal units). After adjustment, the factors were multiplied by installed capacity to estimate dependable capacity. Intermittent hydropower capacity (i.e., difference between installed and dependable capacity) was assumed to have economic value, and benefits for intermittent capacity were claimed in the update at one-half the value of dependable capacity.

(3) The assumption that the water resource available for the production of hydroelectric power is the average monthly gaged flows less total waterway system flows required continuously for other purposes was checked by FERC in the light that recent hydrologic studies by the Southwestern Division of the Corps indicate that future flows will be somewhat less than historic flows due to upstream reservoir regulation and depletions resulting from water use. This check was limited to the comparison of historical and projected flows during the critical hydropower period - June through September. In general, it was determined that the future, critical period flows available for hydropower purposes below Shreveport, Louisiana, through the year 2020 will be about 0.4 percent less than the historical flows used in the current analysis. This will be further investigated and considered in detailed hydropower feasibility studies.

c. Capacity Values. Values of \$71.05 (3-1/4% interest) and \$99.05 (7-3/8% interest) used in previous FERC report were assumed to be valid. These values were escalated by applying factors of 12 percent and 15 percent, respectively, based upon recommendations of the Fort Worth office of FERC. The applicable capacity values at October 1981 price levels are \$79.58 (3-1/4 percent) and \$113.90 (7-5/8 percent).

d. Energy Values. Energy values used in previous FERC report (May 1981) were assumed to be valid. The FERC values for Federal financing at 3-1/4 percent interest were escalated by 12 percent and those for 7-3/8 percent interest were escalated by 15 percent, based upon FERC recommendations.

e. Unit Construction Cost. Unit cost of \$1,600/KW used in previous FERC report (May 1981) was assumed to be valid. That cost was updated from October 1980 price levels to October 1981 price levels by applying a factor of 9.5 percent derived from the ratio of ENR construction cost indices applicable to water and power resource development costs. The applicable unit cost at October 1981 price levels is \$1,750/KW.

f. Construction Period. The construction period of 3 years used in previous FERC report was assumed to be valid and was used in the Corps update of the economic analysis.

g. Contingencies. The contingency allowance of 15 percent used in the previous FERC report was assumed to be valid in the light that FERC estimates of unit construction costs were based on as-experienced costs of four existing projects, on a detailed estimate of one proposed project, and on preliminary estimates of two similar projects under study. Also, the 15 percent contingency allowance is consistent with survey scope estimates used in W. D. Mayo Lock and Dam No. 14 report which was completed in October 1980 and has undergone BERH review. No adjustments were made.

h. Unit O&M Costs. The unit costs of \$6.45/KW used in previous FERC report was assumed to be valid. This unit cost was escalated 15 percent to \$7.40/KW, based on FERC recommendation.

i. Administrative and General Expense. Annual costs estimated at 35 percent of annual O&M costs, as used in previous FERC report, were assumed to be valid. No adjustments were made.

j. Annual fixed charges of insurance and replacements. Allowances of 0.2 percent and 0.4 percent of investment costs, respectively, for insurance and replacement were used in previous FERC report. These allowances were assumed to be valid. No adjustment was made.

RED RIVER WATERWAY
HYDROELECTRIC POWER FEASIBILITY
PRELIMINARY ECONOMIC ANALYSIS
PLAN B-1
SUMMARY

L&D No.	Pool Elev. (Ft.)	Plant Factor (%)	Installed Capacity (KW)	Dependable Capacity (KW)	Average Annual Energy (MWh)	Energy Value (Mills/KWh)	Average Annual Benefits (\$1,000)	Average Annual Charges (\$1,000)	B/C Ratio	Net Benefits (\$1,000)
<u>Federal Financing 3 1/4 percent interest</u>										
2	64	45	36,900	19,200	147,775	36.4	7,611	4,008	1.9	3,603
3	95	54	50,000	31,500	234,649	34.3	11,291	5,431	2.1	5,860
4	120	50	35,000	20,300	154,635	35.2	7,643	3,802	2.0	3,841
5	145	61	20,000	14,200	106,206	33.2	4,887	2,173	2.2	2,714
TOTALS			141,900	85,200	643,265		31,432	15,414	2.0	16,018
<u>Federal Financing 7 5/8 percent interest</u>										
2	64	45	36,900	19,200	147,775	37.6	8,751	7,339	1.19	1,412
3	95	54	50,000	31,500	234,649	35.3	12,925	9,945	1.3	2,980
4	120	50	35,000	20,300	154,635	36.2	8,747	6,961	1.3	1,786
5	145	61	20,000	14,200	106,206	33.9	5,547	3,978	1.4	1,569
TOTALS			141,900	85,200	643,265		35,970	28,223	1.3	7,747

1/ Price level - October 1981. Includes benefits for dependable capacity based on capacity values of \$79.58/KW (3 1/4%) and \$113.90/KW (7 5/8%). Includes benefits for intermittent capacity at one-half the value of dependable capacity.

RED RIVER WATERWAY
HYDROELECTRIC POWER FEASIBILITY
PRELIMINARY ECONOMIC ANALYSIS
PLAN B-3M
SUMMARY

L&D No.	Pool Elev. (Ft.)	Plant Factor (%)	Installed Capacity (KW)	Dependable Capacity (KW)	Average Annual Average (MWh)	Energy Value (Mills/KWh)	Average Annual Benefits (\$1,000)	Average Annual Charges (\$1,000)	B/C Ratio	Net Benefits (\$1,000)
<u>Federal Financing 3 1/4 percent interest</u>										
2	64	45	36,900	19,200	147,775	36.4	7,611	4,008	1.9	3,603
3	87	54	25,000	15,700	117,929	34.3	5,664	2,716	2.1	2,948
4	115	53	42,000	26,000	192,413	34.5	9,344	4,562	2.0	4,782
5	145	52	50,000	30,300	226,418	34.7	11,052	5,431	2.0	5,621
TOTALS			153,400	91,200	684,535		33,671	16,717	2.0	16,954
<u>Federal Financing 7 5/8 percent interest</u>										
2	64	45	36,900	19,200	147,775	37.6	8,751	7,339	1.19	1,412
3	87	54	25,000	15,700	117,929	35.3	6,481	4,973	1.3	1,508
4	115	53	42,000	26,000	192,413	35.5	10,703	8,354	1.3	2,349
5	145	52	50,000	30,300	226,418	35.8	12,679	9,945	1.3	2,734
TOTALS			153,900	91,200	684,535		38,614	30,611	1.3	8,003

1/ Price level - October 1981. Includes benefits for dependable capacity based on capacity values of \$79.58/KW (3 1/4%) and \$113.90/KW (7 5/8%). Includes benefits for intermittent capacity at one-half the value of dependable capacity.

PLAN B-1
Lock & Dam No. 2
Analysis for 36,900 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	19,200 kW
Average Annual Energy	147,775,000 kWh/yr
Annual Plant Factor	45%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (19,200 kW) (\$79.58) = \$ 1,528,000
	Intermittent Capacity (17,700 kW) (\$39.79) = 704,000
	Energy (147,775,000 kWh/yr) (\$0.0364) = 5,379,000
Total Annual Benefits	\$ 7,611,000
Costs:	First cost (36,900 kW) (\$1,750/kW) = \$64,575,000
	Interest during construction (3/2)(.0325) (\$64,575,000) = 3,148,000
Sub Total	\$67,723,000
	Engineering and construction supervision --
	Contingencies (.15) (\$67,723,000) = 10,158,000
Total Investment	\$77,881,000
	Amortization (\$77,881,000) (.04673) = \$ 3,639,000
	O&M (36,900 kW) (\$7.40/kW) = 273,000
	Administrative and general expense (.35) (\$273,000) = 96,000
Total Annual Charges	\$ 4,008,000
B/C (\$7,611,000)/(\$4,008,000) =	1.9
Excess benefits over costs	\$ 3,603,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (19,200kW) (\$113.90) = \$ 2,187,000
	Intermittent Capacity (17,700 kW) (\$56.95) = 1,008,000
	Energy (147,775,000 kWh/yr) (\$0.0376) = 5,556,000
Total Annual Benefits	\$ 8,751,000
Costs:	First cost (36,900 kW) (\$1,750/kW) = \$64,575,000
	Interest during construction (3/2)(.07625) (\$64,575,000) = 7,386,000
Sub Total	\$71,961,000
	Engineering and construction supervision --
	Contingencies (.15) (\$71,961,000) = 10,794,000
Total Investment	\$82,755,000
	Amortization (\$82,755,000) (.08423) = \$ 6,970,000
	O&M (36,900kW) (\$7.40/kW) = 273,000
	Administrative and general expense (.35) (\$273,000) = 96,000
Total Annual Charges	\$ 7,339,000
B/C (\$8,751,000)/(\$7,339,000) =	1.19
Excess benefits over costs	\$ 1,412,000

PLAN B-1
Lock & Dam No. 3
Analysis for 50,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	31,500 kW
Average Annual Energy	234,648,700 kWh/yr
Annual Plant Factor	54%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (31,500 kW) (\$79.58) =	\$ 2,507,000
	Intermittent Capacity (18,500) (\$39.79) =	736,000
	Energy (234,648,700 kWh/yr) (\$0.0343) =	8,048,000
Total Annual Benefits		\$ 11,291,000
Costs:	First cost (50,000 kW) (\$1,750/kW) =	\$ 87,500,000
	Interest during construction (3/2) (.0325)	
	(\$87,500,000) =	4,266,000
Sub Total		\$ 91,766,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$91,766,000) =	13,765,000
Total Investment		\$105,531,000
	Amortization (\$105,531,000) (.04673) =	\$ 4,931,000
	O&M (50,000 kW) (\$7.40/kW) =	370,000
	Administrative and general expense (.35)	
	(\$370,000) =	130,000
Total Annual Charges		\$ 5,431,000
B/C (\$11,291,000)/(\$5,431,000) =		2.1
Excess benefits over costs		\$ 5,860,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (31,500 kW) (\$113.90) =	\$ 3,588,000
	Intermittent Capacity (18,500 kW) (\$56.95) =	1,054,000
	Energy (234,648,000kWh/yr) (\$0.0353) =	8,283,000
Total Annual Benefits		\$ 12,925,000
Costs:	First cost (50,000 kW) (\$1,750/kW) =	\$ 87,500,000
	Interest during construction (3/2) (.07625)	
	(\$87,500,000) =	10,008,000
Sub Total		\$ 97,508,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$97,508,000) =	14,626,000
Total Investment		\$112,134,000
	Amortization (\$112,134,000) (.08423) =	\$ 9,445,000
	O&M (50,000 kW) (\$7.40/kW) =	370,000
	Administrative and general expense (.35)	
	(\$370,000) =	130,000
Total Annual Charges		\$ 9,945,000
B/C (\$12,925,000)/(\$9,945,000) =		1.3
Excess benefits over costs		\$ 2,980,000

PLAN B-1
Lock & Dam No. 4
Analysis for 35,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	20,300 kW
Average Annual Energy	154,635,100 kWh/yr
Annual Plant Factor	50%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (20,300 kW) (\$79.58) = \$ 1,615,000
	Intermittent Capacity (14,700 kW) (\$39.79) = 585,000
	Energy (154,635,100 kWh/yr) (\$0.0352) = 5,443,000
Total Annual Benefits	\$ 7,643,000
Costs:	First cost (35,000 kW) (\$1,750/kW) = \$61,250,000
	Interest during construction (3/2) (.0325) (\$61,250,000) = 2,986,000
Sub Total	\$64,236,000
	Engineering and construction supervision --
	Contingencies (.15) (\$64,236,000) = 9,635,000
Total Investment	\$73,871,000
	Amortization (\$73,871,000) (.04673) = \$ 3,452,000
	O&M (35,000 kW) (\$7.40/kW) = 259,000
	Administrative and general expense (.35) (\$259,000) = 91,000
Total Annual Charges	\$ 3,802,000
B/C (\$7,643,000)/(\$3,802,000) =	2.0
Excess benefits over costs =	\$ 3,841,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (20,300 kW) (\$113.90) = \$ 2,313,000
	Intermittent Capacity (14,700 kW) (\$56.95) = 837,000
	Energy (154,635,100 kWh/yr) (\$0.0362) = 5,598,000
Total Annual Benefits	\$ 8,747,000
Costs:	First cost (35,000 kW) (\$1,750/kW) = \$61,250,000
	Interest during construction (3/2) (.07625) (\$61,250,000) = 7,005,000
Sub Total	\$68,255,000
	Engineering and construction supervision --
	Contingencies (.15) (\$68,255,000) = 10,238,000
Total Investment	\$78,493,000
	Amortization (\$78,493,000) (.08423) = \$ 6,611,000
	O&M (35,000 kW) (\$7.40/kW) = 259,000
	Administrative and general expense (.35) (\$259,000) = 91,000
Total Annual Charges	\$ 6,961,000
B/C (\$8,747,000)/(\$6,961,000) =	1.3
Excess benefits over costs	\$ 1,786,000

PLAN B-1
Lock & Dam No. 5 (145' Pool)
Analysis for 20,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	14,200 kW
Average Annual Energy	106,206,300 kWh/yr
Annual Plant Factor	61%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (14,200 kW) (\$79.58/kW/yr) =	\$ 1,130,000
	Intermittent Capacity (5,800 kW) (\$39.79) =	231,000
	Energy (106,206,300 kWh/yr) (\$0.0322/kWh/yr) =	<u>3,526,000</u>
Total Annual Benefits		\$ 4,887,000
Costs:	First cost (20,000 kW) (\$1,750/kW) =	\$35,000,000
	Interest during construction (3/2) (.0325) (\$35,000,000) =	<u>1,706,000</u>
Sub Total		\$36,706,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$36,706,000) =	<u>5,506,000</u>
Total Investment		\$42,212,000
	Amortization (\$42,212,000) (.04673) =	\$ 1,973,000
	O&M (20,000 kW) (\$7.40/kW) =	148,000
	Administrative and general expense (.35) (\$148,000) =	<u>52,000</u>
Total Annual Charges		\$ 2,173,000
B/C (\$4,887,000)/(\$2,173,000) =		2.2
Excess benefits over costs		\$ 2,714,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (14,200 kW) (\$113.90/kW/yr) =	\$ 1,617,000
	Intermittent Capacity (5,800 kW) (\$56.95) =	330,000
	Energy (106,206,300 kWh/yr) (\$0.0339/kWh/yr) =	<u>3,600,000</u>
Total Annual Benefits		\$ 5,547,000
Costs:	First cost (20,000 kW) (\$1,750 kW) =	\$35,000,000
	Interest during construction (3/2) (.07625) (\$35,000,000) =	<u>4,003,000</u>
Sub Total		\$39,003,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$39,003,000) =	<u>5,850,000</u>
Total Investment		\$44,853,000
	Amortization (\$44,853,000) (.08423) =	\$ 3,778,000
	O&M (20,000 kW) (\$7.40/kW) =	148,000
	Administrative and general expense (.35) (\$148,000) =	<u>52,000</u>
Total Annual Charges		\$ 3,978,000
B/C (\$5,547,000)/(\$3,978,000) =		1.4
Excess benefits over costs		\$ 1,567,000

PLAN B-1
Lock & Dam No. 5 (137' Pool)
Analysis for 12,500 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	7,700 kW
Average Annual Energy	58,417,000 kWh/yr
Annual Plant Factor	53%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (7,700 kW) (\$79.58/kW/yr) =	\$ 613,000
	Intermittent Capacity (4,800 kW) (\$39.79) =	191,000
	Energy (58,417,000 kWh/yr) (\$0.0345/kWh/yr) =	2,015,000
Total Annual Benefits		\$ 2,819,000
 Cost:	 First cost (12,500 kW) (\$1,750/kW) =	 \$21,875,000
	Interest during construction (3/2) (.0325)	
	(\$21,875,000) =	1,066,000
Sub Total		\$22,941,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$22,941,000) =	3,441,000
Total Investment		\$26,382,000
	Amortization (\$26,382,000) (.04673) =	\$ 1,233,000
	O&M (12,500 kW) (\$7.40/kW) =	93,000
	Administrative and general expense (.35)	
	(\$93,000) =	33,000
Total Annual Charges		\$ 1,359,000
 B/C (\$2,819,000)/(\$1,359,000) =		 2.1
Excess benefits over costs		\$ 1,460,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (7,700 kW) (\$113.90/kW/yr) =	\$ 877,000
	Intermittent Capacity (4,800 kW) (\$56.95) =	273,000
	Energy (58,417,000 kWh/yr) (\$0.0355/kWh/yr) =	2,074,000
Total Annual Benefits		\$ 3,224,000
 Costs:	 First cost (12,500 kW) (\$1,750 kW) =	 \$21,875,000
	Interest during construction (3/2) (.07625)	
	(\$21,875,000) =	2,502,000
Sub Total		\$24,377,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$24,377,000) =	3,657,000
Total Investment		\$28,034,000
	Amortization (\$28,034,000) (.08423) =	\$ 2,361,000
	O&M (12,500 kW) (\$7.40/kW) =	93,000
	Administrative and general expense (.35)	
	(\$93,000) =	33,000
Total Annual Charges		\$ 2,487,000
 B/C (\$3,224,000)/(\$2,487,000) =		 1.3
Excess benefits over costs		\$ 737,000

PLAN B-1
Lock & Dam No. 5 (135' Pool)
Analysis for 7,500 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	4,900 kW
Average Annual Energy	36,846,000 kWh/yr
Annual Plant Factor	56%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (4,900 kW) (\$79.58/kW/yr) =	\$ 390,000
	Intermittent Capacity (2,600 kW) (\$39.79) =	103,000
	Energy (36,846,000 kWh/yr) (\$0.339/kWh/yr) =	\$ 1,249,000
Total Annual Benefits		1,742,000
Costs:	First costs (7,500 kW) (\$1,750/kW) =	\$13,125,000
	Interest during construction (3/2)	
	(.0325) (\$13,125,000) =	640,000
Sub Total		\$13,765,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$13,765,000) =	2,065,000
Total Investment		\$15,830,000
	Amortization (\$15,830,000) (.04673) =	\$ 740,000
	O&M (7,500 kW) (\$7.40/kW) =	56,000
	Administrative and general expense (.35)	
	(\$56,000) =	20,000
Total Annual Charges		\$ 816,000
B/C (\$1,742,000)/(\$816,000) =		2.1
Excess benefits over costs		\$ 926,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (4,900 kW) (\$113.90/kW/yr) =	\$ 558,000
	Intermittent Capacity (2,600 kW) (\$56.95) =	148,000
	Energy (36,846,000 kWh/yr) (\$0.0348/kWh/yr) =	1,282,000
Total Annual Benefits		\$ 1,988,000
Costs:	First cost (7,500 kW) (\$1,750 kW) =	\$13,125,000
	Interest during construction (3/2) (.07625)	
	(\$13,125,000) =	1,501,000
Sub Total		\$14,626,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$14,626,000) =	\$ 2,194,000
Total Investment		\$16,820,000
	Amortization (\$16,820,000) (.08423) =	\$ 1,417,000
	O&M (7,500 kW) (\$7.40/kW) =	56,000
	Administrative and general expense (.35)	
	(\$56,000)	20,000
Total Annual Charges		\$ 1,493,000
B/C (\$1,988,000)/(\$1,493,000) =		1.3
Excess benefits over costs		\$ 495,000

PLAN B-3M
Lock & Dam No. 2
Analysis for 36,900 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	19,200 kW
Average Annual Energy	147,775,000 kWh/yr
Annual Plant Factor	45%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	
Dependable Capacity (19,200 kW) (\$79.58) =	\$ 1,528,000
Intermittent Capacity (17,700 kW) (\$39.79) =	704,000
Energy (147,775,000 kWh/yr) (\$0.0364) =	5,379,000
Total Annual Benefits	\$ 7,611,000
Costs:	
First cost (36,900 kW) (\$1,750/kW) =	\$64,575,000
Interest during construction (3/2) (.0325)	
(\$64,575,000) =	3,148,000
Sub Total	\$67,723,000
Engineering and construction supervision	--
Contingencies (.15) (\$67,723,000) =	10,158,000
Total Investment	\$77,881,000
Amortization (\$77,881,000) (.04673) =	\$ 3,639,000
O&M (36,900 kW) (\$7.40/kW) =	273,000
Administrative and general expense (.35)	
(\$273,000) =	96,000
Total Annual Charges	\$ 4,008,000
B/C (\$7,611,000) (\$4,008,000) =	1.9
Excess benefits over costs	\$ 3,603,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	
Dependable Capacity (19,200 kW) (\$113.90) =	\$ 2,187,000
Intermittent Capacity (17,700 kW) (\$56.95) =	1,008,000
Energy (147,775,000 kWh/yr) (\$0.0376) =	5,556,000
Total Annual Benefits	\$ 8,751,000
Costs:	
First cost (36,900 kW) (\$1,750/kW) =	\$64,575,000
Interest during construction (3/2) (.07625)	
(\$64,575,000) =	7,386,000
Sub Total	\$71,961,000
Engineering and construction supervision	--
Contingencies (.15) (\$71,961,000) =	10,794,000
Total Investment	\$82,755,000
Amortization (\$82,755,000) (.08423) =	\$ 6,970,000
O&M (36,900 kW) (\$7.40/kW) =	273,000
Administrative and general expense (.35)	
(\$273,000) =	96,000
Total Annual Charges	\$ 7,339,000
B/C (\$8,751,000)/(\$7,339,000) =	1.19
Excess benefits over costs	\$ 1,412,000

PLAN B-3M
Lock & Dam No. 3
Analysis for 25,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	15,700 kW
Average Annual Energy	117,929,000 kWh/yr
Annual Plant Factor	54%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (15,700 kW) (\$79.58) =	\$ 1,249,000
	Intermittent Capacity (9,300) (\$39.79) =	370,000
	Energy (117,929,000 kWh/yr) (\$0.0343) =	4,045,000
	Total Annual Benefits	<u>5,664,000</u>
Costs:	First cost (25,000 kW) (\$1,750/kW) =	43,750,000
	Interest during construction (3/2) (.0325)	
	(43,750,000) =	2,133,000
	Subtotal	<u>45,883,000</u>
	Engineering & construction supervision	--
	Contingencies (.15) (\$45,883,000) =	6,882,000
	Total Investment	<u>52,765,000</u>
	Amortization (\$52,765,000) (.04673) =	2,466,000
	O&M (25,000 kW) (\$7.40/kW) =	185,000
	Administration & general expenses (.35) (\$185,000) =	65,000
	Total Annual Charges	<u>\$ 2,716,000</u>
	B/C (\$5,664,000)/(\$2,716,000)	2.1
	Excess benefits over costs	<u>\$ 2,948,000</u>

Annual for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (15,700 kW) (\$113.90) =	\$ 1,788,000
	Intermittent Capacity (9,300 kW) (\$56.95) =	530,000
	Energy (117,939,000 kWh/yr) (\$0.0353) =	4,163,000
	Total Annual Benefits	<u>\$ 6,481,000</u>
Costs:	First cost (25,000 kW) (\$1,750/kW) =	43,750,000
	Interest during construction (3/2)(.07635)	
	(\$43,750,000) =	5,004,000
	Subtotal	<u>\$48,754,000</u>
	Engineering and construction supervision	--
	Contingences (.15) (\$48,754,000)	7,313,000
	Total Investment	<u>\$56,067,000</u>
	Amortization (\$56,067,000) (.08423) =	\$ 4,723,000
	O&M (25,000 kW) (\$7.40/kW) =	185,000
	Administration and general expense (.35) (185,000) =	65,000
	Total Annual Charges	<u>\$ 4,973,000</u>
	BC (\$6,481,000)/(\$4,973,000) =	1.3
	Excess benefits over costs	<u>\$ 1,508,000</u>

PLAN B-3M
Lock & Dam No. 4
Analysis for 42,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	26,000 kW
Average Annual Energy	192,413,000 kWh/yr
Annual Plant Factor	53%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (26,000 kW) (\$79.58)=	\$ 2,069,000
	Intermittent Capacity (16,000 kW) (\$39.79)=	637,000
	Energy (192,413,000 kWh/yr) (\$0.0345)=	<u>6,638,000</u>
	Total Annual Benefits	\$ 9,344,000
Costs:	First cost (42,000 kW) (\$1,750/kW)=	73,500,000
	Interest during construction (3/2) (.0325) (\$73,500,000)=	<u>3,583,000</u>
Sub Total		\$77,083,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$77,083,000)=	<u>11,562,000</u>
Total Investment		\$88,645,000
	Amortization (\$88,645,000) (.04673)=	\$ 4,142,000
	O&M (42,000 kW) (\$7.40/kW)=	311,000
	Administrative and general expense (.35) (\$311,000)=	<u>109,000</u>
Total Annual Charges		\$ 4,562,000
B/C (\$9,344,000) / (\$4,562,000)=		2.0
Excess benefits over costs		\$ 4,782,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (26,000 kW) (\$113.90)=	\$ 2,961,000
	Intermittent Capacity (16,000 kW) (\$56.95)=	911,000
	Energy (192,413,000 kWh/yr) (\$0.0355)=	<u>6,831,000</u>
Total Annual Benefits		\$10,703,000
Costs:	First cost (42,000 kW) (\$1,750/kW) =	\$73,500,000
	Interest during construction (3/2) (.07625) (\$73,500,000)=	<u>8,407,000</u>
Sub Total		\$81,907,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$81,907,000)=	<u>12,286,000</u>
Total Investment		\$94,193,000
	Amortization (\$94,193,000) (.08423)=	\$ 7,934,000
	O&M (42,000 kW) (\$7.40/kW)=	311,000
	Administrative and general expense (.35) (\$311,000)=	<u>109,000</u>
Total Annual Charges		\$ 8,354,000
B/C (\$10,703,000) / (\$8,354,000)=		1.3
Excess benefits over costs		\$ 2,349,000

PLAN B-3M
Lock & Dam No. 5 (145' Pool)
Analysis for 50,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	30,300 kW
Average Annual Energy	226,418,000 kWh/yr
Annual Plant Factor	52%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (30,300 kW) (\$79.58/kW/yr)=	\$ 2,411,000
	Intermittent Capacity (19,700 kW) (\$39.79)=	784,000
	Energy (226,418,000 kWh/yr) (\$0.0347/kWh/yr)=	7,857,000
	Total Annual Benefits	\$ 11,052,000
Costs:	First cost (50,000 kW) (\$1,750/kW) =	\$ 87,500,000
	Interest during construction (3/2) (.0325) (\$87,500,000)=	4,266,000
Sub Total		\$ 91,766,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$91,766,000)=	13,765,000
Total Investment		\$105,531,000
	Amortization (\$105,531,000) (.04673)=	\$ 4,931,000
	O&M (50,000 kW) (\$7.40/kW)=	370,000
	Administrative and general expense (.35) (\$370,000)=	130,000
Total Annual Charges		\$ 5,431,000
B/C (\$11,052,000) / (\$5,431,000)=		2.0
Excess benefits over costs		\$ 5,621,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (30,300 kW) (\$113.90/kW/yr)=	\$ 3,451,000
	Intermittent Capacity (19,700 kW) (\$56.95)=	1,122,000
	Energy (226,418,000 kWh/yr) (\$0.0358/kWh/yr)=	8,106,000
	Total Annual Benefits	\$ 12,679,000
Costs:	First cost (50,000 kW) (\$1,750 kW) =	\$ 87,500,000
	Interest during construction (3/2) (.07625) (\$87,500,000)=	10,008,000
Sub Total		\$ 97,508,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$97,508,000)=	14,626,000
Total Investment		\$112,134,000
	Amortization (\$112,134,000) (.08423)=	\$ 9,445,000
	O&M (50,000 kW) (\$7.40/kW)=	370,000
	Administrative and general expense (.35) (\$370,000)=	130,000
Total Annual Charges		\$ 9,945,000
B/C (\$12,679,000) / (\$9,945,000)=		1.3
Excess benefits over costs		\$ 2,734,000

PLAN B-3M
Lock & Dam No. 5 (135' Pool)
Analysis for 25,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	14,600 kW
Average Annual Energy	109,911,000 kWh/yr
Annual Plant Factor	50%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (14,600 kW) (\$79.58/kW/yr) =	\$ 1,162,000
	Intermittent Capacity (10,400 kW) (\$39.79) =	414,000
	Energy (109,911,000 kWh/yr) (\$0.0352/kWh/yr) =	3,869,000
Total Annual Benefits		\$ 5,445,000
Costs:	First cost (25,000 kW) (\$1,750/kW) =	\$43,750,000
	Interest during construction (3/2) (.0325) (\$43,750,000) =	\$ 2,133,000
Sub Total		\$45,883,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$45,883,000) =	\$ 6,882,000
Total Investment		\$52,765,000
	Amortization (\$52,765,000) (.04673) =	\$ 2,466,000
	O&M (25,000 kW) (\$7.40/kW) =	185,000
	Administrative and general expense (.35) (\$185,000) =	65,000
Total Annual Charges		\$ 2,716,000
B/C (\$5,445,000)/(\$2,716,000)		2.0
Excess benefits over costs		\$ 2,729,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (14,600 kW) (\$113.90/kW/yr) =	\$ 1,663,000
	Intermittent Capacity (10,400 kW) (\$56.95) =	592,000
	Energy (109,911,000 kWh/yr) (\$0.0362/kWh/yr) =	3,979,000
Total Annual Benefits		\$ 6,234,000
Costs:	First cost (25,000 kW) (\$1,750 kW) =	\$43,750,000
	Interest during construction (3/2) (.07625) (\$43,750,000) =	5,004,000
Sub Total		\$48,754,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$48,754,000) =	7,313,000
Total Investment		\$56,067,000
	Amortization (\$56,067,000) (.08423) =	\$ 4,723,000
	O&M (25,000 kW) (\$7.40/kW) =	185,000
	Administrative and general expense (.35) (\$185,000) =	65,000
Total Annual Charges		\$ 4,973,000
B/C (\$6,234,000)/(\$4,973,000) =		1.3
Excess benefits over costs		\$ 1,261,000

PLAN B-3M
Lock & Dam No. 5 (137' Pool)
Analysis for 30,000 kW Installation
(1 October 1981 Price Levels)

Dependable Capacity	17,800 kW
Average Annual Energy	134,007,000 kWh/yr
Annual Plant Factor	51%

Analysis for 3-1/4% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (17,800 kW) (\$79.58/kW/yr) =	\$ 1,417,000
	Intermittent Capacity (12,200 kW) (\$39.79) =	485,000
	Energy (134,007,000 kWh/yr) (\$0.0349/kWh/yr) =	4,677,000
	Total Annual Benefits	\$ 6,579,000
Costs:	First Cost (30,000 kW) (\$1,750/kW) =	52,500,000
	Interest during construction (3/2) (.0325)	
	(\$52,500,000) =	2,559,000
	Subtotal	\$55,059,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$55,059,000) =	8,259,000
	Total Investment	\$63,318,000
	Amortization (\$63,318,000) (.04673) =	2,959,000
	O&M (30,000 kW) ((\$7.40/kW) =	222,000
	Administrative and general expense (.35) (\$222,000) =	78,000
	Total Annual Charges	3,259,000
	B/C (\$6,579,000)/(\$3,259,000)	2.0
	Excess benefits over costs	\$ 3,320,000

Analysis for 7-5/8% Interest Rate - Federal Financing

Benefits:	Dependable Capacity (17,800 kW) (\$113.90/kW/yr) =	\$ 2,027,000
	Intermittent Capacity (12,200 kW) (\$56.95) =	695,000
	Energy (134,007,000 kWh/yr) (\$0.0360/kWh/yr) =	4,824,000
	Total Annual Benefits	\$ 7,546,000
Costs:	First cost (30,000 kW) (\$1,750 kW) =	52,500,000
	Interest during construction (3/2) (.07625)	
	(\$52,500,000) =	6,005,000
	Subtotal	\$58,505,000
	Engineering and construction supervision	--
	Contingencies (.15) (\$58,505,000) =	8,776,000
	Total Investment	\$67,281,000
	Amortization (\$67,281,000) (.08423) =	\$ 5,667,000
	O&M (30,000 kW) (\$7.40/kW) =	222,000
	Administrative & general expense (.35) (\$222,000) =	78,000
	Total Annual Charges	\$ 5,967,000
	B/C (\$7,546,000)/(\$5,967,000) =	1.3
	Excess benefits over costs	\$ 1,579,000

FEDERAL ENERGY REGULATORY COMMISSION

REGIONAL OFFICE

819 Taylor Street - Room 9A05
Fort Worth, Texas 76102

May 5, 1981

In reply refer to:
OEPR-FW

Mr. Frederic M. Chatry
Chief, Engineering Division
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Reference: LMNED-MW

Dear Mr. Chatry:

Your letter of April 10, 1981, requested this office to provide a single report on Lock and Dam Nos. 2 through 5 on the Red River Waterway (RRWW) which would summarize the results of the five previous reports and update the economic costs and benefits to an October 1980 price level. You also requested that the interest rates used in the evaluation include both the present rate of 7 3/8% and the RRWW project rate of 3 1/4%. It was subsequently agreed via telephone with your staff that a letter report would suffice for your purposes. Our studies have been completed and the results are summarized herein.

The reports previously completed by FERC that were used in this investigation are dated June 1979, January 1980, May 1980, September 1980 and February 1981. These reports covered Lock and Dam Nos. 2 through 5 on the Red River for the B-1 Plan and B-3M Plan which have been described by the Corps of Engineers, New Orleans District, as alternative plans.

Additional power routings to obtain a more precise determination of installed capacities were not performed for this current investigation. The five reports were reviewed and the capacities, along with their supporting data, were tabulated as shown in Tables 1 through 4. The two plans, B-1 and B-3M, were separated and each was analyzed for each interest rate.

The costs were updated from January 1980 price levels (\$1450/kW) to October 1980 price levels (\$1600/kW) by the Water and Power Resource Service's Construction Cost (ENR) Index. (This cost does not include transmission line cost from the project site to the transmission grid network.) The O&M costs were assumed to be the same as those used in the February 1981 report (\$6.45/kW). All other assumptions of costs and methods of analysis were the same as those indicated in the previous reports. The power benefits used in this analysis

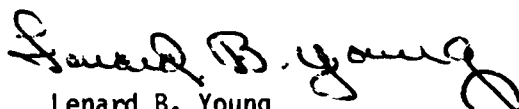
were also updated to October 1980 values and an explanation of the computations and assumptions is enclosed as Attachment A. These updated values are reflected in the Summary Tables 1 through 4 for Lock and Dam Nos. 2 through 5.

A review of Tables 1 through 4 indicates that hydropower has a favorable benefit-to-cost ratio at all four dams and in most cases has a large excess of benefits. Please note that the "R" adjacent to the installed capacity column of the tables denotes the recommended capacity at the time the corresponding FERC report was completed. Based on the updated values the recommended size, if selected by the maximum excess benefits criteria, is changed in some cases as indicated by the asterisk adjacent to the last column. Larger capacities may be desirable in order to maximize the amount of energy production from this renewable resource, thus maximizing the savings of alternative finite energy resources.

Please note that our views and conclusions as expressed herein are submitted at field level and as such are not to be construed as binding on the Federal Energy Regulatory Commission.

We will be pleased to respond to any questions you may have on these matters.

Sincerely yours,


Lenard B. Young
Regional Engineer

Attachments:
As stated

Table 1
Red River Waterway Study For Hydropower
Plan B-1 Federal Financing 7 3/8%

May 1981

Date of Original FERC Report	L&D No.	Pool Elev. (ft)	Plant Factor	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average/ Annual Benefits \$1000	Average/ Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
5/80	2	64	45	36,900	30,000	147,775	32.7	7,803.7	6,498.6	1.20	1,305.1*
	2	64	45	30,000	24,500	123,452	32.7	6,463.6	5,283.5	1.22	1,180.1
	2	64	47	27,500(R)	21,000	117,682	32.2	5,869.4	4,843.2	1.21	1,026.2
	2	64	48	24,800	16,000	104,403	32.0	4,925.7	4,367.7	1.13	558.0
9/80	3	95	52	52,800	49,750	238,965	31.1	12,359.5	9,298.9	1.33	3,060.6
	3	95	54	50,000(R)	49,000	234,649	30.7	12,057.2	8,805.8	1.37	3,251.4*
	3	95	57	45,000	44,000	224,894	30.1	11,127.5	7,925.2	1.40	3,202.3
	3	95	61	40,000	39,000	212,223	29.5	10,123.5	7,044.6	1.44	3,078.9
	3	95	64	35,000	34,000	196,830	29.0	9,075.7	6,164.0	1.47	2,911.7
9/80	4	120	49	35,880	35,880	155,504	31.7	8,483.4	6,319.0	1.34	2,164.4
	4	120	50	35,000(R)	35,000	154,635	31.5	8,337.7	6,164.0	1.35	2,173.7*
	4	120	54	32,000	32,000	150,101	30.7	7,777.7	5,635.7	1.38	2,142.0
	4	120	56	30,000	30,000	146,294	30.3	7,404.2	5,283.5	1.40	2,120.7
	4	120	61	25,000	25,000	133,948	29.5	6,427.7	4,402.9	1.46	2,024.8
1/80	5	135	51	9,500(R)	6,600	42,503	31.3	1,984.1	1,673.1	1.19	311.0
	5	135	56	7,500	5,500	36,846	30.3	1,661.2	1,320.9	1.26	340.3*
	5	135	63	5,000	3,600	27,503	29.1	1,156.9	880.6	1.31	276.3
1/80	5	137	53	12,500(R)	9,600	58,417	30.9	2,756.0	2,201.4	1.25	554.6*
	5	137	58	10,000	7,600	51,095	30.0	2,285.6	1,761.1	1.30	524.5
	5	137	63	8,000	6,500	43,966	29.1	1,923.2	1,408.9	1.37	514.3
1/80	5	145	61	20,000(R)	16,600	106,206	29.5	4,777.3	3,522.3	1.36	1,255.0*
	5	145	63	18,000	14,900	99,184	29.1	4,362.1	3,170.1*	1.38	1,192.0
	5	145	67	15,000	12,700	87,490	28.7	3,768.9	2,641.7	1.43	1,127.2

Assumptions:

Unit Cost \$1600/kW
Capacity Value \$99.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 7 3/8%

1/ Price level - October 1980

(R) - Recommended size from previous report

* - Maximum Excess Benefits for the listed alternatives

Table 2
Red River Waterway Study For Hydropower
Plan B-1
Federal Financing 3 1/4%

May 1981

Date of Original FERC Report	L&D No.	Pool Elev. (Ft)	Plant Factor	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MMHr)	Energy Value Mills/kWh	Average/ Annual Benefits \$1000	Average/ Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
5/80	2	64	45	36,900	30,000	147,775	32.5	6,934.1	3,648.8	1.90	3,285.3*
	2	64	45	30,000	24,500	123,452	32.5	5,752.9	2,966.5	1.94	2,786.4
	2	64	47	27,500(R)	21,000	117,682	32.1	5,269.6	2,719.3	1.94	2,550.3
	2	64	48	24,800	16,000	104,403	31.8	4,456.8	2,452.3	1.82	2,004.5
9/80	3	95	52	52,800	49,750	238,965	31.0	10,942.6	5,221.0	2.10	5,721.6*
	3	95	54	50,000(R)	49,000	234,649	30.6	10,661.7	4,944.1	2.16	5,717.6
	3	95	57	45,000	44,000	224,894	30.1	9,895.5	4,449.7	2.22	5,445.8
	3	95	61	40,000	39,000	212,223	29.6	9,052.7	3,955.3	2.29	5,097.4
	3	95	64	35,000	34,000	196,830	29.1	8,143.4	3,460.9	2.35	4,682.5
9/80	4	120	49	35,880	35,880	155,504	31.6	7,463.2	3,547.9	2.10	3,915.3*
	4	120	50	35,000(R)	35,000	154,635	31.4	7,342.3	3,460.9	2.12	3,881.4
	4	120	54	32,000	32,000	150,101	30.6	6,866.7	3,164.2	2.17	3,702.5
	4	120	56	30,000	30,000	146,294	30.3	6,564.2	2,966.5	2.21	3,597.7
	4	120	61	25,000	25,000	133,948	29.6	5,741.1	2,472.1	2.32	3,269.0
1/80	5	135	51	9,500(R)	6,600	42,503	31.2	1,795.0	939.4	1.91	855.6*
	5	135	56	7,500	5,500	36,846	30.3	1,507.2	741.6	2.03	765.6
	5	135	63	5,000	3,600	27,503	29.3	1,061.6	494.4	2.15	567.2
1/80	5	137	53	12,500(R)	9,600	58,417	30.8	2,481.3	1,236.0	2.01	1,245.3*
	5	137	58	10,000	7,600	51,095	30.0	2,072.8	988.8	2.10	1,084.0
	5	137	63	8,000	6,500	43,966	29.3	1,750.0	791.1	2.21	958.9
1/80	5	145	61	20,000(R)	16,600	106,206	29.6	4,323.1	1,977.6	2.19	2,345.5*
	5	145	63	18,000	14,900	99,184	29.3	3,964.7	1,779.9	2.23	2,184.8
	5	145	67	15,000	12,700	87,490	28.8	3,422.0	1,483.2	2.31	1,938.8

Assumptions:

Unit Cost \$1600/kW
Capacity Value \$71.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 3 1/4%

1/ Price level - October 1980

(R) - Recommended size from previous report

* - Maximum Excess Benefits for the listed alternatives

Table 3
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 7 3/8%

May 1981

Date of Original FERC Report	L&O No.	Pool Elev. (Ft)	Plant Factor	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average/ Annual Benefits \$1000	Average/ Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
2/81	2	58	31	23,265	7,000	63,151	36.4	2,992.0	4,097.3	.73	(1,105.3)
	2	58	42	17,000	7,000	63,151	33.6	2,815.2	2,994.0	.94	(178.8)
	2	58	48	15,000(R)	7,000	63,022	32.0	2,710.0	2,641.7	1.03	68.3
	2	58	52	13,000	7,000	59,451	31.1	2,542.3	2,289.5	1.11	252.8*
6/79	3	87	58	34,000(R)	22,500	154,811	30.0	6,872.9	5,987.9	1.15	885.0
	3	87	64	20,000	15,400	112,296	29.0	4,781.9	3,522.3	1.36	1,259.6*
	3	87	69	15,000	11,500	90,545	28.4	3,710.5	2,641.7	1.40	1,068.8
	3	87	72	12,000	9,300	75,464	28.1	3,041.7	2,113.4	1.44	928.3
6/79	4	115	53	42,000(R)	41,500	192,413	30.9	10,056.1	7,396.8	1.36	2,659.3*
	4	115	66	25,000	24,800	145,447	28.8	6,645.3	4,402.9	1.51	2,242.4
	4	115	71	20,000	20,000	124,458	28.2	5,490.7	3,522.3	1.56	1,968.4
	4	115	75	16,000	16,000	105,550	27.8	4,519.1	2,817.8	1.60	1,701.3
2/81	5	135	47	26,695	26,695	110,509	32.2	6,202.5	4,701.4	1.32	1,501.1
	5	135	47	26,600(R)	26,600	110,509	32.2	6,193.1	4,684.7	1.32	1,508.4
	5	135	50	25,000	25,000	109,911	31.5	5,938.4	4,402.9	1.35	1,535.5*
6/79	5	145	52	50,000(R)	50,000	226,418	31.1	11,994.1	8,805.8	1.36	3,188.3*
	5	145	71	25,000	25,000	155,447	28.2	6,859.8	4,402.9	1.56	2,456.9
	5	145	76	20,000	20,000	132,398	27.7	5,648.4	3,522.3	1.60	2,126.1
	5	145	80	16,000	16,000	111,889	27.3	4,639.3	2,817.8	1.65	1,821.5

Assumptions:

Unit Cost \$1600/kW
Capacity Value \$99.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 7 3/8%

1/ Price level - October 1980

(R) - Recommended size from previous report

* - Maximum Excess Benefits for the listed alternatives

Table 4
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 3 1/4%

May 1981

Date of Original FERC Report	LAD No.	Pool Elev. (Ft.)	Plant Factor	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average/ Annual Benefits \$1000	Average/ Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
2/81	2	58	31	23,265	7,000	63,151	36.1	2,777.1	2,300.5	1.21	476.6
	2	58	42	17,000	7,000	63,151	33.3	2,600.3	1,681.0	1.55	919.3
	2	58	48	15,000(R)	7,000	63,022	31.8	2,501.4	1,483.2	1.69	1,018.2
	2	58	52	13,000	7,000	59,451	31.0	2,340.3	1,285.5	1.82	1,054.8*
6/79	3	87	58	34,000(R)	22,500	154,811	30.0	6,242.9	3,362.0	1.86	2,880.9*
	3	87	64	20,000	15,400	112,296	29.1	4,361.9	1,977.6	2.21	2,384.3
	3	87	69	15,000	11,500	90,545	28.6	3,406.6	1,483.2	2.30	1,923.4
	3	87	72	12,000	9,300	75,464	28.3	2,796.4	1,186.6	2.36	1,609.8
6/79	4	115	53	42,000(R)	41,500	192,413	30.8	8,874.9	4,153.1	2.14	4,721.8*
	4	115	66	25,000	24,800	145,447	28.9	5,965.4	2,472.1	2.41	3,493.3
	4	115	71	20,000	20,000	124,458	28.4	4,955.6	1,977.6	2.51	2,978.0
	4	115	75	16,000	16,000	105,550	28.0	4,092.2	1,582.1	2.59	2,510.1
2/81	5	135	47	26,695	26,695	110,509	32.1	5,444.0	2,639.7	2.06	2,804.3
	5	135	47	26,600(R)	26,600	110,509	32.1	5,437.3	2,630.3	2.07	2,807.0*
	5	135	50	25,000	25,000	109,911	31.4	5,227.4	2,472.1	2.11	2,755.3
6/79	5	145	52	50,000(R)	50,000	226,418	31.0	10,571.4	4,944.1	2.14	5,627.3*
	5	145	71	25,000	25,000	155,447	28.4	6,100.9	2,472.1	2.50	3,718.8
	5	145	76	20,000	20,000	132,398	27.9	5,114.9	1,977.6	2.59	3,137.3
	5	145	80	16,000	16,000	111,889	27.6	4,224.9	1,582.1	2.67	2,642.8

Assumptions:

Unit Cost \$1600/kW
Capacity Value \$71.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 3 1/4%

1/ Price level - October 1980

(R) - Recommended size from previous report

* - Maximum Excess Benefits for the listed alternatives

Explanation of Power Values Used
For RRWW Hydropower Study
May 1981

General

The generalized alternative power values based on a market area encompassing Power Supply Area 35 together with the assumptions applicable to these power value calculations are attached hereto. These are at-market values. The real fuel escalation factors which are used to develop life cycle fuel costs were recently obtained from DOE data published in the Federal Register on October 27, 1980. Plant investment costs were computed using Federal interest rates of $7 \frac{3}{8}$ percent and $3 \frac{1}{4}$ percent, and also using a non-Federal rate of $11 \frac{1}{2}$ percent.

The concept of generalized power values was developed for use by the Corps of Engineers in its National Hydropower Study. At that time, it was assumed that combined cycle generating plants would be a viable alternative for hydro plants operating in the 20-30 percent capacity factor range and the power values were developed accordingly. Our current review of practices in this area of study indicates that combined cycle plants are not being presently constructed nor scheduled. Consequently, we have eliminated this alternative from the current calculations of estimated values for hydroelectric plants. The values based on a coal-fired alternative can be used for the 15.1 percent to 100-percent range of hydro capacity factors. The values based on a nuclear alternative can also be used for evaluation of hydro projects with capacity factors of 60 percent or greater.

Attachments

Assumptions & Methodology
Generalized Power Values

May 1981

FORT WORTH REGIONAL OFFICE

Assumptions and Methodology for Computing
Alternative Power Values

Item

Cost Level: October 1980 for plant investment.

Type of Financing Assumed: Private (11 1/2 percent cost of money)
Federal (7 3/8 percent cost of money)
Federal (3 1/4 percent cost of money)

Interim Replacements - None

Taxes - State and Local^{1/} - PSA 35 - 1.65 Percent

^{1/}State and local taxes were computed from weighted average taxes of the major utilities for the years 1977; 1978 and 1979 (Form 1 data).

Thermal Alternative Costs: CONCEPT 5 Computer Program

The Program was run by FWRO using our estimates of construction time for two unit base load plants with a private financing rate of 11 1/2 percent and Federal financing rates of 7 3/8 percent and 3 1/4 percent. The difference in investment cost between "Federal" and "private" is occasioned by the difference in financing rate during the construction period. The combustion turbine investment cost was estimated by FWRO.

Base load unit heat rates were taken from information reported in Forms 1 and 12 and other data on file in this office.

Generating unit sizes were selected for the study area according to sizes which are under construction or planned (assumptions on each of the alternatives are attached).

Alternative Plant Capacity
Factors Range:

0 - 15% combustion turbine (oil-fired)
15.1 - 60% coal-fired station
60.1 - 100% base load nuclear

**Hydroelectric Capacity Value
Adjustment:**

None

**Alternative Plant Substations
and Transmission Lines:**

The design ac voltages of substation and transmission lines were based on the existing and planned ac voltages of lines and substations in the study area. The estimated investment costs for the ac facilities were based on costs obtained from the "Hydro-Electric Power Evaluation" manual. The Handy Whitman Index updated to October 1980 was used to compute these costs.

Project Transmission Lines:

None

Geographical Area:

See attached map.

Capacity & Energy Values:

The FWR0's computerized alternative power value evaluation program was used to calculate at-market capacity values and energy values. This program follows the power value computation routine as contained in the "Hydro-Electric Power Evaluation" manual.

Fuel Costs:

The mid-year 1980 fuel costs for the alternative plants were obtained from DOE data (DOE Region VI Industrial Sector) published in the Federal Register on October 27, 1980. The 1990 fuel costs were escalated for a 30-year period. The year-by-year future values of the fuel costs were multiplied by the present worth factor using the Federal interest rates of 7 3/8 percent and 3 1/4 percent and a private financing rate of 11.5 percent. These future values were summed for a period of 100 years from the project on-line date and multiplied by the capital recovery factor to obtain the single average annual equivalent value.

Energy Value Adjustments:

Energy value adjustments were also made following the procedures in the power evaluation manual. The following area energy costs were used to make the energy adjustments for each of the alternative generating plants average capacity factor range.

System Average Energy Costs^{1/} PSA 35
(mills/kWh)

<u>Plant Capacity Factor Range</u>			
<u>0.15.0%</u>	<u>15.1-30.0%</u>	<u>30.1-60%</u>	<u>60.1-100%</u>
38.6	20.1	17.8	14.2

^{1/} The 1979 system average energy costs data was taken from the 1979 Forms 1 and 1M.

DOE Region No. VI
Industrial Sector

	<u>Period</u>		
	<u>1980.5-1985.5</u>	<u>1985.5-1990.5</u>	<u>1990.5-2030.5</u>
<u>Escalation Rates (Percent)</u>			
Fuel = Oil	3.38	2.94	4.13
Fuel = Coal	9.62	1.45	0.60
Fuel = Nuclear ^{1/}	2.90	1.80	2.60

^{1/} Furnished by the Washington Office (FERC)

Average Annual Equivalent Fuel Costs - POL 1990

	<u>Oil</u> <u>\$/100Btu</u>	<u>Coal</u> <u>\$/100Btu</u>	<u>Nuclear</u> <u>mills/kWh</u>
<u>Financing:</u>			
Federal (3 1/4 percent)	17.77	2.77	11.2
Federal (7 3/8 percent)	15.36	2.71	10.2
Private (11 1/2 percent)	13.84	2.67	9.54

MAY 1981

FORT WORTH REGIONAL OFFICE

ASSUMPTION AND METHODOLOGY FOR COMPUTING ALTERNATIVE POWER VALUES

PSA 35

TYPE OF ALTERNATIVE	COMBUSTION TURBINE, OIL-FIRED
NUMBER AND SIZE OF UNITS	2 - 75 MW UNITS
ALTERNATIVE INVESTMENT COST (11 1/2 PRIV. FIN.)	\$230/kW
ALTERNATIVE INVESTMENT COST (7 3/8 FED. FIN.)	\$226/kW
ALTERNATIVE INVESTMENT COST (3 1/4 FED. FIN.)	\$221/kW
ALTERNATIVE HEAT RATE	14,000 Btu/kWh
ALTERNATIVE TRANSMISSION SYSTEM	TIED TO EXISTING SYSTEM
TYPE OF ALTERNATIVE	COAL-FIRED STEAM
NUMBER AND SIZE OF UNITS	2 - 540 MW UNITS
ALTERNATIVE INVESTMENT COST (11 1/2 PRIV. FIN.)	\$772/kW
ALTERNATIVE INVESTMENT COST (7 3/8 FED. FIN.)	\$701/kW
ALTERNATIVE INVESTMENT COST (3 1/4 FED. FIN.)	\$630/kW
ALTERNATIVE HEAT RATE	9,800 Btu/kWh
ALTERNATIVE TRANSMISSION SYSTEM	90 CIRCUIT MILES OF 345-kV
TYPE OF ALTERNATIVE	NUCLEAR STEAM
NUMBER AND SIZE OF UNITS	2 - 940 MW UNITS
ALTERNATIVE INVESTMENT COST (11 1/2 PRIV. FIN.)	\$1,212/kW
ALTERNATIVE INVESTMENT COST (7 3/8 FED. FIN.)	\$1,050/kW
ALTERNATIVE INVESTMENT COST (3 1/4 FED. FIN.)	\$889/kW
ALTERNATIVE HEAT RATE	- - -
ALTERNATIVE FUEL COST	\$100/kW
ALTERNATIVE TRANSMISSION SYSTEM	150 CIRCUIT MILES OF 500-kV

TYPE OF FINANCING ASSUMED: PRIVATE (11 1/2 PERCENT COST OF MONEY)
FEDERAL (7 3/8 PERCENT COST OF MONEY)
FEDERAL (3 1/4 PERCENT COST OF MONEY)

PRICE LEVELS: OCTOBER 1980

RED RIVER LANDS

GENERALIZED POWER VALUES

FSA 35

HYDRO CAPACITY FACTOR (%)	\$/KW-YR	MILLS/KWH ^{1/2/}	TOTAL \$/KW-YR	TOTAL MILLS/KWH ^{1/}
TYPE FINANCING - FED -(7.375%)				
COMBUSTION TURBINE ALTERNATIVE				
0.	138.00	0.0	138.00	0.0
5.	19.85	308.4	154.95	353.7
10.	19.85	173.5	171.85	196.2
15.	19.85	128.5	188.75	143.6
COAL-FIRED ALTERNATIVE				
20.	99.05	43.6	175.45	100.1
25.	99.05	39.3	185.20	84.6
30.	99.05	36.5	194.95	74.2
35.	99.05	36.2	210.10	68.5
40.	99.05	34.2	219.05	62.5
45.	99.05	32.7	228.00	57.8
50.	99.05	31.5	236.90	54.1
55.	99.05	30.5	245.85	51.0
60.	99.05	29.6	254.80	48.5
65.	99.05	28.9	263.70	46.3
70.	99.05	28.3	272.65	44.5
75.	99.05	27.8	281.60	42.9
80.	99.05	27.3	290.55	41.5
85.	99.05	26.9	299.45	40.2
90.	99.05	26.6	308.40	39.1
95.	99.05	26.2	317.35	38.1
100.	99.05	25.9	326.25	37.2
NUCLEAR ALTERNATIVE				
60.	179.45	9.8	230.85	43.9
65.	179.45	10.1	237.10	41.6
70.	179.45	10.4	243.35	39.7
75.	179.45	10.7	249.55	38.0
80.	179.45	10.9	255.80	36.5
85.	179.45	11.1	262.05	35.2
90.	179.45	11.3	268.30	34.0
95.	179.45	11.4	274.55	33.0
100.	179.45	11.6	280.75	32.1

^{1/} Component power values of \$19.85/kw-yr. and 173.5 mills/kwh at 10 percent capacity factor are equivalent to a total annual value of \$171.85/kw-yr. or 196.2 mills (but not both).

^{2/} Energy values reflect average annual equivalent fuel costs escalated from the 1990 project-on-line date and continued for a 30-year period. These year-by-year fuel costs (100 year economic project life from project-on-line date) were present worthed, summed and a single average annual fuel cost was obtained by utilizing the appropriate capital recovery factor.

RED RIVER LAKE'S

GENERALIZED POWER VALUES

PSA 35

HYDRO CAPACITY FACTOR (%)	\$/KW-YR	MILLS/KWH ^{1/2/}	TOTAL \$/KW-YR	TOTAL MILLS/KWH ^{1/}
TYPE FINANCING - FED - (3.25%)				
COMBUSTION TURBINE ALTERNATIVE				
0.	152.40	0.0	152.40	0.0
5.	12.05	359.0	169.30	366.5
10.	12.05	198.8	186.20	212.6
15.	12.05	145.4	203.10	154.6
COAL-FIRED ALTERNATIVE				
20.	71.05	42.8	146.10	83.4
25.	71.05	38.9	156.15	71.3
30.	71.05	36.2	166.20	63.2
35.	71.05	35.7	180.60	58.9
40.	71.05	33.9	189.90	54.2
45.	71.05	32.5	199.20	50.5
50.	71.05	31.4	208.45	47.6
55.	71.05	30.4	217.75	45.2
60.	71.05	29.7	227.05	43.2
65.	71.05	29.0	236.30	41.5
70.	71.05	28.5	245.60	40.1
75.	71.05	28.0	254.90	38.8
80.	71.05	27.6	264.15	37.7
85.	71.05	27.2	273.45	36.7
90.	71.05	26.8	282.75	35.9
95.	71.05	26.6	292.05	35.1
100.	71.05	26.3	301.30	34.4
NUCLEAR ALTERNATIVE				
60.	93.15	11.2	151.90	28.9
65.	93.15	11.4	156.15	27.8
70.	93.15	11.6	164.40	26.8
75.	93.15	11.8	170.65	26.0
80.	93.15	11.9	176.65	25.2
85.	93.15	12.1	183.10	24.6
90.	93.15	12.2	189.35	24.0
95.	93.15	12.3	195.55	23.5
100.	93.15	12.4	201.90	23.0

^{1/} Component power values of \$12.05/kW-yr. and 198.8 mills/kWh at 10 percent capacity factor are equivalent to a total annual value of \$186.20/kW-yr. or 212.6 mills (but not both).

^{2/} Energy values reflect average annual equivalent fuel costs escalated from the 1990 project-on-line date and continued for a 30-year period. These year-by-year fuel costs (100 year economic project life from project-on-line date) were present worthed, summed and a single average annual fuel cost was obtained by utilizing the appropriate capital recovery factor.

RED RIVER L&D'S

GENERALIZED POWER VALUES

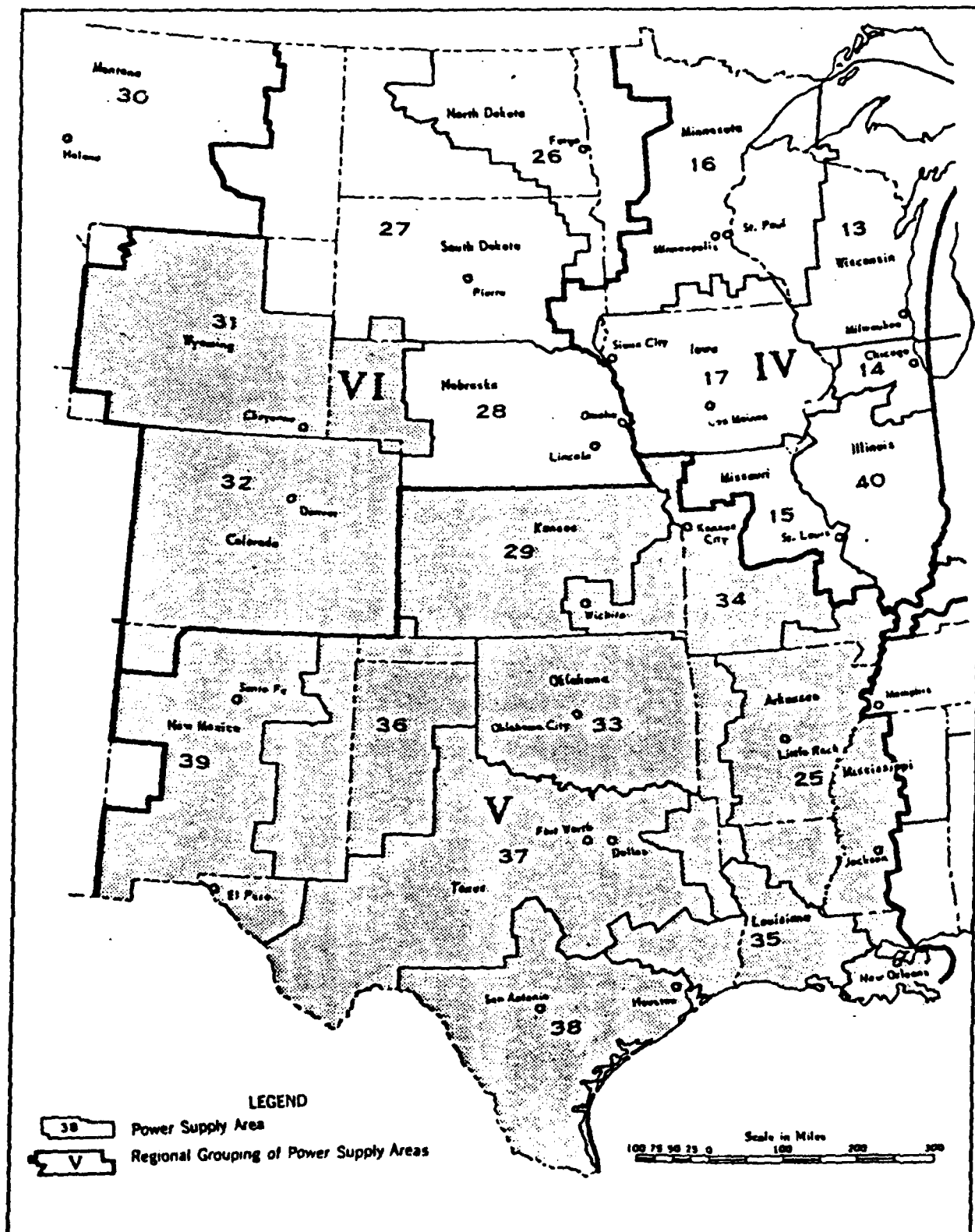
PSA 35

HYDRO CAPACITY FACTOR (%)	\$/KW-YR	MILLS/KWH ^{1/2/}	TOTAL \$/KW-YR	TOTAL MILLS/KWH ^{1/}
TYPE FINANCING - PRIV - (11.5%)				
COMBUSTION TURBINE ALTERNATIVE				
0.	143.75	0.0	143.75	0.0
5.	39.55	276.4	160.65	366.8
10.	39.55	157.5	177.55	202.7
15.	39.55	117.9	194.45	148.0
COAL-FIRED ALTERNATIVE				
20.	173.20	44.2	250.65	143.1
25.	173.20	39.7	260.20	118.8
30.	173.20	36.8	269.75	102.7
35.	173.20	36.7	285.60	93.1
40.	173.20	34.6	294.25	84.0
45.	173.20	32.9	302.95	76.9
50.	173.20	31.6	311.65	71.2
55.	173.20	30.5	320.35	66.5
60.	173.20	29.7	329.05	62.6
65.	173.20	28.9	337.75	59.3
70.	173.20	28.2	346.40	56.5
75.	173.20	27.7	355.10	54.1
80.	173.20	27.2	363.80	51.9
85.	173.20	26.8	372.50	50.0
90.	173.20	26.4	381.20	48.3
95.	173.20	26.0	389.85	46.8
100.	173.20	25.7	398.55	45.5
NUCLEAR ALTERNATIVE				
60.	383.00	8.8	429.30	81.7
65.	383.00	9.2	435.55	76.5
70.	383.00	9.6	441.80	72.1
75.	383.00	9.9	448.05	68.2
80.	383.00	10.2	454.35	64.8
85.	383.00	10.4	460.60	61.9
90.	383.00	10.6	466.85	59.2
95.	383.00	10.8	473.10	56.9
100.	383.00	11.0	479.35	54.7

^{1/} Component power values of \$39.55/kw-yr. and 157.5 mills/kwh at 10 percent capacity factor are equivalent to a total annual value of \$177.55/kw-yr. or 202.7 mills (but not both).

^{2/} Energy values reflect average annual equivalent fuel costs escalated from the 1990 project on-line date and continued for a 30 year period. These year-by-year fuel costs (100 year economic project life from project on-line date) were present worthed, summed and a single average annual fuel cost was obtained by utilizing the appropriate capital recovery factor.

FEDERAL ENERGY REGULATORY COMMISSION
ELECTRIC POWER SUPPLY AREAS
FORT WORTH REGION



FEDERAL ENERGY REGULATORY COMMISSION
REGIONAL OFFICE
819 Taylor Street
Fort Worth, Texas 76102
August 19, 1982

In reply refer to:
OEPR-FW

Mr. Frederic M. Chatry
Chief, Engineering Division
New Orleans District,
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNED-PN

Dear Mr. Chatry:

Your letter of July 28, 1982, requested this office to provide additional hydropower estimates for Lock & Dam Nos. 3 and 5 on the Red River Waterway Project, assuming the same interest rates, costs and price levels used in our report of May 5, 1981.

We have used the same methodology in making the power routings as that used in previous studies. The basic difference between our earlier studies and your requested study is in the pool elevations. It was subsequently agreed, via telephone with your staff, that a letter report would suffice for your purposes. The results of our studies are summarized herein.

The study made on Lock & Dam No. 3, at river mile 137 for the B-3M Plan, uses a headwater elevation of 87 feet and a tailwater elevation of 64 feet at zero discharge. Tables 1 and 2 show the economic analysis for this plan when utilizing an interest rate of 7 3/8 percent and 3 1/4 percent. Some of the assumptions used in making these analyses are shown in these tables. For example, at 7 3/8 percent interest the unit cost was \$1,600/kW, the capacity value was \$99.05/kW, the unit O&M cost was \$6.45/kW, at an October 1980 price level. All of these values and costs were the same as those used in the May 5, 1981 report. For the 3 1/4 percent interest rates, the only items that changed were the values for capacity and energy.

The analysis for Lock & Dam No. 5 at river mile 243 is also for the B-3M Plan. The headwater pool elevation is 137 feet and the tailwater elevation is 115 feet at zero discharge. All assumptions are the same as those used in the May 5, 1981 report and as stated above. Tables 3 and 4 show the results of these analyses.

As indicated in Tables 1 through 4 hydropower has a favorable benefit/cost ratio at both dams for each interest rate. Please note that the "R" adjacent to the excess benefits column denotes the recommended capacity based

on maximum excess benefits. Larger capacities may be desirable in order to maximize the amount of energy production from this renewable resource, thus, maximizing the savings of alternative energy resources. We realize that costs have changed since the earlier report was prepared and the values may not be fully representative at current price levels. However, they should be useful for comparison with the earlier studies. We have also used a constant O&M cost of \$6.45/kW for the range of capacities studied; however, in actual practice O&M unit costs will usually decrease with an increase in installed capacity.

Please note that the views and conclusions expressed herein are submitted at a field level and, as such, are not to be construed as the official views of the Federal Energy Regulatory Commission.

We will be pleased to respond to any questions you may have on these studies.

Sincerely yours,

A handwritten signature in cursive script, reading "Arthur C. Martin".

Arthur C. Martin
Acting Regional Engineer

Attachments:
As stated

Table 1
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 7 3/8% August 1982

L&D No.	Pool Elev. (ft)	Plant Factor (%)	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average ^{1/} Annual Benefits \$1000	Average ^{1/} Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
3	87	40	34,950	23,000	122,891	34.2	6,481.0	6,155.2	1.05	325.8
3	87	47	30,000	23,000	122,891	32.2	6,235.2	5,283.4	1.18	951.8
3	87	51	27,500	22,000	122,235	31.3	6,005.1	4,843.2	1.24	1,161.9
3	87	54	25,000	20,000	117,929	30.7	5,601.4	4,402.9	1.27	1,198.5 (R)
3	87	59	20,000	16,000	103,725	29.8	4,675.8	3,522.3	1.33	1,153.5
3	87	65	15,000	12,000	85,025	28.9	3,645.8	2,641.7	1.38	1,004.1
3	87	68	12,500	10,000	74,135	28.5	3,103.3	2,201.4	1.41	901.9

Assumptions:

Unit Cost \$1,600/kW
Capacity Value \$99.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 7 3/8%
Tailwater - 64 ft. at zero discharge

^{1/} Price level - October 1980

(R) - Recommended plan

August 1982

Table 2
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 3 1/4%

L&D No.	Pool Elev. (ft)	Plant Factor (%)	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average ^{1/} Annual Benefits \$1000	Average ^{1/} Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
3	87	40	34,950	23,000	122,891	33.9	5,800.2	3,456.0	1.68	2,344.2
3	87	47	30,000	23,000	122,891	32.1	5,579.0	2,966.5	1.88	2,612.5
3	87	51	27,500	22,000	122,235	31.2	5,376.8	2,719.3	1.98	2,657.5 (R)
3	87	54	25,000	20,000	117,929	30.6	5,029.6	2,472.0	2.03	2,557.6
3	87	59	20,000	16,000	103,725	29.8	4,227.8	1,977.6	2.14	2,250.2
3	87	65	15,000	12,000	85,025	29.0	3,318.3	1,483.2	2.24	1,835.1
3	87	68	12,500	10,000	74,135	28.7	2,838.1	1,236.0	2.30	1,602.1

Assumptions:

Unit Cost \$1,600/kW
Capacity Value \$71.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 3 1/4%
Tailwater - 64 ft. at zero discharge

^{1/} Price level - October 1980

(R) - Recommended plan

Table 3
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 7 3/8%

August 1982

L&D No.	Pool Elev. (ft)	Plant Factor (%)	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average ^{1/} Annual Benefits \$1000	Average ^{1/} Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
5	137	49	31,680	31,680	135,662	31.7	7,438.4	5,579.3	1.33	1,859.1
5	137	51	30,000	30,000	134,007	31.3	7,165.9	5,283.4	1.36	1,882.5 (R)
5	137	54	27,500	27,500	130,048	30.7	6,716.4	4,843.2	1.39	1,873.2
5	137	57	25,000	25,000	124,826	30.1	6,233.5	4,402.8	1.42	1,830.7
5	137	64	20,000	20,000	111,290	29.0	5,208.4	3,522.3	1.48	1,686.1
5	137	70	15,000	15,000	92,198	28.3	4,094.9	2,641.7	1.55	1,453.2
5	137	74	12,500	12,500	80,853	27.9	3,493.9	2,201.4	1.59	1,292.5

Assumptions:

Unit Cost \$1,600/kW
Capacity Value \$99.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 7 3/8%
Tailwater - 115 ft. at zero discharge

(R) - Recommended plan

^{1/} Price level - October 1980

August 1982

Table 4
Red River Waterway Study For Hydropower
Plan B-3M Federal Financing 3 1/4%

L&D No.	Pool Elev. (ft)	Plant Factor (%)	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value Mills/kWh	Average/ Annual Benefits \$1000	Average/ Annual Charges \$1000	B/C Ratio	Excess Benefits \$1000
5	137	49	31,680	31,680	135,662	31.6	6,537.8	3,132.6	2.09	3,405.2 (R)
5	137	51	30,000	30,000	134,007	31.2	6,312.5	2,966.5	2.13	3,346.0
5	137	54	27,500	27,500	130,048	30.6	5,933.4	2,719.3	2.18	3,214.1
5	137	57	25,000	25,000	124,826	30.1	5,533.5	2,472.0	2.24	3,061.5
5	137	64	20,000	20,000	111,290	29.1	4,659.5	1,977.6	2.36	2,681.9
5	137	70	15,000	15,000	92,198	28.5	3,693.4	1,483.2	2.49	2,210.2
5	137	74	12,500	12,500	80,853	28.1	3,160.1	1,236.0	2.56	1,924.1

Assumptions:

Unit Cost \$1,600/kW
Capacity Value \$71.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 3 1/4%
Tailwater - 115 ft. at zero discharge

(R) - Recommended plan

1/ Price level - October 1980

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX K
COORDINATION ACT REPORT
U.S. FISH AND WILDLIFE SERVICE



United States Department of the Interior

FISH AND WILDLIFE SERVICE

JACKSON MALL OFFICE CENTER

300 WOODROW WILSON AVENUE, SUITE 3185

JACKSON, MISSISSIPPI 39213

July 21, 1982

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60269
New Orleans, Louisiana 70160

Dear Sir:

Attached is the formal Fish and Wildlife Coordination Act Report for the Red River Waterway, Louisiana, Texas, Arkansas, and Oklahoma, Project, Mississippi River to Shreveport, Louisiana, Reach. The report is transmitted to you under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The report has been coordinated with the Louisiana Department of Wildlife and Fisheries (LDWF); a copy of Secretary Guidry's letter of concurrence is attached. We have also incorporated, to the greatest degree practicable, the comments of your agency as stated in your letter of July 20, 1982. We look forward to working with your staff to resolve any differences which now remain or which may arise in the future.

We feel that the high level of coordination maintained by our agencies on this project has been most beneficial. We will continue to work closely with your staff and LDWF personnel in an effort to assist your agency in its preparation of a formal mitigation report in the coming months, as well as on other matters relating to the Red River Waterway Project. We look forward to your cooperation in this matter of mutual concern.

Sincerely,

Robert Misso

Robert J. Misso
Acting Area Manager

Attachment: As Stated

State of Louisiana



DEPARTMENT OF WILDLIFE AND FISHERIES
400 ROYAL STREET
NEW ORLEANS 70130

JESSE J. GUIDRY
SECRETARY

DAVID C. TREEN
GOVERNOR

(504) 342-5868

July 20, 1982

Mr. David M. Soileau
Acting Field Supervisor
U. S. Fish and Wildlife Service
P. O. Box 4305
Lafayette, Louisiana 70502

Re: Red River Waterway
Draft Fish and Wildlife Coordination
Act Report

Dear Mr. Soileau:

Personnel of the Louisiana Department of Wildlife and Fisheries have reviewed the above referenced report and offer the following comments.

The proposed acquisition will satisfy the mitigation for impacts below mile 104 only if the Tensas River National Wildlife Refuge is established. Should this refuge not become reality, the mitigation report and this report will require major revisions.

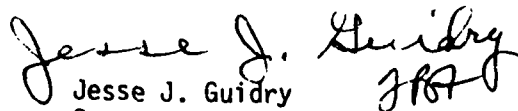
In reviewing this project, we note that our agency has acknowledged in separate letters to the District, Division and Chief of Engineers to manage the wildlife areas resulting from the mitigation and recreation plans and to provide the operation and maintenance required. Further the Corps of Engineers has given the Red River Waterway Commission credit for the funds required for operation and maintenance. Yet the commission has neither made any positive effort to adopt the recreation plan nor assure this department that appropriate mitigation will be obtained.

In the final draft of the Master Plan Design Memorandum No. 4 the Corps of Engineers indicates the use of dredging to maintain continuous boat access to all oxbows. We still encourage the obtaining and maintaining of these access routes.

Mr. David M. Soileau
July 20, 1982
Page -2-

In summary, your report reflects the basic position of this agency concerning the proposed project and mitigation.

Sincerely yours,


Jesse J. Guidry
Secretary

JJG:FOD:fs

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA PROJECT
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA, REACH

FISH AND WILDLIFE COORDINATION ACT REPORT

SUBMITTED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY
THOMAS C. MICHOT, WILDLIFE BIOLOGIST
AND
THOMAS A. HARDAWAY, FISH AND WILDLIFE BIOLOGIST
UNDER THE SUPERVISION OF
DAVID W. FRUGE, ACTING FIELD SUPERVISOR
DIVISION OF ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

RELEASED FROM
U.S. FISH AND WILDLIFE SERVICE
JACKSON AREA OFFICE
JACKSON, MISSISSIPPI

JULY 1982

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EXECUTIVE SUMMARY

The attached document is a formal report of the U.S. Fish and Wildlife Service (FWS) on the recommended plan for the Red River Waterway Louisiana, Texas, Arkansas, and Oklahoma Project, Mississippi River to Shreveport, Louisiana, Reach. Preconstruction planning on that reach was authorized by Public Law 91-439 and approved on October 7, 1970. This report has been prepared and is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). In keeping with the requirements of the Coordination Act, this document should be attached to and made part of any report released for public review or forwarded to Congress for consideration.

The recommended plan (Plan B1) includes navigation, bank stabilization, and recreation features. The navigation feature consists of a 9- by 200-foot channel from the mouth of the Red River to Shreveport, Louisiana (a distance of 236 miles), and five locks and dams to provide the needed lift over the subject river segment. The bank stabilization feature includes, among other structural modifications, channel straightening which will cut off 49 bendways; 28 of these will be preserved as oxbow lakes. The third authorized project feature, recreation, is covered in the Master Plan prepared by the New Orleans District, Corps of Engineers (NODCE). That plan calls for development of 26 recreational sites on approximately 13,000 acres, and predicts \$6,300,000 worth of recreation benefits annually. Unfortunately, the Master Plan has yet to be acted upon by the Red River Waterway Commission.

Approximately 40,000 acres of terrestrial habitat will be affected by the project through spoil disposal, revetment, channel excavation, flooding, freeboard lands, and induced clearing. Forty percent of the affected lands are in agricultural use (pasture and cropland) and 60 percent are wooded. About 70 percent of the affected woodlands are riverfront forests (cottonwood-willow-sycamore); the remainder consists of bottomland hardwood, willow sandbar, pine hardwoods, and wooded swamp habitat types.

These terrestrial habitats support a number of wildlife species, ranging from those which prefer open areas to those primarily limited to bottomland hardwood forests and wooded swamp areas. Furbearers utilizing these areas include raccoon, beaver, red and gray fox, striped skunk, mink, bobcat, and opossum. Game species known to occur in the project area include white-tailed deer, gray and fox squirrel, Eastern cottontail, swamp rabbit, American woodcock, wild turkey, bobwhite, mourning dove, and various species of waterfowl. In addition, many species of non-game birds and mammals, as well as reptiles and amphibians, are common to the area.

Existing aquatic habitat in the project area consists of 22,594 acres of riverine habitat and 3,700 acres of other water bodies (oxbows, borrow pits, and ponds). The riverine system is dynamic and varies from shallow, productive areas to deep, less productive areas; frequent high turbidity levels limit overall productivity.

Principal game fishes harvested in the project area include largemouth bass, black crappie, white crappie, bluegill, redear sunfish, warmouth, green sunfish, channel catfish, blue catfish, white bass, striped bass, and hybrid striped bass. Principal commercial fishes landed in the project area include channel catfish, blue catfish, flathead catfish, gars, smallmouth buffalo, bigmouth buffalo, gizzard shad, carp, and freshwater drum.

The Red River Waterway Project is expected to have significant impacts on the fish and wildlife resources of the area. Sport and commercial fish species and openland wildlife species will benefit and woodland species of wildlife will be adversely affected by the project.

Aquatic habitats under future with-project conditions will change from a strictly riverine system to a more lacustrine system. Fish species composition will change accordingly with an increase in gamefishes (largemouth bass, bluegill, crappie, etc.), and a decrease in riverine species (carp, freshwater drum, buffalos, catfish, etc.). Additional fisheries habitat will be created through flooding of backwater areas and creation of new oxbows due to channel straightening.

On an average annual basis, sport fishing potential is estimated at 115,850 man-days under future without-project conditions and 380,000 man-days under with-project conditions (these figures are annualized over the 15 year construction period, 1975-1990, and the 50 year project life, 1990-2040). Commercial fish are presently being harvested on the river at an estimated rate of 13 pounds per acre; the average annual harvest under future without-project conditions is estimated to be 290,600 pounds valued at \$63,900. With the project in place, commercial harvest is expected to increase to 24 pounds per acre by the year 2040; the annualized harvest will be 532,400 pounds valued at \$111,804.

The above calculations were based on two assumptions: that public access to the aquatic areas would be guaranteed with project implementation and that water levels in the navigation pools would be held relatively constant. The present lack of boat launch facilities on the Red River restricts the harvest of sport and commercial fishes. This problem can be alleviated by features of the Recreation Master Plan, but the Plan has not yet been approved as an integral part of the project. The Master Plan calls for boat launch facilities at each of the 26 recreation sites, which will enhance boat access to the navigation pools and oxbows. Land access is to be provided to 18 of the 28 preserved oxbows; the other oxbows will be accessible by water as long as they remain continuous with the river. However, the predicted formation of a silt plug on the downstream end of these oxbows may preclude boat access to them. No provisions have been made to keep such plugs open, and the question of land ownership and public access on oxbows which have become filled with silt needs to be clarified by the NODCE and the local sponsor (Red River Waterway Commission).

With regard to lands inundated by the navigation pools, the NODCE plans to request that the Red River Waterway Commission acquire perpetual

flowage easements that would assure public use of the waters and prohibit landowners from limiting public access. The Commission has not been eager to act on any recreational aspects of the plan, although recreation is a Congressionally authorized feature of the project. Public access to all aquatic habitats in the project area must be guaranteed if the fishery benefits included in the benefit/cost ratio are to be fully realized.

The second assumption used for calculating fishery benefits (i.e., that relatively constant water levels will be held in the navigation pools) will apparently be violated in Pool 3. A hinge drawdown will occur on Pool 3 about four times each spring. During each hinge operation, the pool elevation will be decreased by seven feet, thereby exposing 920 acres of shallow water habitat for three 15-day periods and one 30-day period (on the average). Such a drawdown would virtually eliminate spawning in Pool 3 and would substantially decrease sport fishing there in the spring. This would have negative, but presently undetermined, impacts on the fishery benefits attributed to the project.

Terrestrial habitat changes associated with project implementation result in a net gain in open lands and a net loss in woodlands. These habitat changes will produce a corresponding change in the species composition of the animal populations of the area. Woodland species such as gray squirrel, red fox, wild turkey, American woodcock, and white-tailed deer will lose habitat and be replaced by species such as eastern cottontail, mourning dove, and bobwhite which prefer open lands. An overall decrease in sport hunting potential for terrestrial species is predicted with project implementation. The baseline potential of 25,530 man-days is expected to decrease to 16,813 man-days by 2040 under with-project conditions (versus 25,794 man-days without the project).

The FWS's Habitat Evaluation Procedures (HEP) were used to assess impacts on wildlife habitat quality and quantity over the life of the project. The results of the HEP analysis reflect the changes in terrestrial habitat types previously mentioned. Eastern cottontail, mourning dove, and bobwhite each showed a gain of approximately 800 Average Annual Habitat Units (AAHU's) over the project life. This increase in benefits to openland species is small in comparison to the negative impacts to woodland species. Red fox and gray squirrel showed losses of 500 and 700 AAHU's, respectively; the six remaining species (white-tailed deer, wild turkey, raccoon, swamp rabbit, wood duck, and American woodcock) each showed losses of 2,000 to 6,000 AAHU's. The total loss in AAHU's for all 11 species was 23,300. Since virtually all of the adverse impacts associated with the project would occur to wildlife species associated with woodland habitat, those impacts form the basis of our compensation determination.

Certain features proposed for inclusion in the project could serve to rectify or reduce some of the adverse project impacts. These include closure dams on bendway cutoffs, management of project lands and spoil areas for wildlife, operational and structural modifications which would

serve to minimize rapid water level fluctuations during fish spawning periods, and creation of waterfowl impoundments. Most of these features were included in the Recreation Master Plan which has not yet been approved.

Project impacts downstream from river mile 104 are to be mitigated through the establishment of the Tensas River National Wildlife Refuge (P.L. 96-284, 96th Congress). Accordingly, a separate HEP analysis was conducted for project impacts upstream from mile 104 to establish compensation needs for that portion of the project. The results of that analysis were similar to those of the total project HEP, i.e., gains in AAHU's were experienced for the open land species and losses were experienced for the woodland species. Since the species which would require compensation represent a typical bottomland hardwood assemblage, the FWS recommends that compensation be provided by the purchase of lands which can be managed for (but may not presently support) bottomland hardwoods. This would constitute in-kind replacement, as the same species which are being impacted by the project would be benefited through the compensation plan.

The number of acres needed to offset wildlife losses is dependent upon the annualized gain in Habitat Units which can be realized for each species via purchase and management of acceptable mitigation lands. Accordingly, the value of potential compensation lands to the evaluation species must be established. Toward this end, the FWS has developed two compensation plans, one involving the purchase and management of forested wetlands outside of the project area and the other involving the purchase, conversion to bottomland hardwoods, and management of certain batture lands within and adjacent to the project area.

The HEP field analysis for the forested wetland management plan was conducted in the lower Red River basin (Avoyelles Parish backwater area). Completion of the HEP analysis indicated that approximately 16,200 acres of forested wetlands must be acquired and managed to offset project losses above mile 104.

The HEP field analysis for compensation with project lands was conducted on batture lands between Shreveport and the Lock and Dam 3 location. This management plan assumes that, once acquired, the mitigation lands would be converted to bottomland hardwoods via selective planting and/or natural succession. Lands on which bottomland hardwood species would be selectively planted would increase in habitat value faster than those allowed to undergo natural succession. The gain in AAHU's, and, accordingly, the technique used to vegetate the area in bottomland hardwoods would determine the number of acres which must be acquired for compensation of adverse project impacts.

In order to present an array of alternatives, we used three conversion scenarios to determine compensation acreages. They were termed maximum selective planting (all lands planted with bottomland hardwood species),

natural succession (no plantings), and partial selective planting (plantings on half of the lands purchased). Regardless of the initial method of conversion to bottomland hardwoods, the mitigation lands would be managed primarily for wildlife and secondarily for timber throughout the life of the project.

According to the HEP analysis, 21,300 acres of batture lands via the natural succession alternative, 12,600 acres via the partial selective planting alternative, or 8,500 acres via the maximum selective planting alternative would be required for mitigation. Again these acreages and management techniques would compensate only for project impacts above river mile 104.

Finally, based on our review of project plans considered for the Red River Waterway, Mississippi River to Shreveport, Louisiana, Reach, the Fish and Wildlife Service recommends that the following measures be implemented in the interest of fish and wildlife conservation.

1. The Recreation Master Plan be fully implemented as an integral part of the project. Included in this plan are the proposed closures of 28 oxbows and provision of access to those lakes, use of spoil material to create waterfowl impoundments and small game management areas, and management of recreational lands for fish and wildlife purposes.
2. Use of the proposed navigation pools as a source of community water supplies be investigated. Such use would decrease the need for using other water bodies in the area and thus minimize losses to fish and wildlife resources.
3. Lands between the levees be purchased, converted to bottomland hardwoods, and managed to mitigate for unavoidable losses to wildlife resources associated with the project upstream from river mile 104. Total acreage required would depend on which of the previously discussed management scenarios were selected. (In lieu of this, 16,200 acres of "off-site" forested wetlands in the Red River basin could be purchased and managed for wildlife to compensate for project impacts upstream from river mile 104).
4. The annual costs associated with operation and management of mitigation lands shall be provided by the Corps of Engineers as an integral part of the total project expenditures.
5. The rights of public access on the navigation pools and oxbows created by the project be specifically defined as early as possible in the planning process.
6. A hinge pool drawdown not be used, as this may have significant adverse impacts on fishery resources. Instead, estate options should be exercised on lands which are subject to spring

flooding adjacent to the navigation pools. Possibly these same affected lands could serve as mitigation sites. If a hinge is deemed absolutely necessary, advanced engineering and design studies should investigate the feasibility of structural measures which could minimize the effects of such drawdowns on shallow water habitat.

7. Recreation and mitigation features be implemented simultaneous with navigation and bank stabilization features of the project.
8. Coordination between FWS and COE shall continue as the project progresses to advanced stages of planning and design.

PROJECT DESCRIPTION

The Red River Waterway project was authorized by Public Law 90-483 of the 90th Congress and approved August 13, 1968. Preconstruction planning for the Mississippi River to Shreveport, Louisiana, reach of the project was authorized by Public Law 91-439 and approved on October 7, 1970. Initial construction funds for bank stabilization works and channel cutoffs were made available in fiscal year 1973.

The Mississippi River to Shreveport reach is a portion of an overall navigation and bank stabilization project in the Red River basin of Louisiana, Texas, Arkansas, and Oklahoma (Figure 1). The other components of the project, as approved by Congress, include bank stabilization and recreational facilities from Shreveport to the Denison Dam along the Texas-Oklahoma border, and navigation from Shreveport to Daingerfield, Texas, by way of Twelve Mile and Cypress Bayous. This report addresses only those impacts to fish and wildlife resources associated with implementation of the Mississippi River to Shreveport reach of the project.

The channel alignment to be implemented is termed the B1 Plan. This alignment will consist of a 9- by 200-foot navigation channel from the mouth of the Red River to Shreveport, Louisiana (a distance of 236 miles), and a total of 5 locks and dams to provide the needed lift over the subject river segment (Table 1). These locks will have clear dimensions of 84 feet by 685 feet (useable chamber length) and minimum depths of 13 feet over the sills. Lock and Dam 1 is located northeast of Marksville, Louisiana, at river mile 43; the pool elevation for this segment will be 40 feet National Geodetic Vertical Datum (NGVD). This lock and dam is currently under construction. Lock and Dam 2 (John H. Overton Lock and Dam) will be located near Poland, Louisiana, at river mile 87; the pool elevation for this segment will be 58 feet NGVD.

Lock and Dam 3 will be located just north of Colfax, Louisiana, at river mile 141; the normal pool elevation there will be 95 feet NGVD. A hinge pool drawdown to 88 feet NGVD will occur on Pool 3 approximately four times annually, usually during the spring months (February through June). The drawdown will expose 920 acres of shallow water bottoms for a period of two to 30 days (15 days on the average) during periods of heavy precipitation upstream. This procedure will eliminate the need for purchasing flowage easements on about 7,000 acres of land which would be flooded during high stages as a result of the project.

Lock and Dam 4 will be located near Lake End, Louisiana, at river mile 206 and will have a pool elevation of 120 feet. Lock and Dam 5 will be located at river mile 250 near Lachute, Louisiana, and will maintain a pool elevation of 145 feet, sufficient to permit navigation past Shreveport and up Twelve Mile Bayou to the Caddo Lake Dam.

Bank revetment and other complementary stabilization and river-training works are planned for construction to hold the newly developed channel in position. This channel straightening will cut off 49 bendways, of which approximately 28 will be preserved as oxbow lakes; the others will be allowed to silt in.

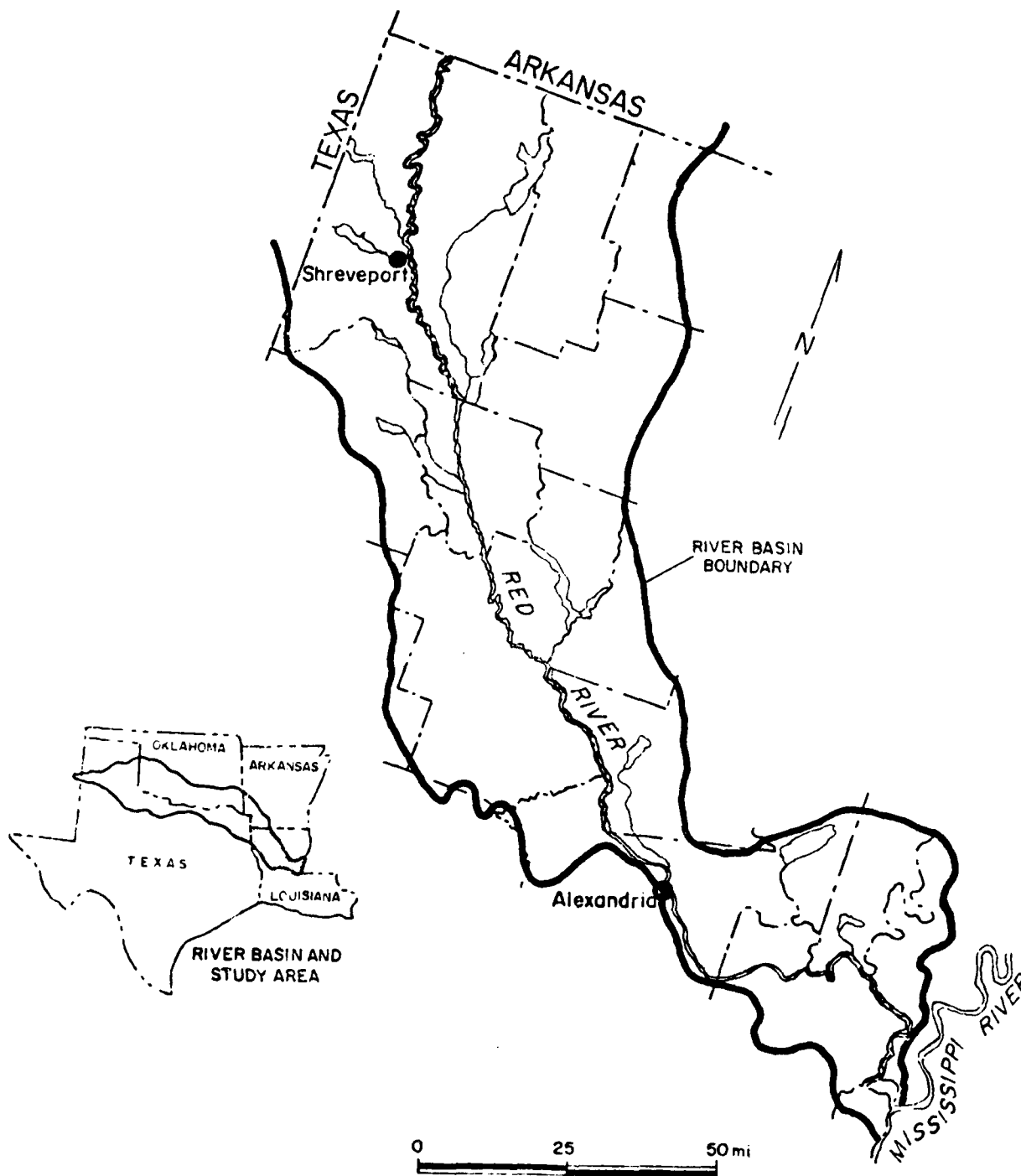


FIGURE 1
GENERAL LOCATION MAP OF THE RED RIVER
STUDY AREA

Table 1. Pertinent construction features of the Red River Waterway Project.

Lock and Dam No.	Location Mile (1967)	Upper Pool Elevation (Ft. NGVD)	Lift (Feet)
1	43	40	36
2	87	64	24
3	141.5	95	31
4	206	120	25
5	250	145	25

Another major authorized purpose of the project is to provide public recreational facilities within the project area. To accomplish this goal, the New Orleans District Corps of Engineers (NODCE) has prepared a Recreation Master Plan outlining the location of the sites to be developed and the types of activities which are planned for these areas. The plan calls for the development of 26 sites on approximately 13,000 acres. About \$6,300,000 worth of annual recreation benefits are expected with this recreation plan. However, actual implementation of the proposed Recreation Master Plan is needed if these benefits are to be realized; the plan has not yet been approved by the local sponsor (Red River Waterway Commission). NODCE sent a letter to the Red River Waterway Commission on March 5, 1982, asking for adoption of the Master Plan; the Commission has yet to act on the plan.

The Red River Waterway project, when fully implemented, will affect about 26,000 acres of aquatic habitat and about 53,000 acres of terrestrial habitat via lock and dam construction, channel excavation, revetments, flooding, spoil disposal, freeboard, clearing of forested lands, and recreational development. Table 2 shows the breakdown of terrestrial acres impacted, excluding recreation and mitigation lands. The project plans call for the purchase of perpetual flowage easements on the lands to be inundated by the navigation pools. The easements are to include provisions that will assure use of the water by the public for recreation activities such as boating, fishing, hunting, and swimming, and will prohibit limitation of public access by landowners.

In 1980 the Chief of Engineers sent a report to the Secretary of the Army entitled "Red River Waterway, Mississippi River to Shreveport, Louisiana - Acquisition of Wildlife Mitigation Lands." This interim mitigation report recommended the acquisition and management of about 12,000 acres of woodland-wetland habitat. However, this figure did not include compensation for wildlife losses due to flooding of lands adjacent to the pools behind Locks and Dams 3, 4, and 5, and the report recognized that additional mitigation may be required (more detailed mapping of the project area showed that there would be more flooding than originally anticipated). The figure of 12,000 acres was not based on habitat values but on man-day use. The interim mitigation report recognized the need to reduce reliance on man-day use analysis to establish mitigation requirements and indicated that additional habitat evaluation would be conducted. The report included provisions for the transfer of fee ownership of mitigation lands to the appropriate management agency of the State of Louisiana, as well as a provision clarifying local wildlife management responsibilities. Finally, the report proposed that sufficient funds be allocated to acquisition of the mitigation lands to insure that the mitigation plan is implemented prior to the time at which project-induced losses otherwise could be expected to occur.

The establishment of the Tensas National Wildlife Refuge via P.L. 96-285 (96th Congress) would serve as mitigation for losses caused by six projects, including the lower 104 miles of the Red River Waterway Project.

Table 2. Habitat types and acreages impacted by the Red River Waterway Project. Acreage figures include 6,680 wooded acres expected to be cleared due to project implementation as well as acres impacted by actual construction and flooding.

Habitat Type	Acres
Pasture	10,621
Cropland	5,394
Riverfront hardwoods	17,321
Bottomland hardwoods	2,455
Willow/sandbar	2,711
Pine hardwoods	634
Wooded swamp	700
Total	39,836

Since 23 to 25 percent of the total woodland acreage to be adversely impacted occur below mile 104, the Tensas purchase would provide approximately 24 percent of the original 12,000-acre package of mitigation needs. Project impacts upstream from mile 104 were re-assessed using the FWS' Habitat Evaluation Procedures (as explained in the methodology section) to arrive at revised compensation requirements.

In 1982 the Secretary of the Army returned the interim mitigation report to NODCE. Since the purchase of the Tensas will compensate for damages below river mile 104, the proposal for a 12,000-acre purchase has been abandoned in anticipation of the forthcoming habitat-based compensation determination for impacts above mile 104. FWS' contribution to the subject determination is included in this report.

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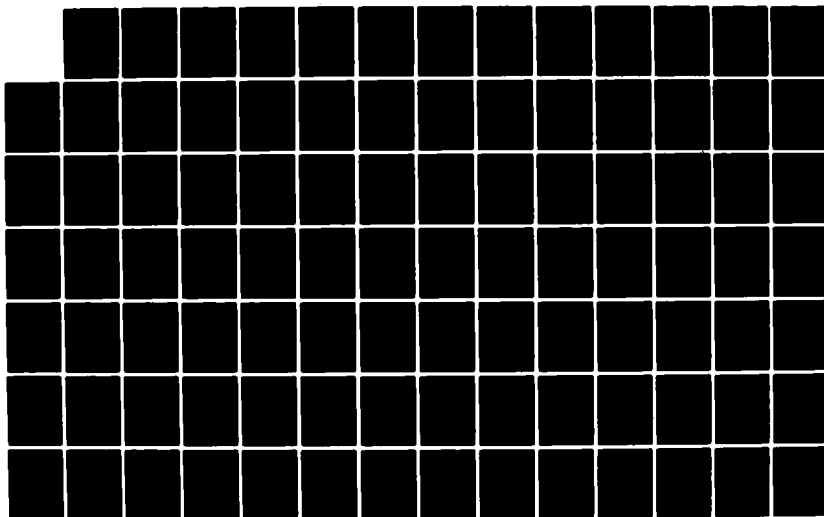
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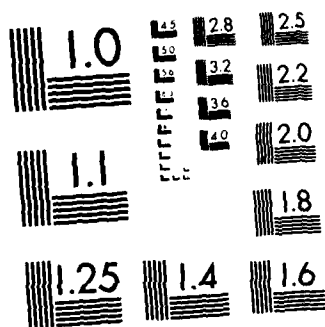
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AREA SETTING

Geographical Location

The lower basin of the Red River includes portions of the states of Oklahoma, Texas, Arkansas, and Louisiana, and extends from Denison Dam at Lake Texoma Reservoir southeastward to the Mississippi River (Figure 1). The width of the basin ranges from about 130 miles in the upper portion to 20 miles in the lower portion; the basin is about 400 miles in length. It comprises an area of approximately 29,500 square miles. The basin is a large alluvial valley flanked by gently rolling terrain. Elevations in the basin are generally below 400 feet NGVD. Levees have been constructed along the Mississippi River to Shreveport reach of the Red River, generally parallel to and within 1 mile of the river. These levees, in conjunction with the high bluffs along some portions of the river, provide flood protection for low lying areas upstream from river mile 43. Downstream from mile 43 (the Lock and Dam 1 location) there is no levee on the right descending bank and a large backwater area of about 200 square miles is located in this portion of Avoyelles Parish. A levee exists on the left descending bank from mile 34 (confluence with the Black River) to the Mississippi River, but the area between miles 34 and 43 is subject to backwater flooding.

The area of project influence on fish and wildlife resources includes the 275 mile segment of the Red River between the Mississippi River and Shreveport, and those land and water areas adjacent to the river which will be directly impacted by flooding, channel construction, induced clearing, and other aspects related to project construction and operation. These habitats are primarily restricted to the area between the levees and bluffs which parallel the river.

Approximately 50 percent of the lands in the project area are in agricultural production. Of these, almost 65 percent are in pasture while the remainder is in row crop production, primarily soybeans. The wooded areas above Lock and Dam 1 are primarily elongated strips paralleling the river, and isolated blocks adjacent to the river. However, a large expanse of woodlands is found in the backwater area below Lock and Dam 1.

Land use patterns within the project area and vicinity are rather stable. The majority of the Red River valley has been cleared and in agricultural production for some time. Land use change projections made by the NODCE, in consultation with FWS, show that 10 percent of the wooded areas in the project vicinity will be cleared by the year 1985; there will be no significant land use changes after that time.

Fishery Resources

Aquatic areas to be affected by the project include river channel, tributary streams, backwaters, oxbows, borrow pits, and ponds. Riverine habitat is perhaps the single most important aquatic habitat in the project area. It contains the greatest acreage within the 275 mile

project reach, comprising approximately 27,440 acres. It is a dynamic system which varies from shallow, productive areas to deep, less productive areas. However, frequent high turbidity levels in the Red River limit its overall biological productivity.

Major tributary systems flowing into the project area include Loggy Bayou, Bayou Pierre, Coushatta Bayou, Cane River, Bayou Rigolette, Cross Bayou, Saline Bayou, and Bayou Nantachie. These are primarily low-gradient streams in which water quality is influenced to a large degree by agricultural runoff. Some of these streams are utilized as spawning and nursery areas for sport and commercial fishes found in the river proper.

Numerous water bodies are isolated from the main river channel during normal and low water periods. These vary from large oxbows to small ponds and are found between the levees and bluffs along the river. These water bodies range in area from a few acres to over 100 acres. Approximately 3,700 acres of these isolated oxbows and ponds are found within the project reach. Borrow pits are found along the project reach and are usually the result of levee construction. The borrow pits are of lesser importance to fisheries than the natural lakes and river channel. The large backwater area below Lock and Dam 1 and the batture areas along the river are usually flooded during late winter or spring and, at that time, serve as important spawning and nursery sites for the various sport and commercial fish species which occur in the project area.

Principal game fishes harvested in the project area include largemouth bass, black crappie, white crappie, bluegill, redear sunfish, warmouth, green sunfish, channel catfish, blue catfish, white bass, striped bass and hybrid striped bass. Some bank fishing takes place along accessible reaches of the river. The lack of adequate public boat launching facilities along the Red River is a limiting factor affecting the harvest of sport and commercial fishes in the river proper.

The average annual sport fishing potential in the project area is estimated to be 115,850 man-days. The Red River, alone, is capable of supporting approximately 72,880 man-days of sport fishing, annually, on 22,590 acres of riverine habitat. Other water bodies totaling 3,700 acres (oxbows and ponds) are capable of sustaining approximately 42,970 man-days of sport fishing, annually. These estimates of baseline potential for sport fishing on the Red River in the project reach are not expected to change significantly under the future without-project condition (Table 3).

Principal commercial fishes landed in the project area include channel catfish, blue catfish, flathead catfish, gars, smallmouth buffalo, bigmouth buffalo, gizzard shad, carp, and freshwater drum. The commercial fish harvest for the project reach in 1975 (i.e., the baseline year) was approximately 290,550 pounds valued at \$63,900, according to data adapted from statistical records compiled by the National Marine Fisheries Service, New Orleans, Louisiana. This harvest is sustained on

Table 3. Sportfishery resources expected on the Red River Waterway under future without-project conditions.

Aquatic Habitat Type	Target Year										
	0 1975	1 1976	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040	
Natural River Channel (acres) ^a	22,594	22,594	22,594	22,594	22,594	22,594	22,594	22,594	22,594	22,594	
Available size sport fish (lbs/acre) ^b	10	10	10	10	10	10	10	10	10	10	
Potential sportfishing man-days	72,884	72,884	72,884	72,884	72,884	72,884	72,884	72,884	72,884	72,884	
Other waterbodies (acres) ^c	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	
Available size sport fish (lbs/acre) ^d	36	36	36	36	36	36	36	36	36	36	
Potential sportfishing man-days	42,968	42,968	42,968	42,968	42,968	42,968	42,968	42,968	42,968	42,968	
Total potential sport-fishing man-days	115,852	115,852	115,852	115,852	115,852	115,852	115,852	115,852	115,852	115,852	

a. Computed by assuming that 233 miles of natural river are located within the project reach and that the river is 800 feet wide.

b. Data from Louisiana Department of Wildlife and Fisheries letter report, dated April 5, 1974, reproduced on page I-25, General Design Memorandum No. 2, Red River Waterway, Mississippi River to Shreveport, Louisiana, NODCE, May 1976.

c. Data from 1980 habitat mapping studies on file with FWS, Lafayette, Louisiana, or NODCE, New Orleans, Louisiana.

d. From fish population sampling conducted by interagency team in July 1979.

the 22,590 acres of riverine habitat in the project reach and is not expected to change significantly under the future without-project condition (Table 4).

Wildlife Resources

Terrestrial habitats which will be impacted by this project are bottomland hardwoods, riverfront forests, wooded swamps, mixed pine-hardwoods, sandbars, and open lands (Table 2). Typical tree species within the bottomland hardwood areas include bitter pecan, Drummond red maple, hackberry, swamp privet, green ash, honeylocust, waterlocust, overcup oak, Nuttall oak, willow oak, water oak, hawthorn, pecan, persimmon, sweetgum, cherrybark oak, cow oak, water elm, winged elm, American elm, and cedar elm.

Sandbars, precursors to riverfront forests, were distinct enough in the project reach to be mapped and, therefore, were evaluated as a separate habitat type. Sandbar willows usually are pioneer species in colonizing newly emergent sandbars.

Riverfront forest, an early seral stage of bottomland hardwoods, is characterized by sandbar willow, black willow, cottonwood, and sycamore. Sycamore and cottonwood, which first become established on the higher banks of the river and eventually extend landward therefrom, may be found in association with hackberry, American elm, and boxelder. Riverfront forest (cottonwood-willow-sycamore) is the dominant wooded habitat along the project reach.

Wooded swamp habitat in the project reach is primarily associated with lakes, backwater swamps, and old stream channels. The dominant vegetation includes baldcypress, tupelogum, black willow, Drummond red maple, pumpkin ash, swamp privet, and buttonbush.

Longleaf and shortleaf pine forests were historically found in the hills on either side of the Red River and have been gradually replaced by the faster growing loblolly pine. Hardwoods found in association with loblolly pines and shortleaf pines include white oak, southern red oak, post oak, blackjack oak, and various hickory species.

Open lands are the most prevalent habitat type within the project reach. For the purpose of this report the open lands were divided into pasture lands and croplands. Pasture lands range from cleared sandbar and batture lands to improved pastures. Croplands are usually planted with a variety of crops, with soybeans being the predominant type.

The terrestrial habitats in the project area support a number of wildlife species, ranging from those which prefer the open agricultural areas to those primarily limited to bottomland hardwood forests and wooded swamp areas. Furbearers utilizing these areas include raccoon, beaver, red and gray fox, striped skunk, mink, bobcat, and opossum.

Table 4. Commercial fish harvest expected on the Red River Waterway under future without-project conditions.

Aquatic Habitat Type	Target Year									
	0 1975	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040	
Natural river channel (acres)	22,594	22,594	22,594	22,594	22,594	22,594	22,594	22,594	22,594	
Commercial harvest ^a (lbs)	290,551	290,551	290,551	290,551	290,551	290,551	290,551	290,551	290,551	
Pounds per acre harvested ^b	13	13	13	13	13	13	13	13	13	
Value (dollars)	63,921	63,921	63,921	63,921	63,921	63,921	63,921	63,921	63,921	
Other waterbodies (acres)	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	
Commercial harvest (lbs)	no data	no data	no data	no data	no data	no data	no data	no data	no data	
Pounds per acre harvested	no data	no data	no data	no data	no data	no data	no data	no data	no data	
Value (dollars)	no data	no data	no data	no data	no data	no data	no data	no data	no data	

a. Data for baseline condition (1975), computed from data supplied by National Marine Fisheries Service (NMFS), New Orleans, Louisiana. Values represent 71 percent of reported commercial finfish landings for the Red River in Louisiana (excluding Avoyelles Parish backwater area), based on the fact that project area contains 71 percent of acreage of Red River Waterway in Louisiana.

b. Average price for commercial fish for 1975, 1976, 1977, and 1978 is \$0.21 per pound (computed from NMFS data); this figure was multiplied by pounds of commercial finfish landings to obtain commercial fishing value for all target years.

Game species known to occur in the project area include white-tailed deer, gray and fox squirrel, Eastern cottontail, swamp rabbit, American woodcock, wild turkey, various species of waterfowl, bobwhite, and mourning dove. Nonconsumptive recreational opportunities, such as nature study, bird watching, camping, and boating, are limited in the project area, due mainly to a lack of public access. However, the potential for these activities does exist.

Estimates were developed for population levels of certain recreationally important species. These species will support a certain number of man-days of use based on sustained annual harvest rates and hunter success rates for the different habitat types. The results of these calculations, summarized for baseline and future without-project conditions, are presented in Table 5. Slight decreases in both populations and man-day usage will occur for those species which are primarily associated with woodland habitats. Rabbit, quail, and dove will experience overall increases in population numbers and corresponding man-day use potential due to the conversion of wooded areas to open lands. The projected future without-project changes in populations of the evaluation species are considered minimal. This is primarily the result of the low land clearing rate (i.e., a total of only 10 percent) predicted for the next 50 years.

In addition to the man-day analysis, a Habitat Evaluation Procedures (HEP) analysis was performed. The HEP analysis showed that the habitat to be impacted is, overall, of average quality, and that those species which prefer wooded habitats will be adversely impacted under future with-project conditions; this is due in part to the projected clearing of woodlands under those conditions. The HEP and other analysis methods are discussed in greater detail in the Methodology and Impacts sections.

Endangered Species

Endangered species currently protected by the Endangered Species Act of 1973 which may occur in the project area include the American alligator, Florida panther, red-cockaded woodpecker, southern bald eagle, arctic peregrine falcon, Eskimo curlew, ivory-billed woodpecker, and Bachman's warbler. The American alligator probably occurs throughout a large portion of the project area. The southern bald eagle, arctic peregrine falcon, and Eskimo curlew may occur in the area as seasonal transients. Suitable habitat for the Florida panther, ivory-billed woodpecker, and Bachman's warbler is located in the lower reach of the project area below Lock and Dam 1; however, the occurrence of these species in the area is doubtful. The red-cockaded woodpecker prefers stands of over-mature pine trees; numerous stands of pine in the vicinity of the Lock and Dam 3 location may provide suitable habitat for these birds.

Table 5. Wildlife populations and man-day potentials for certain species under baseline, future without project, and future with project conditions, terrestrial habitat.

Species	Populations (individuals)		Man-day Use Potential	
	Baseline	Future w/o ^c	Future w/o	Future with ^c
Deer	356	334	2,542	2,375
Turkey	140	131	2,277	2,128
Squirrel	3,759	3,510	1,128	1,053
Wood Duck	483 ^a	448 ^a	107 ^b	100 ^b
Woodcock	768	718	153	143
Rabbit	14,489	14,802	4,345	4,439
Quail	4,781	5,179	1,420	1,541
Dove	17,390	18,917	5,217	5,675
Non-consumptive use	-	-	8,341	8,340
Total			25,530	25,794
				16,425

a. Breeding population of resident wood ducks only.

b. All waterfowl.

c. Values are for the year 2040, the end of the project life. Actual figures will fluctuate over the life of the project.

Management Areas

The Louisiana Department of Wildlife and Fisheries operates several wildlife management areas in the vicinity of the Red River; these include Soda Lake, Bodcau, Loggy Bayou, Alexander State Forest, Saline, Spring Bayou, Grassy Lake, Pomme de Terre, Red River, and Three Rivers. Public hunting is allowed on these areas as well as in the Kisatchie National Forest; portions of the latter area are situated on either side of the Red River along the project reach. Within the national forests the U.S. Forest Service operates the Red Dirt and Catahoula National Wildlife Management Preserves and Kisatchie Hills Wilderness Area.

Recreation

Recreational sites within the project area are essentially non-existent. With the exception of boat launching facilities at Simmesport, Louisiana, there are no public boat ramps on the main river itself between Shreveport and the Mississippi River. There are a few ramps on some of the tributaries flowing into the Red River, but these are generally primitive sites and are not easily accessible by the public. Access to the river is primarily across private lands, further reducing the recreational use of the area. A number of recreational sites are located in the general project vicinity, including those at Lake Buhlow, Toledo Bend, Indian Creek, and Chicot Park. However, none of these are associated with the Red River proper.

IMPACT ASSESSMENT METHODOLOGY

Introduction

Navigation projects, reservoirs, and other water development activities frequently impact the quality and quantity of our Nation's fish and wildlife resources. Two aspirations of society should be considered when evaluating federal projects: (1) the promotion of economic development and human well-being by maintaining a viable and thriving economy; and (2) the conservation of productive natural systems and environmental quality, also essential to human well-being. These aspirations often tend to conflict or compete; superficially they appear to be almost mutually exclusive. Congress and other governmental entities have sought to address this apparent conflict by enacting numerous laws, regulations, and policies during recent years, most of which are designed to guide water resource planning to the conclusion which best fulfills both of the above-listed societal aspirations. The Fish and Wildlife Coordination Act (FWCA) plays a key role in this effort.

The FWCA provides a basic procedural framework for the orderly consideration of fish and wildlife impacts resulting from water development projects. The Congressional statement of purpose contained in the FWCA is that fish and wildlife conservation shall receive equal consideration with other project features of water development projects. Specific procedural requirements of the Act are first, that the impacts of a project upon fish and wildlife be fully identified; and second, that conservation measures be formulated and considered for inclusion as integral features of project plans. It is to this end that the remainder of this report will identify, as specifically as practicable, the fish and wildlife impacts of the current proposal and discuss means of mitigating such impacts where required. It is appropriate beforehand, however, to briefly review the procedures used to measure impacts and the policies associated with recommendations to mitigate these impacts.

The U.S. Fish and Wildlife Service employs two basic analytical methods to identify and quantify project impacts, i.e., the HEP and a man-day analysis. Both methods were used in the evaluation of impacts to terrestrial (wildlife) species; only the man-day analysis was used to evaluate aquatic (fishery) impacts.

HEP Analysis

The HEP analysis was developed by the Fish and Wildlife Service (FWS) to provide a method for describing baseline habitat conditions and predicting future habitat conditions in terms of habitat quality and quantity. This system is based on the assumption that all habitat has inherent value to wildlife and that impacts to wildlife habitat, in terms of modifications in quality and quantity, can be measured and compared.

In implementing the HEP (1980 version), a representative list of species or species groups is selected for the project area, and these species (or groups) are used as evaluation elements in determining habitat quality. The habitat suitability for each of the evaluation elements is rated between 0 and 1, with 0 being the poorest and 1 being the optimal score. The scores for all sample plots within a particular habitat type are averaged for each evaluation element, and the resulting number is called the Habitat Suitability Index (HSI) for that evaluation element in that habitat type. A weighted average HSI must be derived for those species which are evaluated in more than one cover type. The HSI for each evaluation element (species) is then multiplied by the total area (acres) of available habitat to determine the total number of Habitat Units (HU's). HU's are the product of quality (HSI) and quantity (area) of the habitat for a particular species, and provide a standardized basis for comparing habitat changes over time and space.

Man-day Analysis

A man-day analysis expresses tangible impacts upon human uses of fish, wildlife, and related recreational resources of the project area. The most accurate method of determining man-day use is by surveys or records of actual recreational use. If actual use data are not available, it is possible to estimate human use based on the resource's potential to support that use. Man-day use is generally classified as either general (e.g., warmwater fishing, small game hunting) or specialized (e.g., big game hunting, waterfowl hunting). The applications of the man-day analyses specific to fish and wildlife resources in this project are detailed later in this section.

Of the two impact methodologies previously described, HEP and man-day, it is the policy of the FWS to use HEP as the basic analytical tool for evaluating impacts and formulating subsequent recommendations. This policy is not meant to exclude man-days as a valid concern. On the contrary, recreational use is an important and highly pertinent concern. Efforts to fulfill the conservation purpose of the FWCA, however, must be founded on protecting and maintaining the biological productivity and integrity of the resource base. Only in this manner can we protect and conserve the myriad values that fish and wildlife provide to the Nation. Any measure not founded on the biological basis of resource protection will, in the long run, serve neither the resource nor our use of that resource.

Assessment Methodology - Fishery Resources

A man-day analysis was used to evaluate the sport fishing potential of the area. The number of potential sport fishing man-days was computed by multiplying the number of acres of a particular habitat type by the predicted pounds per acre of available-size sport fish in that habitat type and dividing the product by 3.1 pounds per man-day, the estimated

satisfaction level or average catch of available size sport fish in Louisiana. Acres of habitat type (e.g., oxbows, navigation pools, river channel) were either supplied by the NODCE or planimetered from project maps supplied by the NODCE. Baseline data on sport fish populations were based on block net samples taken from existing oxbows in the Natchitoches, Louisiana, area during the summer of 1979.

Changes in sport and commercial fisheries which would occur on the navigation pools and preserved oxbows after the project is in place were predicted from models developed by personnel from the FWS's National Reservoir Research Program (NRRP) in Fayetteville, Arkansas. Data from existing reservoirs in southeastern United States were used to develop multivariate models which predicted fish standing crop and angler effort and harvest, based on physical parameters of the water bodies. Parameters used as input variables from the Red River Waterway included surface area, mean depth, maximum depth, outlet depth, thermocline depth, annual water level fluctuation, storage ratio, shoreline development, total dissolved solids, chemical type, use type, and growing season.

Baseline (1975) data on the commercial fisheries of the project area were obtained from the National Marine Fisheries Service, Resource Statistics Division, New Orleans, Louisiana. The poundage values used in the commercial harvest estimates represent 71 percent of the reported commercial finfish landings for the Red River in Louisiana; the Avoyelles Parish backwater area (which comprised the remaining 29 percent) was excluded because it is not in the area of project influence). The data values were based on the average gross returns to the fisherman for commercial fish species in 1975-1978 for the 12 Red River parishes (e.g., see Appendix A for 1977 values by species). The values used for each species, although based only on Red River fisheries, were comparable to those for the state of Louisiana presented in Bell and FitzGibbon (1980:211).

Assessment Methodology - Wildlife Resources

Impacts to wildlife resources were determined using man-day analysis and Habitat Evaluation Procedures (HEP). Before these methods could be employed, it was necessary to determine the habitat types and number of acres of each which would be affected. This was done jointly by NODCE and FWS personnel, using NODCE project maps which show the location and extent of flooding, spoil disposal areas, revetment work, new channel construction, and locks and dams. Habitat types impacted by these activities were determined by field investigation and interpretation of color infrared photos. The ratio of pasture to cropland was determined by aerial surveys over the project area during which land use was recorded on the project maps. Determinations were then made as to the amount of each habitat type impacted by flooding, revetment work, spoil disposal, and any other project related construction activities.

The man-day analysis was based on the population density, sustained annual harvest rate, and hunter success rate for selected game species found in the project area; non-consumptive outdoor recreation was also included. Usage determinations were made for baseline, future without-project, and future with-project conditions. A project-induced man-day change was then calculated based on the baseline and future with-project conditions.

The field portion of the HEP analysis was performed April 22-23, 1980, by representatives of the FWS, NODCE, and Louisiana Department of Wildlife and Fisheries (LDWF). A total of 43 sites in 7 habitat types were evaluated. These included pasture (8 sites), cropland (8 sites), mixed pine-hardwoods (3 sites), wooded swamp (4 sites), bottomland hardwood (4 sites), riverfront hardwoods (12 sites), and willow sandbar (4 sites).

Evaluation species are key components used in HEP analyses, and are integral in quantification of habitat suitability and the determination of changes in the number of available HU's. Therefore, a HEP assessment is directly applicable only to the evaluation species selected. An evaluation species can be a single species, a group of species, a species life stage, or a species life requisite. There are primarily two basic approaches to the selection of evaluation species: 1) selection of species with high public interest, economic value, or both; and 2) selection of species to provide a broad ecological perspective of an area. In choosing species for this evaluation, the HEP team concentrated on those which would apply to both ecological and public interest approaches. A total of 26 species which fit into specific feeding and/or reproductive guilds were chosen and used to show impacts on the overall ecological community; those species with high public interest were also included in the appropriate guild. Since the HEP analysis was conducted primarily to determine mitigation needs, only 11 of the original 26 species evaluated were used in the total analysis. These 11 species were considered to have high economic, recreational, and public interest value, and included white-tailed deer, red fox, eastern cottontail, mourning dove, bobwhite, gray squirrel, wild turkey, raccoon, swamp rabbit, wood duck, and American woodcock.

PROJECT IMPACTS

Construction of the Red River Waterway Project will take approximately 15 years, from 1975 to 1990; project life after construction was estimated by NODCE to be 50 years. Implementation of the project will produce substantial changes in the terrestrial and aquatic habitats within the project area.

One of the primary impacts will be the conversion of terrestrial habitat to aquatic habitat. Approximately 9,500 acres of land will be flooded; the majority of these lands are located in the reaches of Locks and Dams 3, 4, and 5, from just below Coushatta to Shreveport. Conversion of habitat types will occur with the disposal of dredged materials on woodland, open land, and aquatic areas. These spoil areas will then be converted to pasture, cropland, or recreational lands. Creation of terrestrial habitat is expected to occur with the siltation of unpreserved oxbows and parts of preserved oxbows. Major bendways will be cut off and preserved by plugging of their upper ends, thus converting riverine habitat to lake habitat. The bank stabilization features of the project will provide protection (from bank caving) to the lands along the river; consequently, about 6,680 acres of these lands will be cleared and put into agricultural production. Due to this induced clearing and the return of spoil areas to agricultural production, pasture and cropland habitats will have net gains in acreage. Wetland habitat will probably be created in the shallow water (0 to 2 feet deep) and freeboard areas associated with the navigation pools. The freeboard areas are the lands between the navigation pools and 3 feet in elevation above the navigation pools which will be subjected to increased soil saturation, occasional flooding, and in places, wave action.

Ground water fluctuations are projected to have impacts on the yields of agricultural crops grown outside of the levees. Data generated in the ground water studies funded by the NODCE were not adequate for use in predicting impacts to fish and wildlife resources. It can be assumed, however, that some marginal agricultural lands may become suitable for supporting wetland vegetation, but no estimates were made as to the location, quantity, or quality of these lands. Impacts resulting from groundwater fluctuations, therefore, were not considered in this evaluation.

Fishery Impacts

It is expected that the Red River Waterway project will significantly change the existing riverine habitat and fish populations over the life of the project. In the navigation pools and oxbows, the fish community will change from a riverine species assemblage (primarily carp, freshwater drum, buffalos, and catfishes) to a typical reservoir species assemblage; the latter includes a higher percentage of gamefishes such as largemouth bass, bluegill, and crannie along with a lower percentage of the riverine species mentioned previously.

Construction of the navigation channel will require cutting off numerous bends in the river channel. Closure dams will be placed on the upper ends of 28 of the major bendways (those at least one mile in length), thus preventing total siltation of these bendways and creating oxbow lakes. Siltation of the downstream opening of each oxbow is expected to eventually cause the formation of a silt plug; such a plug would reduce or eliminate the connection between the oxbow lake and the Red River. Approximately 7,890 acres of oxbows will initially be created via closure dams. However, only 5,455 surface acres of water will remain in these oxbows after the 50-year project life due to periodic riverine flooding and related siltation. Oxbows which are not preserved with a closure dam (about 3,800 acres) are expected to become filled with silt by the year 2000. These newly-formed lands will presumably be allowed to undergo natural succession to a bottomland hardwoods climax vegetation type.

Raising of water levels in the river for navigation purposes will, in some cases, flood the adjacent low-lying areas and thus create additional fisheries habitat. This will be most extensive in the Lock and Dam 5 reach where approximately 4,800 acres of terrestrial habitat will be flooded. Lock and Dam 3 and 4 will each flood about 2,200 acres; a hinge pool will be in operation on Pool 3. The steep slope of the existing river banks below Lock and Dam 3 allows for the raising of water levels to navigation depths with minimal over-bank flooding.

Both commercial and sport fishing are predicted to increase with the project. As shown in Table 3, the sport fishing potential of the Red River in the project area is expected to remain constant at 115,850 man-days under the future without-project conditions. With the project in place (Table 6), sport fishing potential will range from 439,000 man-days in the year 1990 to 402,404 man-days by the end of project life (2040). On an average annual basis, sport fishing potential is estimated at 115,850 man-days under without-project conditions and 380,000 man-days under with-project conditions. These estimates were based on the predicted pounds per acre of available size sport fish and the satisfaction level or average catch per man-day in Louisiana. The actual man-day use with the project in place was predicted by an NRRP model to range from 542,800 man-days in 1990 to 238,900 man-days in 2040. The actual use estimates differ from those for potential use in that the former take into account the initial surge in sport fish populations common to most new lakes and reservoirs during the 7 to 10 year period after construction, and the gradual decline in sport fishing thereafter.

The commercial fish harvest in the oxbows and navigation pools was projected to increase from 3.7 pounds per acre in 1990 to 24.1 pounds per acre in 2040 (Table 7). Commercial fish are currently being harvested at an estimated rate of 13 pounds per acre, for an average annual harvest of 290,600 pounds valued at \$63,900 (1975 price levels); these values are expected to remain constant under without-project conditions. There will be an initial decrease in commercial fisheries harvest during the

Table 6. Sport fishery resources expected with the proposed plan for the Red River Waterway Project

Aquatic Habitat Type	Year										Annualized
	0 1975	1 1976	5 1980	10 1985	15 1990	25 2000	35 2010	45 2020	55 2030	65 2040	
Natural river channel (acres)	22,594 ^b	22,594 ^b	15,063	7,531	0	0	0	0	0	0	
Available size sportfish (lbs/acre)	10	10	10	10							
Potential sportfishing (man-days)	72,884	72,884	48,590	24,294							
Other waterbodies ^c (acres)	3,700	3,700	2,700	1,700	700	700	700	700	700	700	
Available size sportfish ^d (lbs/acre)	36	36	36	36	36	36	36	36	36	36	
Potential sportfishing (man-days)	42,968	42,568	31,355	19,472	8,129	8,129	8,129	8,129	8,129	8,129	
Oxbows with closures (acres)	0	0	2,629	5,258	7,887	7,401	6,915	6,429	5,943	5,454	
Available size sportfish ^e (lbs/acre)	-	-	42	42	42	42	42	42	42	42	
Potential sportfishing (man-days)	-	-	35,619	71,237	106,856	100,272	93,687	87,103	80,518	73,891	
Oxbows without closures (acres)	0	0	3,766	2,510	1,255	0	0	0	0	0	
Available size sportfish ^f (lbs/acre)	-	-	10	10	10						
Potential sportfishing (man-days)	-	-	12,148	8,097	4,048						
Navigation pool (acres)	0	0	10,345	20,691	31,037	31,037	31,037	31,037	31,037	31,037	
Available sportfish ^g (lbs/acre)	-	-	32	32	32	32	32	32	32	32	
Potential sportfishing (man-days)	-	-	106,787	213,584	320,382	320,382	320,382	320,382	320,382	320,382	
Total potential sportfishing (man-days)	115,852	115,852	234,499	336,954	439,415	428,783	422,190	415,614	409,029	402,404	310,022
Predicted actual sportfishing ^h (man-days)	-	-	-	-	542,757	134,810	289,500	272,623	255,745	238,069	

- a. Project in place by 1990.
- b. Computed by assuming that 233 miles of natural river are located within the project reach and that the river is 800 feet wide.
- c. Includes existing oxbows, ponds, and borrow pits in the project area.
- d. From fish population sampling conducted by Interagency team in July 1979.
- e. Data derived from fish population predictions developed for navigation pools and preserved oxbows from the Red River Waterway, Mississippi River to Shreveport Reach, by Fish and Wildlife Service's National Reservoir Research Program (NRRP), Fayetteville, Arkansas.
- f. Assumes that the available size sportfish population in oxbows without closures would be the same as for the pre-project river for the project life.
- g. Adjusted by NRRP to account for the initial surge in sport fish populations common to most new lakes and reservoirs during the 7-10 year period after construction and the gradual decline in sport fishing thereafter. No predictions were made for years before the project was in place (1970-1980) due to insufficient data; thus, an annualized value could not be calculated.

Table 7. Commercial fish harvest expected with the proposed plan for the Red River Waterway project.

Aquatic Habitat Type	Year										Annualized
	0 1975	5 1980	10 1985	15 1990 ^a	25 2000	35 2010	45 2020	55 2030	65 2040		
Natural river channel (acres)	22,594	15,063	7,531	0	0	0	0	0	0	0	
Commercial harvest (lbs)	290,551	195,819	97,903	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Pounds per acre harvested	13	13	13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Value (dollars) ^c	63,921	41,122	20,560	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Other waterbodies (acres)	3,700	2,700	1,700	700	700	700	700	700	700	700	
Commercial harvest (lbs) ^d	no data	35,100	22,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100	
Pounds per acre harvested	no data	13	13	13	13	13	13	13	13	13	
Value (dollars)	no data	7,371	4,641	1,911	1,911	1,911	1,911	1,911	1,911	1,911	
Oxbows with closures (acres)	0	2,629	5,258	7,887	7,401	6,915	6,429	5,943	5,454	5,454	
Commercial harvest (lbs)	0	9,727	19,455	29,182	82,151	107,183	118,294	126,586	131,441	131,441	
Pounds per acre harvested ^e	0	3.7	3.7	3.7	11.1	15.5	18.4	21.3	24.1	24.1	
Value (dollars)	0	2,043	4,085	6,128	17,252	22,508	24,842	26,583	27,603	27,603	
Oxbows without closures (acres)	0	3,766	2,510	1,255	0	0	0	0	0	0	
Commercial harvest (lbs)	0	48,958	32,630	16,315	n/a	n/a	n/a	n/a	n/a	n/a	
Pounds per acre harvested	0	13	13	13							
Value (dollars)	0	10,281	6,852	3,426							
Navigation pool (acres)	0	10,345	20,691	31,037	31,037	31,037	31,037	31,037	31,037	31,037	
Commercial harvest (lbs)	0	38,277	76,557	114,837	344,511	481,074	571,081	661,088	747,992	747,992	
Pounds per acre harvested ^e	0	3.7	3.7	3.7	11.1	15.5	18.4	21.3	24.1	24.1	
Value (dollars)	0	8,038	16,077	24,116	72,347	101,026	119,927	138,828	157,078	157,078	
Total (acres)	22,594	34,503	37,690	40,879	39,138	38,652	38,166	37,680	37,191	37,191	
Commercial harvest ^f (lbs)	290,551	327,881	248,645	169,434	435,762	597,357	698,475	796,774	888,533	888,533	
Value (dollars)	63,921	68,855	52,215	35,581	91,510	125,445	146,680	167,323	186,592	186,592	
										532,402	
										111,804	

a. Project in place by 1990.

b. Data for baseline condition (1975), computed from data supplied by National Marine Fisheries Service, New Orleans, Louisiana. Values represent 71 percent of reported commercial finfish landings for the Red River in Louisiana (excluding the Avoyelles Parish backwater area), based on the fact that project area contains 71 percent of acreage of Red River Waterway in Louisiana.

c. Average price for commercial fish for 1975, 1976, 1977, and 1978 is \$0.21 per pound; this figure was multiplied by pounds of commercial finfish landings to obtain commercial fishing value for all target years and annualized value.

d. It was assumed that commercial fish would be harvested in other water bodies (including ponds, existing oxbows, and borrow pits in the project area) and oxbows without closures at pre-project rate of 13.0 pounds per acre for the life of the project. Identical to calculated harvest for Red River proper.

e. Data derived from predictions developed for oxbows with closures and for navigation pools of Red River Waterway, Mississippi River to Shreveport, by personnel of Fish and Wildlife Service's National Reservoir Research Program.

f. Annualized figures are given for the period 1975 to 2040.

construction period and immediately after the project is completed. However, assuming that the project is in place by 1990, net gains in commercial fish harvest should be noted by the year 2000. By the end of the 50-year project life (2040), the average annual commercial fish harvest is expected to be 888,500 pounds, valued at \$186,600. This represents a 206 percent increase over without-project conditions.

The above predictions for sport and commercial fisheries do not take into consideration the effects of the hinge operations planned for Pool 3. NODCE predicts that, in a typical hydrologic year, a seven-foot hinge drawdown will occur four times between February and June; the drawdown will expose 920 acres of shallow water habitat in the lower one-third of the Pool for three 15-day periods and one 30-day period. There have been no studies which evaluate the impacts of such a temporary drawdown; thus, to quantify its effect on the above fishery predictions would be virtually impossible. It is apparent, however, that some adverse impacts would occur.

The shallow water areas, to be exposed by the hinge operations, would normally have been used extensively for spawning, which reaches peak intensity in the spring months. Thus, developing eggs present in Pool 3 at the time of a hinge would be destroyed. With four such hinges occurring every spring and lasting for 15 to 30 days each, a majority of the spring spawn in Pool 3 would be eliminated. It is possible, however, that recruitment of larval fishes from other pools via entrainment into Pool 3 would reduce the loss in productivity anticipated in that Pool.

We also anticipate that a significant decrease in sport fishing in Pool 3 would result from the hinge operation. The rapid drawdown of clearer waters from off-channel areas and subsequent rapid re-filling of those areas with highly turbid river water would serve to decrease angler success; thus, a decrease in sport fishing man-days and associated recreational benefits is expected. Impacts on commercial fishing cannot be predicted at this time. Although some water quality changes would undoubtedly occur in the absence of a hinge operation due to the influx of flood waters, those changes would be largely confined to the main channel and the backwater areas would be less affected.

Wildlife Impacts

Implementation of the project will result in the loss, conversion, and creation of terrestrial habitat. These changes in habitat types and acreages are summarized in Table 8.

The change in habitat types will produce a corresponding change in the species composition of the animal populations in the area. Woodland species such as gray squirrel, red fox, wild turkey, American woodcock, and white-tailed deer will lose habitat and be replaced by those species such as mourning dove, bobwhite, eastern cottontail, and eastern kingbird, which prefer open lands. Population projections for certain species under with- and without-project conditions (Table 5) depict these changes.

Table 8. Habitat types and acreage of each which will be affected by the Red River Waterway Project.

Habitat Type	Spoil Disposal	Revetment	Channel	Flooding	Freeboard	Induced Clearing	Total
Pasture	3,838	997	1,512	2,595	1,679	N/A	10,621
Cropland	2,324	813	1,222	610	425	N/A	5,394
Riverfront forest	3,146	1,308	1,275	4,163	2,018	5,411	17,321
Bottomland hardwood	620	203	205	571	121	735	2,455
Willow sandbar	713	38	250	1,534	176	N/A	2,711
Pine-hardwoods	203	39	63	None	62	267	634
Wooded swamp	324	29	46	34	None	267	700
Total	11,168	3,427	4,573	9,507	4,481	6,680	39,836

The HEP analysis was used to track changes in wildlife habitat quality and quantity over the life of the project. A summary of the changes is provided in Table 9. Open land species would benefit with implementation of the project, due primarily to the conversion of wooded areas to agricultural use by induced clearing and the expected use of many spoil disposal areas as pasture and cropland. Eastern cottontail, mourning dove, and bobwhite each showed a gain of approximately 800 Average Annual Habitat Units (AAHU's) over the project life. The increase in benefits to the openland species is small in comparison to the negative impacts to the woodland type species. The red fox and gray squirrel showed losses of 500 and 700 AAHU's, respectively; the six remaining species showed losses of 2,000 to 6,000 AAHU's. The total loss in AAHU's for all 11 species was 23,300.

There will also be a loss in man-day use potential (for terrestrial species) with implementation of the project (Table 5). The baseline potential of 25,530 man-days is expected to decrease to 16,813 man-days by 2040 in the future with-project condition (versus 25,794 man-days without the project). The Recreation Master Plan, if implemented, will provide for a substantial increase in the number of recreation man-days. These would primarily be associated with non-consumptive activities such as camping, hiking, picnicking, and the like. A suitable wildlife mitigation plan could negate the loss in man-day use potential associated with the majority of the woodland species (deer, squirrel, turkey, and others).

NODCE prepared a biological assessment which concluded that there would be no adverse impacts on endangered species. The FWS concurred in this determination by letter dated January 16, 1981.

Table 9. Changes in Average Annual Habitat Units (AAHU's) due to Red River Waterway total project implementation (from HEP, Form D).

Species	AAHU's With Project	AAHU's Without Project	Change in AAHU's Due to Project
White-tailed deer	6172.73	11817.36	-5644.63
Red fox	5589.91	7078.01	-488.10
Eastern cottontail	6573.21	5808.00	765.21
Mourning dove	8210.59	7379.52	831.07
Bobwhite	5468.19	4654.74	813.45
Gray squirrel	376.34	1120.63	-744.28
Turkey	791.87	3116.45	-2324.58
Raccoon	2752.98	7560.47	-4807.48
Swamp rabbit	2226.30	8215.19	-5988.89
Wood duck	1270.16	3779.36	-2509.20
American woodcock	1733.57	4962.48	-3228.92
		TOTAL	-23326.36

DISCUSSION

Although there are significant adverse impacts associated with the Red River Waterway Project, there are also benefits which will occur if the multipurpose objectives of the project are implemented simultaneously. The FWS is concerned, however, that the simultaneous implementation of the navigation, recreation, and other related objectives may be lacking in certain respects. Efforts thus far have been largely devoted to implementing the navigation and bank stabilization features of the project. The Recreation Master Plan has been completed but has yet to be approved by the Red River Waterway Commission; such approval must occur before the plan can be adopted by NODCE as an integral part of the project. Approval and implementation of the Master Plan is essential if many of the benefits of the project are to be realized. The FWS also believes that the increased water storage supplied by the locks and dams should be closely examined with respect to increasing the water supply of communities adjacent to the Red River. Many of these communities are presently investigating alternative sources of fresh water; it is highly possible that additional project benefits could be derived by using the Red River Waterway as such a source, thus reducing the need for adversely impacting other existing streams and lakes for this purpose. Damages to fish and wildlife resources in and around Caddo Lake, Lake Bistineau and Bayou Bodcau could possibly be avoided if the Red River navigation pools were also used for water supply.

Implementation of the Red River Waterway Project will have significant impacts on the fish and wildlife resources of the area. Fisheries resources, both commercial and sport, will benefit from the project. However, human use of the project-induced increase in sport fishing potential will hinge largely on the implementation of the proposed Recreation Master Plan. Open land terrestrial wildlife species will also show slight benefits. Virtually all of the adverse impacts associated with the project occur to those wildlife species associated with woodland habitat. These latter impacts form the basis for our compensation determination.

Mitigation and Compensation

When the project-induced impacts are identified on a Federal project such as this one, the planning goal should not only be the achievement of the stated project purpose but should also include mitigation measures which will offset project-induced losses to fish and wildlife resources. This philosophy is inherent in the Fish and Wildlife Coordination Act.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

- (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring

the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

The Service supports and adopts this definition of mitigation and considers the specific elements to represent the desirable sequence of steps in the mitigation planning process.

Mitigation of project-induced impacts to fish and wildlife resources can be accomplished within the context of the above definition in several ways. Due to the nature of the navigational aspects of the project, the only way to avoid the impacts is to forego all portions of the work. Selection of lower pool elevations could have minimized the impacts to some extent, but the NODCE has determined that the elevations selected were in the best public interest. Certain features which could be included in the project design would serve to rectify and/or reduce the impacts. These include closure dams on bendway cutoffs, management of project lands and spoil areas for wildlife, operational and structural modifications which would serve to minimize rapid water level fluctuation during fish spawning periods, and creation of wetland impoundments. Some of these features are discussed below. Impacts to fish and wildlife resources which are still outstanding must be compensated for by a combination of land acquisition and management. Various scenarios for such compensation are presented and discussed later in this section.

Mitigation through Project Design

One of the primary mitigative measures planned by the NODCE for this project is the placement of closure dams on the upper end of the major bendway cutoffs. This action will reduce siltation and preserve these bendways as backwater oxbow lakes, and thus will contribute significantly to the fisheries and other recreational benefits of the project. However, unless public access to these areas is provided, these potential benefits will not be realized. The possibility that access will not be provided is very real indeed. Louisiana law currently prohibits the expropriation of private lands for recreational purposes, thereby restricting the flexibility necessary to acquire access routes to and around these lakes. The Recreation Master Plan (which has not yet been approved) calls for land access to 18 of the 28 preserved oxbows. The NODCE has stated (by letter to FWS dated August 19, 1981) that water access can be provided by maintaining a small channel through the (state-owned) silt plug expected to form on the downstream end of each oxbow, but that such work is not presently called for in the plan. We feel that the NODCE should clarify this point. Representatives of the FWS and LDWF have previously expressed their desire that the lower ends of the oxbows be kept open. If public access cannot be provided to all preserved oxbows, the fisheries and recreational benefits included in the project justification should be decreased accordingly. Since these benefits were used in determining the overall benefit-to-cost (B/C) ratio for this project, any decreases may drop the B/C ratio below parity.

Small bendway cutoffs (i.e., those less than one mile in length) will not be preserved and will be allowed to silt in, thus creating terrestrial habitat. In projecting the future with-project condition, it was assumed that these areas, totalling approximately 3,800 acres, would be allowed to go through natural succession, ultimately producing bottomland hardwoods and riverfront forests. This process would partially offset losses to other wooded areas; credit for this partial offset was provided for in the HEP analysis. For these mitigative measures to be successful, the responsible agencies must acquire these lands in fee title. An outstanding example of failure in this regard exists in two such areas, the Clarence and Kateland cutoffs. These areas were allowed to silt in and are now in agricultural production. It may be, as the NODCE August 19, 1982, letter to the FWS notes, that the State of Louisiana would have a claim of ownership and control to these lands and any new lands formed from siltation of the river channel. Nevertheless, it should be stressed that, if public access and ownership cannot be guaranteed for these areas, any potential mitigation credits will be negated.

In addition to the measures discussed above, there are several other potential mitigative measures which can be implemented, using project lands, to further offset losses to wildlife resources. One such measure would be the management of freeboard and shallow water areas for wildlife. These lands, which are located primarily in the reaches of Locks and Dams 3, 4, and 5, total about 6,000 acres. The selected plan calls for purchase of flood easements on these lands. However, if they were acquired in fee title and managed for wildlife, public benefits would be greatly increased. The FWS has pursued this concept further, in later segments of this report, as an alternative for compensating for unavoidable wildlife losses.

Other structural mitigative measures include the conversion of certain spoil disposal areas to small game management areas and the creation of marsh impoundments for the benefit of waterfowl and other aquatic-oriented wildlife species. Six areas totalling about 2,300 acres have been designated as wildlife management areas in the Recreation Master Plan (1,500 of these acres will be used initially for spoil disposal). However, acquisition of these areas is dependent upon the Red River Waterway Commission's approval of the Master Plan. In conducting the HEP for this project, it was assumed that these sites would be converted to management areas and credit was given accordingly. If these areas are not dedicated to wildlife management, then the overall compensation plan and acreages required for wildlife compensation must be adjusted. In any event the NODCE should consider acquiring additional spoil areas and severed lands in fee title for small game management areas whenever possible.

The NODCE should also explore the possibility of creating wetland impoundments along the length of the project. Preliminary discussions have been held between the FWS and the NODCE pertaining to the possibility of constructing such impoundments, and we request that this

office be given the opportunity to work with the NODCE to further develop this concept as design work on the waterway progresses.

Structural measures which could reduce adverse impacts on fishery resources from the Pool 3 hinge operations have been briefly discussed with NODCE. An example of such measures would be a low-level wier, with a crest elevation of one foot below the normal pool elevation, at the mouth of a large oxbow or backwater area. Such a structure would allow small boat access into the backwater area at normal pool elevation, but would only allow water levels in the backwater area to decrease by one foot during hinge operations. Thus the backwater area would remain viable for fish spawning and for sport and commercial fishing during the drawdown. Other measures (e.g., manipulation of water levels to maximize biological benefits during hinge drawdowns) should be considered as well. The details of such structural measures should be fully investigated by the NODCE as part of their advanced engineering and design studies.

An alternative to the use of a hinge pool as a means of reducing flood damages would be purchase of flood easements or fee title on the lands adjacent to Pool 3 which would be susceptible to spring flooding. The FWS would favor such an alternative since it would eliminate the adverse effects associated with the hinge pool operation and the lands in question could possibly provide for the mitigation of terrestrial wildlife losses.

Compensation through Management of Existing Public Lands

Consideration has been given to the possibility of compensating for project impacts by providing funding to other Federal and State agencies for the management of their existing lands. The assumption would be that existing lands in public ownership are ineffectively managed at present, and will be throughout the project life and beyond. Thus, by providing funds for the life of the project and beyond (until project impacts cease to occur and natural conditions recover), wildlife improvements equal to project impacts could theoretically be obtained if enough funds were provided for management of enough lands. Lands under the management of the U.S. Forest Service, FWS, and LDWF, would be the ones considered.

The concept, to be technically sound, would require that lands to be managed with project funds be below their reasonably obtainable wildlife potential. It would also require that public use of these lands be such that it could be greatly increased in response to the increase in wildlife potential. One problem we have with the concept is that public lands of the several agencies are fully dedicated to management based upon the purpose of the lands in question. National forests are administered under a concept of multiple use, National wildlife refuges emphasize protection of fish and wildlife resources of both National and State concern, and State management areas emphasize wildlife productivity and public use. Public use aspects of National wildlife refuges, as well as National forests, are presently being given more emphasis than ever before. State lands and National forest lands are, in many

instances, approaching a condition whereby it will be difficult to provide additional public use and yet still protect habitat and wildlife values. State agencies are becoming acutely aware of the need to acquire additional public wildlife lands to meet the increasing demand for sportsmen and general outdoor wildlife-oriented use.

A second problem with the concept is that each of the agencies having lands have sources of funding available. If the present amount of available funding is inadequate, there are established sources through which the situation can be rectified. Even where funding is presently inadequate, for the concept to be technically sound we would have to assume that, throughout the entire project life and beyond, such funding inadequacies via established and proper sources would continue to exist. Given the tremendous increase in public demand for wildlife areas and the ever decreasing availability of wildlife lands, it is difficult to comprehend how the existing public wildlife areas and National forests in the general area of project effect will not be adequately funded in the future. If we are correct in our belief that public interest and pressure will ensure that future management funds will be adequate for effectively carrying out wildlife management programs, then to provide project funds to accomplish that which will be accomplished anyway via established and proper sources would have no net positive impact upon wildlife values. In the final analysis, such a funding approach would likely be shown to be of little net value in terms of compensating for project impacts.

A third problem with the concept is that the total cost involved in such an endeavor could possibly exceed that associated with the acquisition alternative. One very basic reason for this possibility is that the cost of providing an increase in Habitat Units on lands which are already managed and held in public trust will likely be far greater than that for accomplishing the same increase on a totally unmanaged area, where development pressures may ultimately reduce or eliminate wildlife value and where timber management may not be geared to the optimization of wildlife value. The per unit increase in cost for elevating wildlife values which are already near the top of the scale in terms of value, as opposed to the cost of elevating values on unmanaged lands having lower wildlife value, would likely be substantial. Thus, acquisition of unmanaged lands for dedication to optimum wildlife management and associated public use may well have an overall lower cost.

Regardless of which compensation approach is ultimately recommended to Congress, it is clear that the proposal should be oriented heavily toward the establishment of additional bottomland hardwood and wooded swamp wildlife values to offset the major impact which the project will have on these nationally significant and threatened habitat types and the wildlife species so dependent upon them. The FWS considers these habitat types to be of high value for the evaluation species involved and to be under such widespread local, regional, and national threat from development that they are becoming scarce. Consequently, we do not believe there should be any net loss of the habitat values provided by these habitat types.

Compensation through Land Acquisition

Even after all possible structural mitigative measures have been taken, there will still be unavoidable impacts to wildlife resources which will require compensation. This type of compensation normally consists of the purchase of similar type habitat and the management of the purchased lands to adequately offset project-induced losses to biological productivity.

Fee title acquisition has been the traditional manner through which wildlife mitigation and compensation lands have been obtained. Fee title acquisition is generally the most advantageous in terms of biological realization of the impact offsetting goal since management is accomplished on the fewest acres, administration is less cumbersome and cost effectiveness is assured. Situations may arise where less than fee title estates should be given priority consideration. The Service will consider less than fee title estate possibilities if the alternative estate plan meets the following criteria:

- It would fully achieve the mitigation goal for the specific project.
- It is cost-effective in comparison to fee title land acquisition (taking into account the initial development costs as well as continuing operation, maintenance, replacement, and administrative costs).
- It is to be funded by the lead project agency (as authorized and appropriated by Congress) or private developer as an integral part of overall project cost. Such funding must include that required by the lead agency, or by any other agency which assumes a participating role in the mitigation effort, for initial development, operation, maintenance, replacement, or administrative costs.
- It would be the ultimate responsibility of the lead project agency to enforce and administer the continuous effective implementation of such means and measures, particularly where a lease or easement is involved, even in instances where the Fish and Wildlife Service, involved State Fish and Wildlife Agency, or Indian Tribal Agency may agree to participate in management efforts.
- It would provide public benefits similar in scope and extent to those expected to be achieved via fee title land acquisition.
- It would provide for a duration of effectiveness for the life of the project plus such additional time required for the adverse effects of an abandoned project to cease to occur.

Other than for the cost-effectiveness criterion, it may seem to be technically possible to implement our mitigation and compensation recommendations involving land acquisition via a less-than fee title estate.

Other than for the cost-effectiveness criterion, it may seem to be technically possible to implement our mitigation and compensation recommendations involving land acquisition via a less-than fee title estate. The easement estates involved, however, must require inclusion of development, water management, timber, general vegetative and wildlife planting manipulation, and access control. Only through such controls will the wildlife resource and associated public benefit be realized. These provisions would essentially entail the control of all surface rights to the property involved. It is doubtful, however, that such a plan could be cost-effective. Based on cost estimates for similar easements performed by an independent appraiser for NODCE relative to the Atchafalaya Basin project, it would not be unreasonable to assume that the cost of such a comprehensive easement package (without public access) would exceed 70 percent of the cost of complete acquisition. The cost of public access rights was estimated to be approximately 20 percent of the cost of fee title acquisition; this would bring total easement cost up to 90 percent.

The administration of easements on private property may, in itself, be unfeasible. As professional biologists, foresters, and engineers attempt to manage the area in a manner which would provide for conservation and multiple use, pressures to weaken these easements could come from development interests. Pressure could also be brought to bear on governmental officials not to enforce easement provisions. Thus, public interests and investments in the mitigation land may be jeopardized by adoption of an easement plan in lieu of fee purchase. In addition, the costs associated with the attempted administration of the easements could easily exceed the 10 percent saved by not buying the land outright. More tax dollars, then, could be spent on the easements and with less guarantee that public benefits would be realized. With fee acquisition, on the other hand, the avenue for development pressures are essentially removed. Once the lands in question are publicly owned, fish and wildlife conservation and public use is assured. Accordingly, further consideration of an easement approach does not appear warranted.

Compensation Determination

Since project impacts below river mile 104 would be mitigated by establishment of the Tensas River National Wildlife Refuge (P.L. 96-284, 96th Congress), the NODCE (by letter dated September 15, 1981) has asked FWS to evaluate impacts and develop mitigation needs for areas upstream of river mile 104. Accordingly, a separate HEP analysis was conducted for this portion of the project; that analysis includes impacts from the Recreation Master Plan, as well as the approved navigation plan. The calculations of AAHU's for these two plans under future with- and future without-project conditions are presented in Appendix B. AAHU's from both plans were added together to arrive at a total value for each species.

The HEP analysis revealed that, of the 11 evaluation elements (species or species groups) chosen for complete impact analysis, mourning dove, bobwhite, and eastern cottontail would benefit from implementation of the project (Table 10). Therefore, those species were not considered further in the mitigation analysis. The other evaluation species showed net losses of Habitat Units; these losses must be replaced through implementation of a suitable mitigation plan.

Table 10. Changes in Average Annual Habitat Units due to project implementation on the Red River Waterway upstream from river mile 104 (from HEP, Form D).

Species	AAHU's With Project	AAHU's Without Project	Change in AAHU's Due to Project
White-tailed deer	8790	14176	-5386
Red fox	7663	8054	-391
Eastern cottontail	7754	7330	424
Mourning dove	9294	8456	838
Bobwhite	6324	5882	442
Gray squirrel	1774	2180	-406
Turkey	2223	4317	-2094
Raccoon	4118	8073	-3955
Swamp rabbit	3831	8878	-5047
Wood duck	1594	3810	-2216
American woodcock	2358	5688	-3330
		TOTAL	-21121

The FWS mitigation policy (Federal Register, Vol. 46, pp. 7644-7663, January 23, 1981) has designated four Resource Categories which are used to insure that the level of mitigation recommended will be consistent with the fish and wildlife resource values involved. These categories are as follows:

Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this resource category is that there should be no loss of existing habitat value.

Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.

Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.

Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Based on the results of the HEP analysis and the criteria established for each Resource Category in the FWS mitigation policy, the bottomland hardwood and wooded swamp habitats were placed in Resource Category 2; pine hardwoods, riverfront forests, and willow sandbar habitats were placed in Resource Category 3; and agricultural lands were placed in Resource Category 4. Losses to species in Resource Category 2 habitats should be replaced with in-kind habitat value, while losses to species in Resource Category 3 habitats can be replaced with either in-kind or out-of-kind habitat value. There were no losses to species in Category 4.

Changes in habitat values in the impacted areas were determined through assessment of probable impacts to the evaluation species used in the HEP analysis; these impacts were expressed as changes in Average Annual Habitat Units (AAHU's) for those particular species (Table 10). By replacing habitat value losses with similar habitat values, populations of species associated with that habitat can be expected to remain relatively stable in the area over time. This is generally referred to as in-kind replacement. By replacing habitat value losses with different habitats or increasing management of different habitats, populations of species will be different from the evaluation species, depending on the ecological attributes of the replacement habitat. This will result in

no net loss of total habitat value, but may result in significant differences in fish and wildlife populations. This is generally referred to as out-of-kind replacement.

The species which will require compensation for this project are those which represent a typical bottomland hardwood assemblage. Therefore, the Service recommends that compensation be made with purchase and management of bottomland hardwoods. This would constitute in-kind replacement, as the same species which are being impacted with the project will be benefited through the mitigation plan.

The amount of mitigation acres needed to offset wildlife losses is determined by the annualized gain of HU's which can be realized for each evaluation species through purchase and management of acceptable mitigation lands. Consequently, the value of potential compensation lands to these species must first be established. To assist the Corps, the FWS has developed two compensation plans, one involving the purchase and management of forested wetlands outside of the project area, and the other involving the purchase, conversion to bottomland hardwoods, and management of certain batture lands within and adjacent to the project area.

Compensation via Acquisition and Management of Forested Wetlands Outside of the Project Area

The 1980 interim mitigation report released by the Office of the Chief of Engineers (OCE) recommended the acquisition and management of 12,000 acres of wooded-wetland habitat as mitigation for the Red River Waterway project. Subsequently, a HEP field analysis was conducted on this habitat type in July 1980, in the lower Red River Basin (Avoyelles Parish) to determine the value of these areas to the evaluation species and the corresponding number of HU's which could be realized through purchase and management of that number of acres. This increase in HU's determines the number of acres actually needed for acquisition and management to offset project losses.

Habitat Units can be gained through the prevention of expected losses in Habitat Units due to land clearing or other land use changes and through management practices which increase the carrying capacity of an area. The projected rate of land clearing for Avoyelles Parish, for wooded and shrub swamp habitats, was estimated, from data presented in MacDonald (1979), to be 22 percent from 1978 to 1995 and 20 percent from 1995 to 2015; no land clearing was projected beyond the latter year. These figures were used in determining the HU's to be "saved" by preserving an area as a forested wetland (preservation credit). Wooded and shrub swamp habitats were used here because of the lack of large remnant tracts of mature bottomland hardwoods in Avoyelles Parish. The management potential, or increase in HSI value due to management, was projected to be 10 percent over 50 years for each species (evaluation element). This 10 percent management figure is based on the results of a HEP compensation determination conducted in the vicinity of Spring Bayou WMA during January 1980 by representatives of the FWS, LDWF, Louisiana Department

of Transportation and Development, and U.S. Coast Guard, and on advice and information supplied at that time by the LDWF biologists in charge of nearby management areas (U.S. Fish and Wildlife Service 1981).

In determining the compensation acres required, a candidate compensation area of any manageable size is selected (in this case 12,000 acres), estimates of AAHU's for with- and without-management are computed, and the net increase in AAHU's is determined. In this case, it was projected that 4,512 of the original 12,000 acres would be cleared and put into agricultural production by Target Year 35; accordingly, acquisition of that area would provide a preservation credit, immediately, before any credit for management is applied. The combination of preservation credit (4,512 acres) and management potential (10 percent increase in HSI for each species over project life) results in a net gain in HU's associated with this mitigation option. The net increase in HU's was determined for each of the evaluation species and annualized over the project life; these calculations are presented in Appendix C (Tables C-1 and C-2 show the calculation of AAHU's for white-tailed deer, used as an example; baseline HSI's used to calculate AAHU's for the other species are shown in Table C-3). The difference between the AAHU's under future with-management and those for the future without-management is the change in AAHU's which can be achieved as a result of implementation of the management plan (Table C-4). The latter value is compared to the change in AAHU's which occurs due to implementation of the proposed project (Table C-5).

Since we are dealing with Resource Category 2, our compensation goal is to precisely offset the HU loss for each evaluation species (no net loss of in-kind habitat value). Therefore, the list of target species must be identical to the list of negatively impacted species. The ideal compensation plan will provide, for each individual species, an increase in HU's equal in magnitude to the HU losses. A mathematical expression of this goal is:

$$\sum_{i=1}^n (M_i + I_i)^2 = 0$$

where M = HU's gained through compensation for a target species,
 I = HU losses for same species,
 i = species number, and
 n = total number of identified species.

The optimum compensation area is one which will optimize the achievement of the in-kind goal. This area minimizes the total HU over-compensations and under-compensations by a sum of squares technique and is calculated by the following formula:

$$\text{Optimum Compensation Area} = -A \left(\sum_{i=1}^n M_i I + \sum_{i=1}^n M_i^2 \right)$$

where M, I, i, and n conform to previous usage, and
 A = size of candidate compensation area.

Based on this procedure, it was found that approximately 16,200 acres of forested wetlands in the lower Red River Basin would have to be acquired and managed to fully offset losses to wildlife productivity resulting from project impacts above mile 104 (Table 11).

Compensation via Acquisition and Management of Batture Lands

As an alternative to the acquisition and management of forested wetlands, the Service has investigated the possibility of compensating for project impacts by managing certain project lands and other lands adjacent to them along the Red River batture. The management plan derived for this alternative would primarily involve the project reach between Shreveport and Lock and Dam 3. It is based on a hypothetical management area of 15,500 acres, which would include 6,600 acres of open land (pasture, cropland, and spoil disposal sites); 4,300 acres of woodlands (riverfront forest and bottomland hardwood); 3,300 acres of freeboard lands (contains both open land and wooded area); and 1,300 acres of shallow water (less than 2 feet in depth). The freeboard lands, shallow water areas, and spoil disposal sites are considered project lands, as easements will have to be purchased on them to accommodate the desired use. However, by acquiring these lands in fee title and managing them for wildlife, they would, in essence, serve a dual purpose for only an incremental increase in price.

This management plan assumes that, once acquired, these lands (with the exception of the shallow water areas) would be converted to bottomland hardwoods via selective planting and/or natural succession. The lands would then be managed for optimal use of wildlife and timber resources. The following discussion describes how conversion to a bottomland hardwood type habitat could be achieved through the selective planting process.

Open land - At the time of acquisition, the existing open land areas would consist primarily of pasture, cropland, and spoil disposal areas. The pastures would be a mixture of improved and unimproved areas. The improved pastures would consist of a variety of grasses, some with pecan and sycamore trees occurring throughout, while the unimproved pastures would contain blackberry, honeysuckle, multiflora rose, pecan, honeylocust, and a variety of herbaceous weedy species. The majority of the cropland is currently in soybean production. Spoil disposal areas would probably be colonized with grasses, blackberry, honeysuckle, and black willow. In the selective planting process, mast producing trees such as Nuttall oak, willow oak, and water oak would be planted in the lower areas which are prone to periodic flooding. The slightly higher and drier areas would be planted in shagbark hickory, swamp chestnut oak, native pecan, cherrybark oak, and white oak. In addition to these mast bearing trees, yaupon, black cherry, and persimmon would be planted where appropriate on these open land sites. There would also be a number of plant species which would naturally invade the area. These include roughleaf dogwood,

Table 11. Potential mitigation plans and their associated acreage requirements (based on HEP) for Red River Waterway project impacts upstream from river mile 104.

Mitigation Plan	Acres Required
Forested wetland management	16,237
Management of batture lands	
Natural Succession	21,273
Partial Selective Planting	12,597
Maximum Selective Planting	8,486

hackberry, green ash, elms, honeylocust, sweetgum, American beautyberry, arrowwood, elderberry, poison ivy, rattan vine, and other species typical of bottomland hardwoods.

Freeboard - The freeboard areas are the lands between the navigation pools and 3 feet in elevation above the navigation pools, and which would be subjected to increased soil saturation, occasional flooding, and, in places, wave action. Most of the habitat types in the project area would have some areas in the freeboard zone. Due to the increase in wetness of these areas, they would provide an excellent foundation for the creation of wooded wetland type habitat, which would be accomplished by planting overcup oak, Nuttall oak, laurel oak, hawthorn, persimmon, and sweet bay in the lower portions of the freeboard areas. Swamp chestnut oak, water oak, willow oak, and red mulberry would be planted at the higher elevations. Additionally, the areas should naturally become colonized with sweetgum, eastern hophornbeam, deciduous holly, roughleaf dogwood, elm, black willow, green ash, hackberry, swamp privet, red maple, elderberry, honeysuckle, greenbriar, poison ivy, and rattanvine.

Wooded Areas - The riverfront forest and bottomland hardwood associations in the proposed management area currently exist as isolated woodlots or as narrow bands along the river. Riverfront forest may be in the form of black or sandbar willow stands interspersed with cottonwood, mature cottonwood-sycamore stands, or various intermediate successional stages. The bottomland hardwoods are primarily early successional with green ash, hackberry, elms, box elder, red maple, roughleaf dogwood, and young oaks occurring as an understory in over-mature cottonwoods and sycamores. These wooded areas could be enhanced for wildlife by selective cutting and planting. For instance, willows and cottonwood have limited value for wildlife. These species would be thinned, primarily in the early successional stages, and replaced with more desirable mast producing trees. Succession in the bottomland hardwood areas would be accelerated by the removal of some over-mature cottonwood and sycamore, thus allowing the more desirable understory species to grow. Not all large trees would be removed, however, as they could be used by certain wildlife species as den sites.

Shallow Water - Shallow water areas (those less than 2 feet in depth) would be created along the edge of the navigation pools. If properly planned for and managed, these areas could be beneficial to a number of aquatic-oriented wildlife species. The degree of usefulness would depend on the amount of water fluctuation which would occur in the navigation pools. Controlled fluctuation of the water level would allow for the establishment of various seed producing grasses, such as wild rice, millet, smartweed, and panic grass. In addition, sedges, nutgrasses, pondweed, and buttonbush, along with the previously mentioned grasses, would be established in the area, through planting if necessary. Wooded areas, e.g. riverfront forest, which would be in this shallow water zone would not be cleared, as the trees which die would provide potential nesting cavities for wood ducks and other cavity nesting

species. In addition, wood duck nesting boxes would be installed along the perimeter of the navigation pool to further enhance the area for this species.

Selective planting: projected habitat changes over time. The value of the lands described above to various wildlife species would change with time. In the following discussion, these projected changes are addressed for selected target years. The projections are based primarily on the expected growth and maturation of the plant species which would have been established on the various sites.

Year 0 - The area has been acquired and the management plan is being implemented. The current value of the area to wildlife is the same as that determined for the HEP baseline conditions.

Year 5 - The majority of the selective plantings in the open land and freeboard areas are completed and these areas have also been colonized by shrubs, vines, and tree species from adjacent wooded areas. The habitat is greatly improved for white-tailed deer, red fox, turkey, raccoon, and swamp rabbit. Some selective cutting and planting has taken place in the wooded areas and their value to wildlife has increased somewhat over the baseline conditions. The shallow water areas, as a result of water fluctuation and plantings, are being utilized by waterfowl, but not to their full potential. Some wood duck boxes have been erected.

Year 15 - Maturation of the shrub and small tree species, such as yaupon, deciduous holly, sweetbay, and roughleaf dogwood, along with continued growth of the mast producing oaks and colonization by vines and other herbaceous species, has produced excellent habitat for white-tailed deer, red fox, turkey, raccoon, swamp rabbit, and American woodcock in the freeboard and former open land areas. The former riverfront forest and bottomland hardwood areas are beginning to mature, and are thus providing high quality habitat for most forest-dwelling species. The selective cutting and planting program for these wooded areas was completed in Year 10. The shallow water area is being heavily utilized by waterfowl. All wood duck boxes are in place and this species has increased in numbers in the management area.

Year 25 - Nuttall oak, willow oak, water oak, laurel oak, pecan, persimmon, black cherry, and some others have been producing fruit for approximately 5 years, thus the area is further enhanced for squirrel, deer, turkey, and raccoon. Optimum habitat is now provided for American woodcock. The original riverfront forest and bottomland hardwood areas continue to mature and are now considered quality areas.

Year 50 - The entire area is now one contiguous tract of bottomland hardwoods. All oak species are producing mast and the area is considered optimum habitat for a number of species, including gray squirrel, white-tailed deer, turkey, red fox, swamp rabbit, and raccoon. The

shallow water areas of the navigation pools continue to provide important habitat for migratory and resident waterfowl, furbearers, herons, and egrets.

Natural succession: projected habitat changes over time. An alternative to planting the area with desirable bottomland hardwood species is to allow natural succession to take place and, through this process, slowly convert the area to a mature bottomland hardwood forest over a longer period of time. The primary disadvantage of this method is that the majority of the pioneer tree species are of minimal value to most of the evaluation species for which compensation is required. These trees include sweetgum, various elms, hackberry, black and sandbar willow, green ash, red maple, and locusts. Mast producing oaks would eventually become established in the understory, but would not reach their full potential until the previously mentioned pioneer tree species have been removed, either through natural or artificial means. A number of native shrubs and vines, many of which are important to most of the evaluation species would also invade and colonize the area. These plants include elderberry, arrowwood, honeysuckle, greenbriar, hawthorn, rattanvine, American beautyberry, sumac, poison ivy, blackberry, and grapes. As with the planted areas, the value of these lands to wildlife would change as the vegetation changes. These changes under the natural succession process were projected and used as the basis for the HEP compensation determination, and are described for selected target years in the following discussion.

Year 0 - The area has been acquired and the value to wildlife is the same as that determined with the HEP for project baseline conditions.

Year 5 - The pasture and cropland areas are fairly well covered with shrubs, vines, grasses, and seedling trees. These areas are comparable to those which would undergo the intensive planting program previously described. Habitat is improved for white-tailed deer, rabbit, fox, and others which derive life support requirements from early successional areas. There has been little change in the wooded areas from the Year 0 conditions. Some trees in the freeboard areas have died due to increased water levels; thus the area has been opened up for colonization by herbaceous undergrowth. Some annual grasses can be found along the edge of the shallow water habitat with emergents occurring in the slightly deeper zones.

Year 15 - The colonizer tree species (elm, ash, hackberry, sweetgum, etc.) are beginning to exert their dominance in the open land areas but the understory is still rather dense. Willows are dominant in the wetter freeboard areas and along the edge of the shallow water zone. Den trees are available in the freeboard areas. Overmature cottonwood and sycamore trees can be found in most of the older wooded areas.

Year 25 - The former open land areas are now a dense thicket of honeylocust, hackberry, sweetgum, elm, and ash, with few mast producing trees. The majority of the undergrowth is shaded out. Existing oaks in the wooded

areas are beginning to produce mast. The over-mature cottonwoods and sycamores are dying, thus open areas are being produced in the forest. Overall undergrowth is moderate in these wooded areas. The dead den trees in the freeboard zone are being lost to storms and high winds, thus natural wood duck nesting areas are being removed. The whole area has decreased in value over that of earlier years due to the reduction of desirable understory vegetation and the lack of adequate numbers of mast bearing trees.

Year 50 - The former open land areas are occupied by an overstory of large hackberry, sweetgum, and elms with an understory of young oaks. The original wooded areas are similar to those areas, but have more mature, mast-producing oaks scattered throughout the area. Dead trees are abundant and undergrowth moderate.

Partial selective planting

The two scenarios presented above were termed maximum selective planting and natural succession, respectively. In a third scenario, termed partial selective planting, half of the lands would be converted through selective planting and the other half allowed to go through natural succession.

These three alternatives were evaluated to determine the number of acres which would have to be acquired in order to compensate for project impacts to biological productivity. According to this evaluation, 21,273 acres would be needed for the natural succession alternative, 12,597 acres for the partial selective planting alternative, and 8,486 acres for the maximum selective planting alternative (Table 11). Supporting documentation and HEP forms on these alternatives are presented in Appendix D.

Management Considerations

Fundamental to attainment of fish, wildlife, and related recreational resource benefits is the concept that biological productivity on project lands must be significantly increased in order to support a realistic increase in human use of those resources. The only realistic method of increasing biological productivity is to implement specific management measures designed to achieve that end. The management models which have been previously presented are based upon the assumptions that acquisition of necessary rights to develop and manage subject lands for fish and wildlife would occur, and that increased human use (within the biological limits) would occur. Should any of these assumptions not be met, the level of benefits attributable to the project would decrease accordingly.

Delegation of management authority for project lands is also integrally related to fish and wildlife benefits attributable to the project. Management of lands and waters designated for fish and wildlife and related purposes should be accomplished in accordance with a General Plan developed jointly by the Corps of Engineers, the Fish and Wildlife Service, and the Louisiana Department of Wildlife and Fisheries. Such

action is appropriate, based upon Section 3 of the Fish and Wildlife Coordination Act, the procedures of which have been formalized in a Memorandum of Agreement between the FWS and the Corps. The General Plan would describe the management responsibilities of the agencies involved. Generally, the FWS administers those lands of particular value to nationally significant fish and wildlife resources such as migratory waterfowl and anadromous fishes. The State fish and game agency is normally provided the opportunity to manage resident game species, but may also manage migratory birds on areas under their control. Should neither the Service nor the Louisiana Department of Wildlife and Fisheries accept the management option, other arrangements would become appropriate. Should mitigation lands become available for management, we believe that priority consideration should be given to the views of the LDWF relative to any interests in management which they may express.

A final management consideration pertaining to the mitigation proposals is management funding, including requirements for initial development as well as continuing operation and maintenance activities. Such funding is mandatory if calculated benefits are to be validly attributed to the project. Historically, our agencies have mutually agreed that the costs for initial development are legitimate project expenses.

Disagreement between our agencies has unfortunately been the rule, rather than the exception, with respect to the legitimacy of assigning the continuing costs for operation and maintenance requirements to the project. Recognizing that benefits to fish and wildlife are crucial to the economic feasibility of the Red River Waterway Project, we recommend that the annual operation and maintenance costs be designated as non-reimbursable project costs. We further recommend that full consideration be given to the concept of partial, perhaps full, recovery of these operation and maintenance costs through timber harvest receipts from project lands owned in fee title. Under this concept, the Corps would initially provide required funds from its normal Congressional appropriation to the management authority. The duration of the initial period would depend upon timber stand conditions when fish and wildlife management begins. When fish and wildlife benefits and public use capability are attained, it is reasonable to assume that the timber harvest plan would begin to yield net profits. Such profits, as well as any other revenues generated on the mitigation area, would be retained by the management authority and would be used to supplement or replace budgeted funds from the Corps. This concept is, we believe, particularly applicable to mitigation lands where timber is present at the time of purchase. Its merits relative to lands upon which timber must be established would appear to be greatly reduced.

Cost

The NODCE made preliminary estimates for the costs associated with acquisition of wildlife mitigation lands in 1981. These estimates indicate that forested wetlands in eastern Avoyelles Parish could be

obtained for \$500 per acre for fee title purchase, plus a \$30 per acre development cost. LDWF estimates that the annual cost for management of existing wildlife management areas in the Red River backwater area of Avoyelles Parish averages \$2.50 per acre.

The NODCE Real Estate Division has appraised project lands in the batture to range in value from \$300 per acre for sandbars and low areas to \$1,000 per acre for arable lands. According to LDWF, the cost of planting the mitigation lands with bottomland hardwood species would be approximately \$75 per acre. This figure is based on a 12 ft.-by-12 ft. spacing of seedlings (to allow mechanized weed and brush control). Thus, 300 trees per acre will be planted at a cost of approximately \$100 per 1,000 seedlings. Site preparation will cost about \$25 per acre and the planting costs will be \$20 per acre.

When a \$30-per-acre additional development cost (NODCE estimate) is included, the total initial cost for purchase, planting, and development of mitigation lands between the levees would range between \$405 and \$1,105 per acre, as opposed to \$330 to \$1,030 per acre for natural succession. Some of these costs may already be included in the project plans for purposes other than wildlife mitigation (e.g., flowage easements or other estate requirements). The annual management costs for these lands would be \$2.50 per acre. A more precise estimate of mitigation costs will be developed jointly by NODCE, FWS, and LDWF for inclusion in NODCE's mitigation report.

Future Coordination

The FWS plans to continue its coordination with the Corps of Engineers as the project enters more advanced stages of planning and design. This coordination will focus on mitigation through project design and acquisition of mitigation lands. Project design features which warrant further FWS input include structural measures associated with the hinge pool operation in Pool 3 and creation of wetland impoundments along the length of the project. On the subject of land acquisition, a mitigation report is to be prepared by NODCE, in coordination with FWS and LDWF. The report, scheduled for completion by the end of 1982, is expected to contain a recommendation for a formal mitigation plan (land acquisition and management) for the project. The FWS plans to be intimately involved in the preparation of that report.

In addition, FWS would expect to be involved in any future problems or decisions dealing with fish and wildlife resources which may arise.

RECOMMENDATIONS

Based on our review of project plans considered for the Red River Waterway, Mississippi River to Shreveport, Louisiana, reach, the FWS recommends that the following measures be implemented in the interest of fish and wildlife conservation.

1. The Recreation Master Plan be fully implemented as an integral part of the project. Included in this plan are the proposed closures of 28 oxbows and provision of access to those lakes, use of spoil material to create waterfowl impoundments and small game management areas, and management of recreational lands for fish and wildlife purposes.
2. Use of the proposed navigation pools as a source of community water supplies be investigated. Such use would decrease the need for using other water bodies in the area and thus minimize losses to fish and wildlife resources.
3. Lands between the levees be purchased, converted to bottomland hardwoods, and managed to mitigate for unavoidable losses to wildlife resources associated with the project upstream from river mile 104. Total acreage required would depend on which of the previously discussed management scenarios were selected. (In lieu of this, 16,200 acres of "off-site" forested wetlands in the Red River basin could be purchased and managed for wildlife to compensate for project impacts upstream from river mile 104).
4. The annual costs associated with operation and management of mitigation lands shall be provided by the Corps of Engineers as an integral part of the total project expenditures.
5. The rights of public access on the navigation pools and oxbows created by the project be specifically defined as early as possible in the planning process.
6. A hinge pool drawdown not be used, as this may have significant adverse impacts on fishery resources. Instead, estate options should be exercised on lands which are subject to spring flooding adjacent to the navigation pools. Possibly these same affected lands could serve as mitigation sites. If a hinge is deemed absolutely necessary, advanced engineering and design studies should investigate the feasibility of structural measures which could minimize the effects of such drawdowns on shallow water habitat and associated fish populations.
7. Recreation and mitigation features be implemented simultaneously with navigation and bank stabilization features of the project.
8. Coordination between FWS and COE shall continue as the project progresses to advanced stages of planning and design.

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APPENDIX A

COMMERCIAL FISHERY HARVEST DATA

Table A-1. Commercial freshwater fish harvest and values for Red River project area, 1977. Data obtained from National Marine Fisheries Service, New Orleans, Louisiana.

Species	Harvest	Value	Value/lb
Bowfin	8,600 lbs	\$1,249	\$0.14
Buffalofish	672,200	102,511	0.15
Carp	74,900	4,494	0.06
Catfish	355,600	135,128	0.38
Paddlefish	10,300	1,133	0.11
Freshwater drum	203,300	26,429	0.13
Garfish	59,400	9,504	0.16
TOTAL	1,384,300	280,448	0.20

APPENDIX B

PROJECT IMPACTS UPSTREAM FROM

RIVER MILE 104 - HEP FORMS

Table B-1. Form C: Calculation of AAHU's available for each species under future without-project conditions for the approved plan (excluding areas affected only by the recreation plan) upstream from river mile 104, Red River Waterway Project.

1 DEER				AAHU=	10919.09
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	32326.00	.35			.00
1	32326.00	.35	0 TO 1	1	11168.63
5	32329.00	.34	1 TO 5	5	44417.95
10	32332.00	.34	5 TO 10	10	54881.00
65	32332.00	.34	10 TO 65	65	599273.10
	TOTAL HABITAT UNIT YEARS=				709740.70

2 FOX				AAHU=	6661.49
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	15059.00	.42			.00
1	15162.00	.42	0 TO 1	1	6301.07
5	15574.00	.42	1 TO 5	5	25602.32
10	16091.00	.42	5 TO 10	10	32931.56
65	16091.00	.42	10 TO 65	65	368161.60
	TOTAL HABITAT UNIT YEARS=				438997.12

3 COTTONTAIL				AAHU=	5514.01
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	13494.00	.38			.00
1	13608.00	.38	0 TO 1	1	5149.38
5	14064.00	.38	1 TO 5	5	21002.87
10	14635.00	.38	5 TO 10	10	27192.29
65	14635.00	.38	10 TO 65	65	305066.20
	TOTAL HABITAT UNIT YEARS=				358410.79

4 DOVE				AAHU=	6885.55
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	12968.00	.49			.00
1	13086.00	.49	0 TO 1	1	6370.20
5	13556.00	.49	1 TO 5	5	26055.86
10	14146.00	.49	5 TO 10	10	33900.55
65	14146.00	.49	10 TO 65	65	381234.40
	TOTAL HABITAT UNIT YEARS=				447560.99

5 BOBWHITE				AAHU=	4365.75
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	13494.00	.30			.00
1	13608.00	.30	0 TO 1	1	4078.85
5	14064.00	.30	1 TO 5	5	15658.53
10	14635.00	.30	5 TO 10	10	21559.86
65	14635.00	.30	10 TO 65	65	241477.10
	TOTAL HABITAT UNIT YEARS=				283774.31

Table B-1. Form C, continued

6 SQUIRREL			AAHU=		1008.61
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	2617.00	.41			.00
1	2598.00	.41	0 TO	1	1074.29
5	2526.00	.41	1 TO	5	4222.17
10	2434.00	.41	5 TO	10	5108.80
65	2434.00	.41	10 TO	65	55154.40
TOTAL HABITAT			UNIT YEARS=		65559.66
7 TURKEY			AAHU=		2871.45
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	16946.00	.18			.00
1	16828.00	.18	0 TO	1	3058.53
5	16361.00	.18	1 TO	5	12014.41
10	15774.00	.18	5 TO	10	14541.08
65	15774.00	.18	10 TO	65	157030.10
TOTAL HABITAT			UNIT YEARS=		186644.15
8 RACCOON			AAHU=		6801.76
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18947.00	.38			.00
1	18832.00	.38	0 TO	1	7196.90
5	18377.00	.38	1 TO	5	28353.23
10	17806.00	.38	5 TO	10	34419.28
65	17806.00	.38	10 TO	65	372145.20
TOTAL HABITAT			UNIT YEARS=		442114.66
9 SWAMP RABBIT			AAHU=		7466.11
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18947.00	.42			.00
1	18832.00	.42	0 TO	1	7924.15
5	18377.00	.42	1 TO	5	31181.12
10	17806.00	.42	5 TO	10	37811.70
65	17806.00	.42	10 TO	65	408380.30
TOTAL HABITAT			UNIT YEARS=		485297.29
10 WOOD DUCK			AAHU=		3184.19
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18947.00	.18			.00
1	18832.00	.18	0 TO	1	3341.28
5	18377.00	.18	1 TO	5	13209.04
10	17806.00	.18	5 TO	10	16101.42
65	17806.00	.18	10 TO	65	174320.60
TOTAL HABITAT			UNIT YEARS=		206972.36
11 WOODCOCK			AAHU=		4639.51
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	16741.00	.29			.00
1	16642.00	.29	0 TO	1	4907.30
5	16247.00	.29	1 TO	5	19338.72
10	15752.00	.29	5 TO	10	23479.45
65	15752.00	.29	10 TO	65	253843.00
TOTAL HABITAT			UNIT YEARS=		301568.47

Table B-2. Form C: Calculation of AAHU's available for each species under future without-project condition for the recreation plan upstream from river mile 104, Red River Waterway Project.

1 DEEP				
TARGET YEAR	AREA	HSI	AAHU= YEARS	3254.66 HU-YEARS
0	8555.00	.39		.00
1	8562.00	.39	0 TO 1	3312.01
5	8590.00	.38	1 TO 5	13112.01
50	8590.00	.38	5 TO 50	146402.90
	TOTAL HABITAT UNIT YEARS=			148826.90

2 FOX				
TARGET YEAR	AREA	HSI	AAHU= YEARS	1382.51 HU-YEARS
0	2960.00	.43		.00
1	3018.00	.43	0 TO 1	1295.33
5	3246.00	.43	1 TO 5	5410.75
50	3246.00	.43	5 TO 50	62913.37
	TOTAL HABITAT UNIT YEARS=			69625.55

3 COTTONTAIL				
TARGET YEAR	AREA	HSI	AAHU= YEARS	1815.59 HU-YEARS
0	4823.00	.36		.00
1	4862.00	.36	0 TO 1	1752.68
5	5016.00	.36	1 TO 5	7157.43
50	5016.00	.36	5 TO 50	81869.31
	TOTAL HABITAT UNIT YEARS=			90779.43

4 DOVE				
TARGET YEAR	AREA	HSI	AAHU= YEARS	1570.36 HU-YEARS
0	2960.00	.49		.00
1	3018.00	.49	0 TO 1	1449.78
5	3246.00	.49	1 TO 5	6082.71
50	3246.00	.49	5 TO 50	70985.44
	TOTAL HABITAT UNIT YEARS=			78517.93

5 BOBWHITE				
TARGET YEAR	AREA	HSI	AAHU= YEARS	1515.69 HU-YEARS
0	4823.00	.30		.00
1	4862.00	.30	0 TO 1	1467.41
5	5016.00	.30	1 TO 5	5983.95
50	5016.00	.30	5 TO 50	68332.94
	TOTAL HABITAT UNIT YEARS=			75784.30

Table B-2. Form C, continued

6 SQUIRREL				AAHU=	1171.26
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	1863.00	.66			.00
1	1844.00	.66	0 TO 1		1223.31
5	1770.00	.66	1 TO 5		4770.48
50	1770.00	.66	5 TO 50		52568.98
	TOTAL HABITAT UNIT YEARS=				53563.77

7 TURKEY				AAHU=	1446.18
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	5029.00	.30			.00
1	4978.00	.30	0 TO 1		1510.75
5	4778.00	.30	1 TO 5		5890.28
50	4778.00	.30	5 TO 50		64907.97
	TOTAL HABITAT UNIT YEARS=				72309.00

8 RACCOON				AAHU=	1270.56
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	3732.00	.36			.00
1	3700.00	.36	0 TO 1		1322.01
5	3574.00	.35	1 TO 5		5165.98
50	3574.00	.35	5 TO 50		57040.17
	TOTAL HABITAT UNIT YEARS=				63528.10

9 SWAMP RABBIT				AAHU=	1411.88
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	3732.00	.40			.00
1	3700.00	.40	0 TO 1		1470.86
5	3574.00	.39	1 TO 5		5744.43
50	3574.00	.39	5 TO 50		63378.87
	TOTAL HABITAT UNIT YEARS=				70594.16

10 WOOD DUCK				AAHU=	625.88
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	3732.00	.17			.00
1	3700.00	.17	0 TO 1		647.68
5	3574.00	.17	1 TO 5		2541.09
50	3574.00	.17	5 TO 50		28105.18
	TOTAL HABITAT UNIT YEARS=				31293.95

11 WOODCOCK				AAHU=	1048.11
TARGET YEAR	AREA	HSI		YEARS	HU-YEARS
0	3732.00	.29			.00
1	3700.00	.29	0 TO 1		1089.11
5	3574.00	.29	1 TO 5		4260.79
50	3574.00	.29	5 TO 50		47055.57
	TOTAL HABITAT UNIT YEARS=				52405.47

Table B-3. Form C: Calculation of AAHU's available for each species under future with-project conditions for the approved plan (excluding areas affected only by the recreation plan) upstream from river mile 104, Red River Waterway Project.

1 DEER			AAHU=		6037.83
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	32326.00	.35			.00
1	32036.00	.34	0 TO	1	11086.42
5	30482.00	.33	1 TO	5	41957.33
10	27282.00	.30	5 TO	10	45665.55
15	19735.00	.24	10 TO	15	33298.73
25	20033.00	.25	15 TO	25	48660.23
35	20357.00	.25	25 TO	35	50179.84
45	20681.00	.26	35 TO	45	52161.29
55	21005.00	.26	45 TO	55	54018.16
65	21329.00	.27	55 TO	65	56431.91
TOTAL HABITAT UNIT YEARS=					392459.47

2 FOX			AAHU=		6595.40
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	15059.00	.42			.00
1	15334.00	.42	0 TO	1	6329.31
5	16040.00	.42	1 TO	5	26071.55
10	16529.00	.40	5 TO	10	33340.25
15	15695.00	.39	10 TO	15	31987.17
25	16104.00	.39	15 TO	25	62087.81
35	16328.00	.39	25 TO	35	63485.78
45	16864.00	.39	35 TO	45	65223.12
55	17026.00	.39	45 TO	55	66763.19
65	20191.00	.40	55 TO	65	73413.06
TOTAL HABITAT UNIT YEARS=					428701.25

3 COTTONTAIL			AAHU=		6198.83
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	13494.00	.33			.00
1	13752.00	.33	0 TO	1	5176.73
5	14788.00	.33	1 TO	5	21603.73
10	15807.00	.33	5 TO	10	28874.43
15	15863.00	.33	10 TO	15	29888.52
25	16174.00	.33	15 TO	25	60711.09
35	16398.00	.33	25 TO	35	62049.61
45	16934.00	.33	35 TO	45	63664.96
55	17096.00	.33	45 TO	55	65167.38
65	17258.00	.33	55 TO	65	65787.87
TOTAL HABITAT UNIT YEARS=					402924.34

Table B-3. Form C, continued

4 DOVE			AAHU=		8170.65
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	12968.00	.49			.00
1	13246.00	.49	0 TO	1	6409.32
5	14360.00	.49	1 TO	5	27026.62
10	29868.00	.49	5 TO	10	53870.55
15	15801.00	.47	10 TO	15	54758.95
25	16174.00	.47	15 TO	25	75380.06
35	16398.00	.47	25 TO	35	76544.12
45	16934.00	.47	35 TO	45	78413.94
55	16596.00	.47	45 TO	55	78963.06
65	17258.00	.47	55 TO	65	79726.06
TOTAL HABITAT UNIT YEARS=					531032.68

5 BOBWHITE			AAHU=		4969.79
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	13494.00	.30			.00
1	13752.00	.30	0 TO	1	4100.52
5	14798.00	.30	1 TO	5	17152.19
10	15693.00	.30	5 TO	10	23053.12
15	15635.00	.31	10 TO	15	24093.26
25	15920.00	.31	15 TO	25	48989.34
35	16144.00	.31	25 TO	35	49859.45
45	16680.00	.31	35 TO	45	51041.25
55	16842.00	.31	45 TO	55	52126.64
65	17004.00	.31	55 TO	65	52630.47
TOTAL HABITAT UNIT YEARS=					323036.24

6 SQUIRREL			AAHU=		404.97
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	2617.00	.41			.00
1	2594.00	.41	0 TO	1	1070.86
5	2108.00	.41	1 TO	5	3869.26
10	2134.00	.31	5 TO	10	3837.90
15	1584.00	.14	10 TO	15	2139.63
25	1740.00	.13	15 TO	25	2216.82
35	1740.00	.13	25 TO	35	2192.40
45	1740.00	.13	35 TO	45	2192.40
55	1740.00	.13	45 TO	55	2192.40
65	4743.00	.27	55 TO	65	6741.10
TOTAL HABITAT UNIT YEARS=					26452.77

7 TURKEY			AAHU=		922.09
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	16946.00	.18			.00
1	16391.00	.18	0 TO	1	3016.90
5	13777.00	.18	1 TO	5	10951.85
10	9976.00	.18	5 TO	10	10663.91
15	2840.00	.15	10 TO	15	5390.00
25	3285.00	.15	15 TO	25	4622.15
35	3508.00	.15	25 TO	35	5026.82
45	4045.00	.15	35 TO	45	5589.21
55	4207.00	.15	45 TO	55	6106.47
65	4369.00	.25	55 TO	65	8568.46
TOTAL HABITAT UNIT YEARS=					59935.76

Table B-3. Form C, continued

8 RACCOON			AAHU=		2590.46
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18947.00	.38			.00
1	18393.00	.38	0 TO	1	7113.26
5	15781.00	.38	1 TO	5	25907.36
10	12457.00	.36	5 TO	10	26003.87
15	5728.00	.29	10 TO	15	14846.39
25	5923.00	.30	15 TO	25	16954.15
35	6023.00	.30	25 TO	35	17889.55
45	5811.00	.32	35 TO	45	18398.68
55	5973.00	.32	45 TO	55	18883.99
65	6135.00	.42	55 TO	65	22382.61
TOTAL HABITAT UNIT YEARS=					168379.86

9 SWAMP RABBIT			AAHU=		2520.66
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18947.00	.42			.00
1	18393.00	.42	0 TO	1	7832.11
5	15781.00	.41	1 TO	5	28437.97
10	11643.00	.40	5 TO	10	27859.47
15	4100.00	.31	10 TO	15	14165.80
25	4113.00	.51	15 TO	25	16695.10
35	4213.00	.35	25 TO	35	17804.46
45	4001.00	.40	35 TO	45	15351.34
55	4163.00	.40	45 TO	55	16307.72
65	4325.00	.51	55 TO	65	19389.11
TOTAL HABITAT UNIT YEARS=					163843.07

10 WOOD DUCK			AAHU=		1104.06
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	18875.00	.18			.00
1	18393.00	.18	0 TO	1	3298.22
5	15781.00	.18	1 TO	5	12130.89
10	11643.00	.18	5 TO	10	12236.23
15	4100.00	.18	10 TO	15	7144.20
25	4113.00	.18	15 TO	25	7514.85
35	4213.00	.18	25 TO	35	7514.13
45	4001.00	.18	35 TO	45	7290.80
55	4163.00	.18	45 TO	55	7143.50
65	4325.00	.18	55 TO	65	7491.06
TOTAL HABITAT UNIT YEARS=					71763.87

11 WOODCOCK			AAHU=		1601.43
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	16741.00	.29			.00
1	16196.00	.29	0 TO	1	4841.73
5	14014.00	.29	1 TO	5	17704.50
10	10775.00	.28	5 TO	10	17769.96
15	4620.00	.23	10 TO	15	10031.06
25	4643.00	.24	15 TO	25	10999.94
35	4743.00	.24	25 TO	35	11404.32
45	4531.00	.26	35 TO	45	11728.78
55	4693.00	.26	45 TO	55	12060.51
65	1852.00	.19	55 TO	65	7552.31
TOTAL HABITAT UNIT YEARS=					104093.10

Table B-4. Form C: Calculation of AAHU's available for each species under with-project conditions for the recreation plan upstream from river mile 104, Red River Waterway Project.

1 DEER			AAHU=	2751.86
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	8555.00	.39		.00
1	8293.00	.39	0 TO 1	3243.30
5	7252.00	.39	1 TO 5	12001.43
10	5350.00	.40	5 TO 10	12930.36
20	5661.00	.49	10 TO 20	25941.08
50	5661.00	.49	20 TO 50	83556.31
TOTAL HABITAT UNIT YEARS=				137593.08

2 FOX			AAHU=	1067.15
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	2960.00	.43		.00
1	2882.00	.44	0 TO 1	1273.53
5	2571.00	.46	1 TO 5	4894.51
10	2181.00	.42	5 TO 10	5222.14
20	2095.00	.51	10 TO 20	9913.72
50	2095.00	.51	20 TO 50	32053.49
TOTAL HABITAT UNIT YEARS=				53357.39

3 COTTONTAIL			AAHU=	1555.00
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	4823.00	.36		.00
1	4821.00	.35	0 TO 1	1723.87
5	4823.00	.32	1 TO 5	6490.39
10	4823.00	.26	5 TO 10	4957.13
20	4823.00	.33	10 TO 20	14251.96
50	4823.00	.33	20 TO 50	43326.45
TOTAL HABITAT UNIT YEARS=				77749.83

4 DOVE			AAHU=	1122.82
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	2960.00	.49		.00
1	2959.00	.47	0 TO 1	1411.68
5	2960.00	.41	1 TO 5	5179.10
10	2960.00	.34	5 TO 10	5535.20
20	2960.00	.38	10 TO 20	10626.39
50	2960.00	.38	20 TO 50	33388.79
TOTAL HABITAT UNIT YEARS=				56141.16

Table B-4. Form C, continued

5 BOBWHITE			AAHU=	1354.10
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	4823.00	.30		.00
1	4780.00	.30	0 TO 1	1442.87
5	4616.00	.28	1 TO 5	5431.87
10	2960.00	.22	5 TO 10	4735.18
20	4271.00	.36	10 TO 20	10559.03
50	4271.00	.36	20 TO 50	45436.13
TOTAL HABITAT UNIT YEARS=				67705.07

6 SQUIRREL			AAHU=	1366.87
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	1863.00	.66		.00
1	1916.00	.64	0 TO 1	1231.88
5	2133.00	.59	1 TO 5	4994.32
10	2403.00	.53	5 TO 10	6344.10
20	2463.00	.57	10 TO 20	13444.37
50	2463.00	.57	20 TO 50	42339.96
TOTAL HABITAT UNIT YEARS=				68343.62

7 TURKEY			AAHU=	1301.22
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	5029.00	.30		.00
1	4852.00	.31	0 TO 1	1501.85
5	4149.00	.32	1 TO 5	5457.64
10	3271.00	.36	5 TO 10	6312.33
20	3341.00	.39	10 TO 20	12399.36
50	3341.00	.39	20 TO 50	39189.92
TOTAL HABITAT UNIT YEARS=				65061.15

8 RACCOON			AAHU=	1528.45
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	3732.00	.36		.00
1	3794.00	.35	0 TO 1	1330.19
5	4047.00	.33	1 TO 5	5369.65
10	4362.00	.33	5 TO 10	6947.01
20	5402.00	.29	10 TO 20	15130.00
50	5402.00	.29	20 TO 50	47645.62
TOTAL HABITAT UNIT YEARS=				76422.48

Table B-4. Form C, continued

9 SWAMP RABBIT				AAHU=	1309.88
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	3732.00	.40			.00
1	3767.00	.39	0 TO 1		1464.15
5	3912.00	.35	1 TO 5		5603.73
10	4092.00	.31	5 TO 10		6590.97
20	4132.00	.31	10 TO 20		12911.67
50	4132.00	.31	20 TO 50		38923.42
TOTAL HABITAT UNIT YEARS=					65493.94

10 WOOD DUCK				AAHU=	430.03
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	3732.00	.17			.00
1	3606.00	.18	0 TO 1		640.23
5	3104.00	.18	1 TO 5		2374.67
10	3219.00	.18	5 TO 10		2877.25
20	2337.00	.19	10 TO 20		5318.22
50	2337.00	.19	20 TO 50		13391.00
TOTAL HABITAT UNIT YEARS=					24501.37

11 WOODCOCK				AAHU=	756.82
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	3732.00	.29			.00
1	3671.00	.29	0 TO 1		1075.31
5	3430.00	.26	1 TO 5		3921.63
10	2387.00	.28	5 TO 10		3948.61
20	3062.00	.24	10 TO 20		7032.82
50	3062.00	.24	20 TO 50		21862.67
TOTAL HABITAT UNIT YEARS=					37841.09

APPENDIX C

FORESTED WETLAND MANAGEMENT - HEP FORMS

Table C-1
Form C. Calculation of Average Annual Habitat Units available for an evaluation species under a proposed action.

1. Study name	2. Study area	3. Proposed action
Red River Waterway	Forested Wetland Mitigation	Without management
4. Evaluation species	5. HSI and area by target year (TY)	
White-tailed Deer	Baseline (TY0)	TY 15 (1976)
	Area	Area
	HSI	HSI
	Area	Area
	TY 35 (2010)	TY 65 (2040)
	Area	Area
	HSI	HSI
	Area	Area
	TY 35 (2010)	TY 65 (2040)
	Area	Area
	HSI	HSI
	Area	Area

where: T_1 = First year of time interval
 T_2 = Last year of time interval
 A_1 = Habitat area at first target year
 A_2 = Habitat area at second target year
 H_1 = HSI at the first target year
 H_2 = HSI at the second target year

6.

$$\text{Total number of HU years} = (T_2 - T_1) \left[\left(\frac{A_1 H_1 + A_2 H_2}{3} \right) + \left(\frac{A_1 H_1 + A_2 H_2}{6} \right) \right]$$

62.

7. Habitat Units between target years	8. 377152.5
6A. $(1-0) \left[((12000 \times 0.68 + 12000 \times 0.68) \div 3) + ((12000 \times 0.68 + 12000 \times 0.68) \div 6) \right]$	8160
6B. $(15-1) \left[((12000 \times 0.68 + 9360 \times 0.68) \div 3) + ((12000 \times 0.68 + 9360 \times 0.68) \div 6) \right]$	101673.6
6C. $(35-15) \left[((9360 \times 0.68 + 7488 \times 0.68) \div 3) + ((7488 \times 0.68 + 9360 \times 0.68) \div 6) \right]$	114566.4
6D. $(65-35) \left[((7488 \times 0.68 + 7488 \times 0.68) \div 3) + ((7488 \times 0.68 + 7488 \times 0.68) \div 6) \right]$	152755.2
6E. Total from additional target years	
9. Life of project	Sum of Habitat Units
65	8. 377152.5
10. Average Annual HU's Block 8 + Block 9	5802.4

Table C-3. Baseline HSI values used to calculate AAHU's (Form C) for the forested wetland mitigation area (see text for explanation of calculations).

Species	HSI
White-tailed deer	0.680
Red fox	0.325
Gray squirrel	0.480
Turkey	0.410
Raccoon	0.710
Swamp rabbit	0.660
Wood duck	0.660
American woodcock	0.330

Table C-4
Form D. Determination of net change in Average Annual Habitat Units of future conditions
with an action vs. future without the action.

1. Study Red River Waterway		2. Proposed action Forested Wetland Management	
3. Evaluation species	4. Average Annual Habitat Units		5. Change in Average Annual Habitat Units
	a. Future with action (mgt.)	b. Future without action	
White-tailed Deer	8562	5802	2760
Red Fox	4092	2767	1325
Gray Squirrel	6048	4086	1962
Turkey	5166	3490	1676
Raccoon	8946	6044	2902
Swamp Rabbit	8316	5618	2698
Wood duck	8316	5618	2698
American Woodcock	4158	2809	1349
		Total	6. 17370

Table C-5

Form H. Calculation of compensation area requirements for a proposed action with a proposed management plan.

[illegible]

APPENDIX D

MANAGEMENT OF BATTURE LANDS - HEP FORMS

Table D-1. Form C: Calculation of AAHU's available for each species under future without-mitigation conditions for Red River batture lands.

1 DEER				AAHU=	4950.07
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	15500.00	.33			.00
1	15500.00	.33	0 TO 1		5037.49
5	15500.00	.32	1 TO 5		19963.97
50	15500.00	.32	5 TO 50		222502.10
TOTAL HABITAT UNIT YEARS=					247503.59
2 FOX				AAHU=	5872.63
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	15500.00	.38			.00
1	15500.00	.38	0 TO 1		5843.50
5	15500.00	.38	1 TO 5		23435.97
50	15500.00	.38	5 TO 50		264352.10
TOTAL HABITAT UNIT YEARS=					293631.59
6 SQUIRREL				AAHU=	1435.65
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	6850.00	.22			.00
1	6850.00	.22	0 TO 1		1507.00
5	6505.00	.22	1 TO 5		5876.20
50	6505.00	.22	5 TO 50		64399.48
TOTAL HABITAT UNIT YEARS=					71782.68
7 TURKEY				AAHU=	1109.37
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	6850.00	.17			.00
1	6850.00	.17	0 TO 1		1164.50
5	6505.00	.17	1 TO 5		4540.70
50	6505.00	.17	5 TO 50		49763.22
TOTAL HABITAT UNIT YEARS=					55468.41
8 RACCOON				AAHU=	2675.53
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	6850.00	.41			.00
1	6850.00	.41	0 TO 1		2808.50
5	6505.00	.41	1 TO 5		10951.09
50	6505.00	.41	5 TO 50		120017.10
TOTAL HABITAT UNIT YEARS=					133776.71
9 SWAMP RABBIT				AAHU=	3001.82
TARGET YEAR	AREA	HSI	YEARS		HU-YEARS
0	6850.00	.46			.00

Table D-1 (continued)

TARGET YEAR	AREA	BSI	YEARS	BU-YEARS
0	6850.00	.46		.00
1	6850.00	.46	0 TC 1	3151.00
5	6505.00	.46	1 TC 5	12286.59
50	6505.00	.46	5 TC 50	134653.40
TOTAL PRESENT UNIT YEARS=				150090.97

10 WOOD LUCK			AAU=	1109.37
TARGET YEAR	AREA	BSI	YEARS	BU-YEARS
0	6850.00	.17		.00
1	6850.00	.17	0 TC 1	1164.50
5	6505.00	.17	1 TC 5	4540.70
50	6505.00	.17	5 TC 50	45762.22
TOTAL PRESENT UNIT YEARS=				55468.41

11 WOODCOCK			AAU=	1957.71
TARGET YEAR	AREA	BSI	YEARS	BU-YEARS
0	6850.00	.30		.00
1	6850.00	.30	0 TC 1	2055.00
5	6505.00	.30	1 TC 5	8012.00
50	6505.00	.30	5 TC 50	87817.44
TOTAL PRESENT UNIT YEARS=				97885.43

Table D-2. Form C: Calculation of AAHU's available for each species under future with-mitigation conditions, natural succession option, for Red River batture lands.

1 DEER				AAHU=	6799.41
TARGET YEAR	AREA	HSI	YEARS	HL-YEARS	
0	15500.00	.33			.00
1	15500.00	.33	0 TC 1		5037.49
5	14200.00	.59	1 TC 5		27148.45
15	14200.00	.46	5 TC 15		76466.94
25	14200.00	.41	15 TC 25		63757.97
50	14200.00	.53	25 TC 50		167559.70
	TOTAL HAPITAT	UNIT YEARS=			339970.00

2 FOX				AAHU=	4986.36
TARGET YEAR	AREA	HSI	YEARS	HL-YEARS	
0	15500.00	.38			.00
1	15500.00	.38	0 TC 1		5843.50
5	14200.00	.49	1 TC 5		25788.70
15	14200.00	.38	5 TC 15		61769.92
25	14200.00	.28	15 TC 25		46930.94
50	14200.00	.33	25 TC 50		108984.80
	TOTAL HAPITAT	UNIT YEARS=			249317.87

6 SCUIPPPI				AAHU=	3872.55
TARGET YEAR	AREA	HSI	YEARS	HL-YEARS	
0	6850.00	.22			.00
1	6850.00	.22	0 TC 1		1507.00
5	14200.00	.16	1 TC 5		7875.50
15	14200.00	.18	5 TC 15		24494.98
25	14200.00	.26	15 TC 25		31594.98
50	14200.00	.46	25 TC 50		128154.90
	TOTAL HAPITAT	UNIT YEARS=			193627.32

7 TURKEY				AAHU=	2682.42
TARGET YEAR	AREA	HSI	YEARS	HL-YEARS	
0	6850.00	.17			.00
1	6850.00	.17	0 TC 1		1164.50
5	14200.00	.32	1 TC 5		10587.99
15	14200.00	.13	5 TC 15		31665.97
25	14200.00	.13	15 TC 25		18460.00
50	14200.00	.28	25 TC 50		72242.44
	TOTAL HAPITAT	UNIT YEARS=			134120.90

8 PACCOCN				AAHU=	5409.90
TARGET YEAR	AREA	HSI	YEARS	HL-YEARS	
0	6850.00	.41			.00
1	6850.00	.41	0 TC 1		2808.50

Table D-2 (continued)

5	15500.00	.40	1 TC	5	18175.58
15	15500.00	.36	5 TC	15	59364.96
25	15500.00	.32	15 TC	25	52777.42
50	15500.00	.39	25 TC	50	127368.60
TOTAL FAFITAT UNIT YEARS=					270495.08

5 SWAMP FAIDIT				FAFU=	4552.81
TARGET YEAR	AFPA	ESJ	YEARS	BU-YIAPS	
0	6850.00	.46			.00
1	6850.00	.46	0 TC	1	3151.00
5	15500.00	.38	1 TC	5	18417.16
15	15500.00	.32	5 TC	15	53629.96
25	15500.00	.28	15 TC	25	45879.96
50	15500.00	.28	25 TC	50	106562.40
TOTAL FAFITAT UNIT YEARS=					227640.45

10 WOOD FOCK				FAFU=	2700.74
TARGET YEAR	AFPA	ESJ	YEARS	BU-YIAPS	
0	6850.00	.17			.00
1	6850.00	.17	0 TC	1	1164.50
5	8900.00	.27	1 TC	5	6998.33
15	8900.00	.32	5 TC	15	26299.49
25	8900.00	.28	15 TC	25	26522.48
50	15500.00	.21	25 TC	50	73652.44
TOTAL FAFITAT UNIT YEARS=					135037.23

11 WOODCOCK				FAFU=	4820.10
TARGET YEAR	AFPA	ESJ	YEARS	BU-YIAPS	
0	6850.00	.30			.00
1	6850.00	.30	0 TC	1	2055.00
5	14200.00	.32	1 TC	5	13170.48
15	14200.00	.35	5 TC	15	50835.94
25	14200.00	.42	15 TC	25	57438.98
50	14200.00	.25	25 TC	50	117504.90
TOTAL FAFITAT UNIT YEARS=					241005.28

Table D-3. Form C: Calculations of AAHU's available for each species under future with-mitigation conditions, partial selective planting option, for Red River batture lands.

1 DEER				AAHU=	8821.01
TARGET YEAR	AREA	BSI	YEARS	PU-YEARS	
0	15500.00	.33			.00
1	15500.00	.33	0 TC 1		5017.45
5	14200.00	.63	1 TC 5		28260.58
15	14200.00	.61	5 TC 15		81465.94
25	14200.00	.61	15 TC 25		86761.87
50	14200.00	.70	25 TC 50		232524.90
	TOTAL HABITAT	UNIT YEARS=			443050.76

2 FOX				AAHU=	6625.04
TARGET YEAR	AREA	BSI	YEARS	PU-YEARS	
0	15500.00	.38			.00
1	15500.00	.38	0 TC 1		5843.50
5	14200.00	.45	1 TC 5		25788.70
15	14200.00	.43	5 TC 15		65319.96
25	14200.00	.45	15 TC 25		62479.96
50	14200.00	.52	25 TC 50		171819.80
	TOTAL HABITAT	UNIT YEARS=			231251.93

6 SCUPIPPI				AAHU=	6007.71
TARGET YEAR	AREA	BSI	YEARS	PU-YEARS	
0	6850.00	.22			.00
1	6850.00	.22	0 TC 1		1507.00
5	14200.00	.17	1 TC 5		8134.00
15	14200.00	.28	5 TC 15		32375.99
25	14200.00	.45	15 TC 25		51758.95
50	14200.00	.72	25 TC 50		206609.80
	TOTAL HABITAT	UNIT YEARS=			300385.75

7 TURKEY				AAHU=	5200.37
TARGET YEAR	AREA	BSI	YEARS	PU-YEARS	
0	6850.00	.17			.00
1	6850.00	.17	0 TC 1		1164.50
5	14200.00	.34	1 TC 5		11222.49
15	14200.00	.28	5 TC 15		44019.96
25	14200.00	.36	15 TC 25		45581.95
50	14200.00	.53	25 TC 50		156329.70
	TOTAL HABITAT	UNIT YEARS=			260318.65

8 RACCOON				AAHU=	6801.89
TARGET YEAR	AREA	BSI	YEARS	PU-YEARS	
0	6850.00	.41			.00
1	6850.00	.41	0 TC 1		2808.50

Table D-3 (continued)

5	15500.00	.42	1 TC	5	18528.84
15	15500.00	.39	5 TC	15	62309.92
25	15500.00	.45	15 TC	25	65022.42
50	15500.00	.54	25 TC	50	191424.90
TOTAL HABITAT UNIT YEARS=					340094.56

9 SWAMP FAEBIT			AAHU=		5647.19
TARGET YEAR	AFIA	HSJ	YEARS		BU-YEARS
0	6850.00	.46			.00
1	6850.00	.46	0 TC	1	3151.00
5	15500.00	.39	1 TC	5	18770.41
15	15500.00	.37	5 TC	15	58899.96
25	15500.00	.36	15 TC	25	56419.92
50	15500.00	.39	25 TC	50	145118.50
TOTAL HABITAT UNIT YEARS=					282399.79

10 WOOD DUCK			AAHU=		2601.76
TARGET YEAR	AFIA	HSJ	YEARS		BU-YEARS
0	6850.00	.17			.00
1	6850.00	.17	0 TC	1	1164.50
5	8900.00	.30	1 TC	5	7540.62
15	8900.00	.38	5 TC	15	10462.48
25	12200.00	.31	15 TC	25	136249.48
50	15500.00	.30	25 TC	50	104651.10
TOTAL HABITAT UNIT YEARS=					180088.15

11 WOODCOCK			AAHU=		5704.72
TARGET YEAR	AFIA	HSJ	YEARS		BU-YEARS
0	6850.00	.30			.00
1	6850.00	.30	0 TC	1	2055.00
5	14200.00	.34	1 TC	5	13452.48
15	14200.00	.42	5 TC	15	54172.97
25	14200.00	.50	15 TC	25	65745.94
50	14200.00	.35	25 TC	50	149609.80
TOTAL HABITAT UNIT YEARS=					285236.20

Table D-4. Form C: Calculations of AAHU's available for each species under future with-mitigation conditions, maximum selective planting option, for Red River batture lands.

1 DEER				AAHU=	10846.17
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	15500.00	.33			.00
1	15500.00	.33	0 TO 1		5037.49
5	14200.00	.67	1 TO 5		29372.70
15	14200.00	.75	5 TO 15		100464.90
25	14200.00	.80	15 TO 25		109765.90
50	14200.00	.88	25 TO 50		297667.40
TOTAL HABITAT UNIT YEARS=					542308.45

2 FOX				AAHU=	8265.84
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	15500.00	.38			.00
1	15500.00	.38	0 TO 1		5843.50
5	14200.00	.49	1 TO 5		25738.70
15	14200.00	.48	5 TO 15		63798.94
25	14200.00	.62	15 TO 25		78028.94
50	14200.00	.70	25 TO 50		234832.30
TOTAL HABITAT UNIT YEARS=					413292.39

6 SQUIRREL				AAHU=	8146.19
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	6850.00	.22			.00
1	6850.00	.22	0 TO 1		1507.00
5	14200.00	.18	1 TO 5		8415.99
15	14200.00	.38	5 TO 15		40327.97
25	14200.00	.63	15 TO 25		71993.94
50	14200.00	.98	25 TO 50		285064.80
TOTAL HABITAT UNIT YEARS=					407309.71

7 TURKEY				AAHU=	7722.05
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	6850.00	.17			.00
1	6850.00	.17	0 TO 1		1164.50
5	14200.00	.37	1 TO 5		11833.49
15	14200.00	.42	5 TO 15		56231.95
25	14200.00	.60	15 TO 25		72632.87
50	14200.00	.78	25 TO 50		244239.80
TOTAL HABITAT UNIT YEARS=					386102.63

8 RACCOON				AAHU=	8193.10
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS	
0	6850.00	.41			.00
1	6850.00	.41	0 TO 1		2808.50

Table D-4 (continued)

5	15500.00	.43	1 TO 5	18882.11
15	15500.00	.41	5 TO 15	65332.42
25	15500.00	.59	15 TO 25	77344.87
50	15500.00	.68	25 TO 50	245287.20
TOTAL HABITAT UNIT YEARS=				409655.15

9 SWAMP RABBIT			AAHU=	6731.00
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	6850.00	.46		.00
1	6850.00	.46	0 TO 1	3151.00
5	15500.00	.40	1 TO 5	19098.44
15	15500.00	.42	5 TO 15	64014.96
25	15500.00	.44	15 TO 25	66804.94
50	15500.00	.51	25 TO 50	183481.00
TOTAL HABITAT UNIT YEARS=				336550.33

10 WOOD DUCK			AAHU=	4340.83
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	6850.00	.17		.00
1	6850.00	.17	0 TO 1	1164.50
5	8900.00	.34	1 TO 5	8082.93
15	8900.00	.44	5 TO 15	34665.48
25	8900.00	.49	15 TO 25	41384.96
50	15500.00	.39	25 TO 50	131743.60
TOTAL HABITAT UNIT YEARS=				217041.50

11 WOODCOCK			AAHU=	6574.67
TARGET YEAR	AREA	HSI	YEARS	HU-YEARS
0	6850.00	.30		.00
1	6850.00	.30	0 TO 1	2055.00
5	14200.00	.35	1 TO 5	13710.99
15	14200.00	.46	5 TO 15	57367.97
25	14200.00	.58	15 TO 25	73839.94
50	14200.00	.45	25 TO 50	181759.80
TOTAL HABITAT UNIT YEARS=				328733.70

Table D-5
Form D. Determination of net change in Average Annual Habitat Units of future conditions
with an action vs. future without the action.

1. Study Red River Waterway		2. Proposed action Between levees: natural succession	
3. Evaluation species	4. Average Annual Habitat Units		5. Change in Average Annual Habitat Units
	a. Future with action	b. Future without action	
White-tailed Deer	6799.41	4950.07	1849.34
Red Fox	4986.36	5872.63	-886.27
Gray Squirrel	3872.55	1435.65	2436.89
Turkey	2682.42	1109.37	1573.05
Raccoon	5409.90	2675.53	2734.37
Swamp Rabbit	4552.81	3001.82	1550.99
Wood Duck	2700.74	1109.37	1591.38
American Woodcock	4820.10	1957.71	2862.39
Total	13712.13		

Table D-6.
Form D. Determination of net change in Average Annual Habitat Unit, of future conditions with an action vs. future without the action.

1. Study Red River Waterway		2. Proposed action Between levees: partial selective planting	
3. Evaluation species	4. Average Annual Habitat Units		5. Change in Average Annual Habitat Units
	a. Future with action	b. Future without action	
White-tailed Deer	8821.01	4950.07	3870.94
Red Fox	6625.04	5872.63	752.41
Gray Squirrel	6007.71	1435.65	4572.06
Turkey	5206.37	1109.37	4097.00
Raccoon	6801.89	2675.53	4126.35
Swamp Rabbit	5647.19	3001.82	2645.37
Wood Duck	3601.76	1109.37	2492.39
American Woodcock	5704.72	1957.71	3747.02
Total		26303.54	6.

Table D-7
Form D. Determination of net change in Average Annual Habitat Units of future conditions with an action vs. future without the action.

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Form H. Calculation of compensation area requirements for a proposed action with a proposed management plan.

[illegible]

Form H. Calculation of compensation area requirements for a proposed action with a proposed management plan.

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Table D-10.

Form H. Calculation of compensation area requirements for a proposed action with a proposed management plan.

[illegible]

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX L
COST ESTIMATES

L-1

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX L
Cost Estimates

1. General. This appendix presents estimates of first costs for the two plans under consideration, B-1 and B-3M, for the Mississippi River to Shreveport reach of the Red River Waterway Project. The basis of the estimates for various cost account features is explained in order to obtain an understanding of the degree of accuracy of the estimates. A comparison by features of the two plans under consideration is presented, and the reasons for the cost differences are explained. Table 2 presents a summary comparison of the two plans by features for the total project, and Tables 3 through 7 present comparisons by features for each of pools 1 through 5. Detailed real estate estimates are presented in pages L-11 through L-24.

2. Plans Considered. The General Reevaluation Report presents the results of a restudy which includes a comparative analysis of two plans for providing navigation, bank stabilization, and recreation for the Mississippi River to Shreveport reach.. These plans are the B-3 Modified (B-3M) and the B-1. The B-3M plan was developed and recommended in the Phase 1 GDM No. 2. The primary differences between the two plans are alternate locations and pool elevations for Locks and Dams 3, 4, and 5. A tabulation of the physical differences between the two plans is presented in the main text of the General Reevaluation Report. First costs for both plans have been developed and are presented in this appendix.

3. Basis of Estimates.

a. General. The estimates for some cost account features are generally considered to be more reliable than those for others. Lock and Dam No. 1 is presently under construction, and thus the features in Pool 1 associated with the lock and dam are based on actual contract costs. In addition, plans and specifications have been prepared for John H. Overton Lock and Dam (Lock and Dam No. 2), and the costs of features associated with this Lock and Dam are derived from the bid schedule based on these plans and specifications. Although the quantity estimates for Locks and Dams 3, 4, and 5 are not considered as reliable as those for Locks and Dams 1 and 2, the individual items and the estimated unit costs are based on experiences gained from Locks and Dams 1 and 2. Thus, the estimated unit costs for Locks and Dams 3, 4, and 5 are considered to be more reliable than generally presented in a Phase 1 document. In addition, some Phase 2 design memoranda, including detailed design memoranda for Locks and Dams 1 and 2, have been prepared. The cost estimates presented in these documents have been updated and used where applicable in this appendix.

b. Real Estate Costs. The market data approach was used in arriving at the real estate estimate for the B-1 and B-3M plans. Comparable sales of similar properties were used to arrive at the various values for the different classes land.

c. Relocations. Railroad bridge and utility relocations cost are based on Phase I GDM No. 2. Updated highway bridge costs are based on approved relocation design memoranda. An appropriate price level factor has been applied to all previously developed relocation costs.

d. Locks and Dams. As stated in paragraph 3a. of this appendix, Lock and Dam No. 1 is under construction, and plans and specifications have been completed for Lock and Dam No. 2. The experiences gained on these two locks and dams have been used in developing the individual items comprising features 04. and 05., for Dams and Locks, respectively, and the unit costs for these items for Locks and Dams 3, 4, and 5. Therefore, the cost estimates developed for these features, and presented herein, are considered to be a detailed scope. In addition to features 04. and 05., much of features 08., Roads, and 19., Buildings, Grounds, and Utilities, have been included in the construction contract for Lock and Dam No. 1 and in the plans and specifications for Lock and Dam No. 2. As a result, the experiences gained on these features for Locks and Dams 1 and 2 have been applied to Locks and Dams, 3, 4, and 5.

e. Channels and Canals. The estimated costs for bank stabilization and realignment items are generally based on Phase 2 GDM No. 1, Project Design, Stabilization and Cutoffs. However, several realignment and stabilization items have been constructed, and cost experiences gained on these items have been applied to other unconstructed items. In addition, the realignment and stabilization at Lock and Dam No. 1 is included in the ongoing construction contract. Realignment and stabilization at Lock and Dam No. 2 is included in the completed plans and specifications for Lock and Dam No. 2.

f. Levees and Floodwalls. As discussed in the General Reevaluation Report, topographic maps have been developed which allowed a better determination of the impingement of pools on existing levees in Pools 3 and 5 for each of the alternatives under consideration. New cost estimates for modifications required on existing levees have been made as a result of this mapping.

g. Recreation Facilities, Cultural Resources, and Permanent Operating Equipment. Cost estimates for feature 14., Recreation Facilities, are based on Phase 1 GDM No. 2. However, a master plan for recreational development has been prepared, and upon approval, the project cost estimate will be revised to reflect the newer estimated costs. Cultural resources estimates are based on preliminary investigations, and do not reflect the results of any intensive field surveys. The estimates for permanent operating equipment in Pools 1 and 2 are based on detailed design memoranda prepared for each pool. It is anticipated that similar costs will be required for Pools 3, 4, and 5, as indicated by the presented estimated costs for feature 20. in these pools.

h. E&D and S&A. Total estimated costs for E&D and S&A are based on actual costs to date and projections of remaining costs. Design experience gained on Locks and Dams 1 and 2, and construction experience gained on Lock and Dam 1, have provided a reliable basis for estimates of total costs for these features. Project cost increases for these features are being identified as the need arises, and appropriate adjustments made to the project cost estimate.

4. Price Level. The price level of estimates for plans B-1 and B-3M is 1 October 1981. This price level was chosen in order to compare costs directly to the latest approved project cost estimate (PB-3). A comparison of the recommended plan to the PB-3 is presented in the General Reevaluation Report.

5. Comparison of First Costs.

a. General. A summary comparison of estimated construction costs for plans B-1 and B-3M is presented in Table 2. The two plans are compared by individual pools in Table 3 through 7. Explanations for the differences in costs of the two plans are given in the following paragraphs.

b. Real Estate Costs. A summary of the real estate costs for the total project and for each pool is presented in Table 2-7. Detailed costs are presented in pages L-11 to L-24. Real estate costs for the B-1 plan are \$2,992,000 less than the B-3M plan.

(1) Construction Lands. Only minor differences in land requirements for the B-1 and B-3M plans occur. The differences that occur are directly related to the difference in locations of Locks and Dams 3, 4, and 5. Approximately 20,344 and 20,249 acres of land (including 3,000 acres for recreational development) will be required for the construction of the B-1 and B-3M plans, respectively. These acreages consist of lands to be acquired for perpetual right-of-way and fee, perpetual disposal, 5-year temporary easements, and severed lands. Thus, the B-1 plan requires approximately 95 more acres for construction than the B-3M plan.

(2) Flowage Easements. Flowage easements will be required in Pools 2, 3, 4 and 5 for both the B-1 and B-3M plans. The acreages required for flowage easements in each pool are presented in Table 1.

Table 1

<u>Pool No</u>	<u>B-1 (acres)</u>	<u>B-3M (acres)</u>
2	16	16
3	2,966	455
4	526	2,730
5 (145')	3,811	4,687
	<u>7,319</u>	<u>7,888</u>

(3) Recreation Lands. The recreation land requirements for the B-1 and B-3M plans are the same. These lands will be used for recreation facilities at lock and dam sites and selected locations along the navigation channel.

(4) Wildlife Mitigation Lands. Costs for mitigation lands have not been included in the cost estimates because mitigation has not been authorized. Mitigation requirements are discussed in detail in Appendix E.

c. Relocations.

(1) Roads and Bridges. Modifications are required to the LA Highway 107/115 bridge in Pool No. 1 and the LA Highway 3026/28 bridge in Pool No. 2 for both plans. Since these modifications consist of equipment alterations to the bridges, the cost of the work is not contingent on the plan selected. The total cost of this item for both plans is \$464,000. The cost of the LA Highway 107/115 bridge work was approved by DM No. 5 and the cost of the modifications to the LA Highway 3026/28 bridge was approved by DM No. 16-B.

(2) Railroads and Bridges. Two railroad bridges in Pool No. 2 owned by the Louisiana and Arkansas Railroad and the Missouri Pacific Railroad will require major modifications. These modifications involve replacing the existing swing spans with vertical lift spans. The cost of this work, \$18,570,000, is the same for both plans. The project plan approved in GDM 2 provided for the relocation of two railroad bridges in Pool 5 owned by the St. Louis and Southwestern Railroad and the Illinois Central Railroad. After GDM 2 was submitted, the Caddo Bossier Port Commission established a port at mile 214 (realined). This site is located downstream of both of these bridges. Based on the analysis in Appendix A, the bridges will not be relocated at this time, and the costs for the relocations are not included.

(3) Utilities. Both plans will require the relocation of 21 submerged pipelines and 3 submarine cables. Additionally, Plan B-1 will require the relocation of two aerial powerlines, while Plan B-3M will require the relocation of only one aerial powerline. The cost of the utility relocations in pools 2, 3, and 4 differs for each plan due to the change of locations of Locks and Dams 3, 4, and 5 however, with the exception of the additional powerline relocation for Plan B-1, the total cost for utility relocations for both plans is equal. The change in pool elevations does not substantially change the relocations cost.

(4) Outfall Pipes. A total of 82 outfall pipes are located in the Mississippi River to Shreveport reach. Although some of these facilities may be partially or totally submerged by some of the pool elevations under consideration, detailed studies have determined that the hydraulic capabilities of these facilities will not be adversely affected by either plan.

d. Locks and Dams. The cost of the five navigation dams is \$7,076,000 less for Plan B-1 than Plan B-3M. This is due, in part, to

the difference in gate requirements for the navigation dams. The remaining cost differences for the navigation dams as well as cost differences for the locks are due to differences in design related to various pool heights.

e. Access Roads. The cost for access roads for Plan B-1 is 1,932,000 less than for Plan B-3M. This difference is primarily due to the Plan B-1 lock and dam sites being more accessible to the existing road system in the project area.

f. Channel and Canals. Plan B-1 costs are \$11,237,000 less than the costs for Plan B-3M. These differences are primarily related to the design of river training works for the various pool elevations in each plan and costs associated with channel work at lock and dam sites.

g. Levees and Floodwalls. Plan B-3M costs are \$277,000 less than Plan B-1. This difference is related to the length of levee in each pool impacted by the various pool elevations.

TABLE 2

SUMMARY OF FIRST COST POOLS 1 - 5^{1/}

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs B-3M PLAN
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	B-3M
01.	Real Estate Costs ^{2/}	\$ 23,928,000	\$ 26,920,000
02.	Relocations		
.1	Roads	464,000	464,000
.4	Railroads	18,570,000	18,570,000
.7	Utilities	<u>5,456,000</u>	<u>5,139,000</u>
	Subtotal-Relocations	\$24,490,000	\$24,173,000
04.	Navigation Dams	305,440,000	312,516,000
05.	Navigation Locks	374,067,000	373,651,000
08.	Access Roads	6,167,000	8,099,000
09.	Channels & Canals	598,629,000	609,866,000
11.	Levees & Floodwalls	8,688,000	8,411,000
14.	Recreation Facilities	47,720,000	47,720,000
18.	Cultural Resources	75,000	75,000
19.	Buildings, Grounds, & Utilities	5,860,000	5,860,000
20.	Permanent Operating Equipment	<u>791,000</u>	<u>791,000</u>
	Subtotal-Items 04.-20.	\$1,347,437,000	\$1,366,989,000
	Subtotal	\$1,395,855,000	\$1,418,082,000
30.	Engineering & Design	118,810,000	118,810,000
31.	Supervision & Administration	72,525,000	72,525,000
	Navigation Aids	<u>4,132,000</u>	<u>4,132,000</u>
	TOTAL	\$1,591,322,000	\$1,613,549,000

^{1/} Costs do not include wildlife mitigation.^{2/} Detailed Real Estate costs shown pages L-11 to L-24.

TABLE 3

POOL NO. 1 FIRST COST
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs B-3M PLAN
(October 1981 Price Levels and Actual Contract Amounts)

Cost Acct. No.	Item	B-1 and B-3M
01.	Real Estate Costs	\$ 4,930,000 ^{1/}
02.	Relocations	
.1	Roads	\$ 279,000
.4	Railroads	0
.7	Utilities	<u>59,000</u>
	Subtotal-Relocations	\$ 338,000
04.	Navigation Dams	64,624,000
05.	Navigation Locks	76,801,000
08.	Access Roads	2,305,000
09.	Channels & Canals	168,364,000
11.	Levees & Floodwalls	640,000
14.	Recreation Facilities	7,500,000
18.	Cultural Resources	15,000
19.	Buildings, Grounds, & Utilities	1,640,000
20.	Permanent Operating Equipment	<u>200,000</u>
	Subtotal-Items 04.-20.	\$322,089,000
	Subtotal	\$327,357,000
30.	Engineering & Design	24,235,000
31.	Supervision & Administration	17,596,000
	Navigation Aids	<u>826,000</u>
	TOTAL	\$370,014,000

^{1/} Includes costs below Lock and Dam No. 1.

TABLE 4

POOL NO. 2 FIRST COST
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN VS B-3M PLAN
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	B-3M
01.	Real Estate Costs	\$ 4,378,000	\$ 4,468,000
02.	Relocations		
.1	Roads	\$ 185,000	\$ 185,000
.4	Railroads	18,570,000	18,570,000
.7	Utilities	225,000	225,000
	Subtotal-Relocations	\$ 18,980,000	\$ 18,980,000
04.	Navigation Dams	\$ 49,542,000	\$ 49,542,000
05.	Navigation Locks	79,376,000	79,376,000
08.	Access Roads	1,850,000	1,850,000
09.	Channels & Canals	135,125,000	135,125,000
11.	Levees & Floodwalls	3,390,000	3,390,000
14.	Recreation Facilities	13,370,000	13,370,000
18.	Cultural Resources	15,000	15,000
19.	Buildings, Grounds, & Utilities	1,760,000	1,760,000
20.	Permanent Operating Equipment	229,000	229,000
	Subtotal-Items 04.-20.	\$284,657,000	\$284,657,000
	Subtotal	\$308,015,000	\$308,105,000
30.	Engineering & Design	23,010,000	23,010,000
31.	Supervision & Administration	16,300,000	16,300,000
	Navigation Aids	826,000	826,000
	TOTAL	\$348,151,000	\$348,241,000

TABLE 5

POOL NO. 3 FIRST COST
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs B-3M PLAN
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	B-3M
01.	Real Estate Costs	\$ 7,217,000	\$ 2,872,000
02.	Relocations		
.1	Roads	0	0
.4	Railroads	0	0
.7	Utilities	2,539,000	1,138,000
	Subtotal-Relocations	\$ 2,539,000	\$ 1,138,000
04.	Navigation Dams	\$ 64,801,000	\$ 54,934,000
05.	Navigation Locks	87,361,000	83,201,000
08.	Access Roads	621,000	1,671,000
09.	Channels & Canals	118,057,000	107,487,000
11.	Levees & Floodwalls	3,728,000 ^{1/}	870,000
14.	Recreation Facilities	8,910,000	8,910,000
18.	Cultural Resources	15,000	15,000
19.	Buildings, Grounds, & Utilities	820,000	820,000
20.	Permanent Operating Equipment	119,000	119,000
	Subtotal-Items 04.-20.	\$284,432,000	\$258,027,000
	Subtotal	\$294,188,000	\$262,037,000
30.	Engineering & Design	25,525,000	25,525,000
31.	Supervision & Administration	12,109,000	12,109,000
	Navigation Aids	826,000	826,000
	TOTAL	\$332,648,000	\$300,497,000

^{1/} Includes \$2,858,000 for levee protection.

TABLE 6

POOL NO. 4 FIRST COST
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs B-3M PLAN
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	B-3M
01.	Real Estate Costs	\$ 3,302,000	\$ 7,266,000
02.	Relocations		
.1	Roads	0	0
.4	Railroads	0	0
.7	Utilities	<u>2,451,000</u>	<u>3,535,000</u>
	Subtotal-Relocations	\$ 2,451,000	\$ 3,535,000
04.	Navigation Dams	\$ 64,966,000	\$ 82,247,000
05.	Navigation Locks	70,507,000	67,016,000
08.	Access Roads	502,000	1,145,000
09.	Channels & Canals	113,277,000	134,769,000
11.	Levees & Floodwalls	500,000	500,000
14.	Recreation Facilities	6,280,000	6,280,000
18.	Cultural Resources	15,000	15,000
19.	Buildings, Grounds, & Utilities	820,000	820,000
20.	Permanent Operating	<u>120,000</u>	<u>120,000</u>
	Subtotal-Items 04.-20.	\$256,987,000	\$292,943,000
	Subtotal	262,640,000	\$303,682,000
30.	Engineering & Design	23,685,000	23,685,000
31.	Supervision & Administration	14,385,000	14,385,000
	Navigation Aids	<u>827,000</u>	<u>827,000</u>
	TOTAL	\$301,537,000	\$342,610,000

TABLE 7

POOL NO. 5 FIRST COST (145')
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA

B-1 PLAN vs B-3M PLAN
(October 1981 Price Levels)

Cost Acct. No.	Item	B-1	B-3M
01.	Real Estate Costs	\$ 4,201,000	\$ 7,384,000
02.	Relocations		
.1	Roads	0	0
.4	Railroads	0	0
.7	Utilities	182,000	182,000
	Subtotal-Relocations	\$ 182,000	\$ 182,000
04.	Navigation Dams	\$ 61,507,000	\$ 61,169,000
05.	Navigation Locks	60,022,000	67,257,000
08.	Access Roads	889,000	1,128,000
09.	Channels & Canals	63,806,000	64,121,000
11.	Levees & Floodwalls	430,000	3,011,000
14.	Recreation Facilities	11,660,000	11,660,000
18.	Cultural Resources	15,000	15,000
19.	Buildings, Grounds, & Utilities	820,000	820,000
20.	Permanent Operating Equipment	123,000	123,000
	Subtotal-Items 04.-20.	\$ 199,272,000	\$ 209,304,000
	Subtotal	\$ 203,655,000	\$ 216,870,000
30.	Engineering & Design	22,355,000	22,355,000
31.	Supervision & Administration	12,135,000	12,135,000
	Navigation Aids	827,000	827,000
	TOTAL	\$ 238,972,000	\$ 252,187,000

1/ Costs shown are for levee protection.

IDENTIFICATION
NUMBER 20709

REVISION NO. 2
REAL ESTATE ESTIMATE

Supplement No. 1 - GDM 2 - Plan Formulation, Site Selection
Mississippi River to Shreveport, Louisiana
Red River Waterway

The purpose of this revision is to reflect changes in acreages of flowage easements and to update values to October 1981 price level.

ESTIMATE OF COSTS (Date of Value October 1981)

Real Estate Cost: B-1 Pool 5, Elev. 145'

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Cropland	18	\$1,130		\$ 20,340
Pasture	305	900		274,500
Woods	756	225		170,100
Perpetual Material Disposal Easement				
Pasture	150	\$ 900 x 80%		\$108,000
Woods	397	225 x 80%		71,460
Temporary Material Disposal Easement (5 yrs.)				
Pasture	113	\$ 900 x 50%		\$ 50,850
Woods	67	225 x 50%		7,538
Subtotal				\$702,788
Flowage Easement				
Pasture	2,517	\$ 900		\$2,265,300
Woods	1,294	225		291,150
Improvements				0
Severance Damages				0
Total (R)				\$3,260,000
Contingencies 25% (R)				815,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)				
Non-Federal 60 tracts @ \$1,400/tract				84,000
Federal 60 tracts @ \$ 700/tract				42,000
c. <u>PL-91-646</u>				0
d. Total Estimated Real Estate Cost				\$4,201,000

Real Estate Cost: B-1 Pool 5, Elev. 137'

a. <u>Lands & Damages</u>	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Subtotal (from B-1 Pool 5, Elev. 145')			\$ 702,788
Flowage Easement			
Pasture	428	\$900	\$ 385,200
Woods	335	565	189,275
Improvements			0
Severance Damages			0
Total (R)			\$1,277,000
Contingencies 25% (R)			319,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)			
Non-Federal 60 tracts @ \$1,400/tract			84,000
Federal 60 tracts @ \$ 700/tract			42,000
c. <u>PL-91-646</u>			0
d. Total Estimated Real Estate Cost			\$1,722,000

Real Estate Cost: B-1 Pool 5, Elev. 135'

a. <u>Lands & Damages</u>	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Subtotal (from B-1 Pool 5, Elev. 145')			\$ 702,788
Flowage Easement			
Pasture	125	\$900	\$ 112,500
Woods	203	565	114,695
Improvements			0
Severance Damages			0
Total (R)			\$ 930,000
Contingencies 25% (R)			232,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)			
Non-Federal 60 tracts @ \$1,400/tract			84,000
Federal 60 tracts @ \$ 700/tract			42,000
c. <u>PL-91-646</u>			0
d. Total Estimated Real Estate Cost			\$1,288,000

Real Estate Cost: B-1 Pool 4

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Pasture	223	\$1,350	\$	301,050
Pasture	486	900		437,400
Woods	681	225		153,225
Perpetual Material Disposal Easement				
Cropland	241	\$1,130 x 80%	\$	217,864
Pasture	5	1,350 x 80%		5,400
Pasture	329	900 x 80%		236,880
Woods	682	225 x 80%		122,760
Temporary Material Disposal Easement (5 yrs.)				
Pasture	636	\$ 900 x 50%	\$	286,200
Woods	263	225 x 50%		29,588
Flowage Easement				
Pasture	321	\$ 900	\$	288,900
Woods	205	225		46,125
Improvements				0
Severance Damages				<u>335,723</u>
Total (R)				\$2,461,000
Contingencies 25% (R)				615,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)				
Non-Federal 60 tracts @ \$1,400/tract				84,000
Federal 60 tracts @ \$ 700/tract				42,000
c. <u>PL-91-646</u>				<u>0</u>
d. Total Estimated Real Estate Cost				\$3,202,000

Real Estate Cost: B-1 Pool 3

a. <u>Lands & Damages</u>	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee			
Cropland	178	\$1,580	\$ 281,240
Cropland	560	1,130	632,800
Pasture	955	900	859,500
Woods	484	225	108,900
Perpetual Material Disposal Easement			
Cropland	285	\$1,130 x 80%	\$ 257,640
Pasture	131	1,350 x 80%	141,480
Pasture	441	900 x 80%	317,520
Woods	1,097	225 x 80%	197,460
Temporary Material Disposal Easement (5 yrs.)			
Cropland	44	\$1,130 x 50%	\$ 24,860
Pasture	25	1,350 x 50%	16,875
Pasture	277	900 x 50%	124,650
Woods	423	225 x 50%	47,588
Flowage Easement			
Pasture	1,901	\$ 900	\$1,710,900
Woods	1,065	225	239,625
Improvements			0
Severance Damages			694,770
Total (R)			\$5,656,000
Contingencies 25% (R)			1,414,000
b. <u>Acquisition Costs</u> (Estimated 70 tracts)			
Non-Federal 70 tracts @ \$1,400/tract			98,000
Federal 70 tracts @ \$ 700/tract			49,000
c. <u>PL-91-646</u>			0
d. Total Estimated Real Estate Cost			\$7,217,000

Real Estate Cost: B-1 Pool 2

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Residential Land	170	\$4,000		\$680,000
Pasture	68	1,350		91,800
Pasture	880	900		792,000
Woods	542	225		121,950
Perpetual Material Disposal Easement				
Residential Land	120	\$4,000 x 80%		\$384,000
Pasture	262	900 x 80%		188,640
Woods	90	225 x 80%		16,200
Temporary Material Disposal Easement (5 yrs.)				
Residential Land	6	\$4,000 x 50%		\$ 12,000
Cropland	10	1,130 x 50%		5,650
Pasture	537	900 x 50%		241,650
Woods	453	225 x 50%		50,963
Flowage Easement				
Woods	16	\$ 225		3,600
Improvements				75,000
Severance Damages				<u>677,800</u>
Total (R)				\$3,341,000
Contingencies 25% (R)				835,000
b. <u>Acquisition Costs</u> (Estimated 70 Tracts)				
Non-Federal 70 tracts @ \$1,400/tract				98,000
Federal 70 tracts @ \$ 700/tract				49,000
c. <u>PL-91-646</u>				<u>55,000</u>
d. Total Estimated Real Estate Cost				\$4,378,000

Real Estate Cost: B-1 Pool 1

a. Lands & Damages

	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee			
Cropland	342	\$1,580	\$ 540,360
Cropland	113	1,130	127,690
Pasture	950	900	855,000
Woods	543	225	122,175

Perpetual Material Disposal Easement

Cropland	180	\$1,580 x 80%	\$ 227,520
Cropland	200	1,130 x 80%	180,800
Pasture	78	900 x 80%	56,160
Woods	26	225 x 80%	4,680

Temporary Material Disposal Easement (5 yrs.)

Cropland	218	\$1,580 x 50%	\$ 172,220
Cropland	141	1,130 x 50%	79,665
Pasture	362	900 x 50%	162,900
Woods	138	225 x 50%	15,525

Flowage Easement

0

Improvements

5,000

Severance Damages

800,000

Total (R)

\$3,350,000

Contingencies 25% (R)

838,000

b. Acquisition Costs (Estimated 60 tracts)

Non-Federal 60 tracts @ \$1,400/tract	84,000
Federal 60 tracts @ \$ 700/tract	42,000

c. P1-91-646

0

d. Total Estimated Real Estate Cost

\$4,314,000

Real Estate Cost: B-1 Lands Below Pool 1

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Pasture	200	\$ 900	\$180,000	
Woods	61	225	13,725	
Perpetual Material Disposal Easement				
Pasture	60	\$ 900 x 80%	\$ 43,200	
Woods	21	225 x 80%	3,780	
Temporary Material Disposal Easement (5 yrs.)				
Cropland	201	\$1,580 x 50%	\$158,790	
Pasture	85	900 x 50%	38,250	
Woods	35	225 x 50%	3,938	
Flowage Easement			0	
Improvements			0	
Severance Damages			<u>0</u>	
Total (R)			\$442,000	
Contingencies 25% (R)			111,000	
b. <u>Acquisition Costs</u> (Estimated 30 tracts)				
Non-Federal 30 tracts @ \$1,400/tract			42,000	
Federal 30 tracts @ \$ 700/tract			21,000	
c. <u>Pl-91-646</u>			<u>0</u>	
d. Total Estimated Real Estate Cost			\$616,000	

Real Estate Cost: B-3-M Pool 5 Elev. 145'

a. <u>Lands & Damages</u>		<u>Unit</u>	<u>Total</u>
	<u>Acres</u>	<u>Value</u>	<u>Value</u>
Perpetual Rights-of-Way & Fee			
Cropland	17	\$1,130	\$ 19,210
Pasture	593	900	533,700
Woods	12	225	2,700
Perpetual Material Disposal Easement			
Pasture	473	\$ 900 x 80%	\$ 340,560
Woods	300	225 x 80%	54,000
Temporary Material Disposal Easement (5 yrs.)			
Cropland	190	\$1,580 x 50%	\$ 150,100
Pasture	132	900 x 50%	59,400
Woods	170	225 x 50%	<u>19,125</u>
Subtotal (R)			\$1,178,795
Flowage Easement			
Pasture	2,785	\$1,350	3,759,750
Woods	1,293	565	730,545
Woods	609	225	<u>137,025</u>
Improvements			0
Severance Damages			<u>0</u>
Total (R)			\$5,806,000
Contingencies 25% (R)			1,452,000
b. <u>Acquisition Costs</u> Estimated 60 tracts)			
Non-Federal 60 tracts @ \$1,400/tract			84,000
Federal 60 tracts @ \$ 700/tract			<u>42,000</u>
c. <u>PL-91-646</u>			<u>0</u>
d. Total Estimated Real Estate Cost			\$7,384,000

Real Estate Cost: B-3-M Pool 5 Elev. 137'

a. <u>Lands & Damages</u>		<u>Unit</u>	<u>Total</u>
	<u>Acres</u>	<u>Value</u>	<u>Value</u>
Subtotal (from B-3-M Pool 5, Eleve. 145')			\$1,178,795
Flowage Easement			
Cropland			
Pasture	376	\$ 900	\$ 338,400
Woods	85	565	48,025
Woods	779	225	175,275
Improvements			0
Severance Damages			<u>0</u>
Total (R)			\$1,740,000
Contingencies 25% (R)			435,000
b. <u>Acquisition Cost</u> (Estimated 60 tracts)			
Non-Federal 60 tracts @ \$1,400/tract			84,000
Federal 60 tracts @ \$ 700/tract			42,000
c. <u>PL-91-646</u>			<u>0</u>
d. Total Estimated Real Estate Cost			\$2,301,000

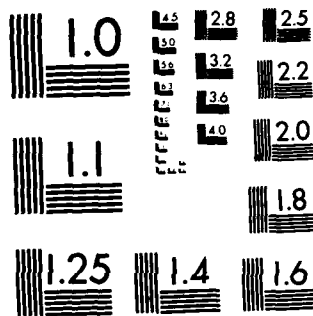
Real Estate Cost: B-3-M Pool 5, Elev. 135'

a. <u>Lands & Damages</u>		<u>Unit</u>	<u>Total</u>
	<u>Acres</u>	<u>Value</u>	<u>Value</u>
Subtotal (from B-3-M Pool 5, Eleve. 145')			\$1,178,795
Flowage Easement			
Pasture	146	\$ 900	\$ 131,400
Woods	33	565	18,645
Woods	338	225	76,050
Improvements			0
Severance Damage			<u>0</u>
Total (R)			\$1,405,000
Contingencies 25% (R)			351,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)			
Non-Federal 60 tracts @ \$1,400/tract)			84,000
Federal 60 tracts @ \$ 700/tract)			42,000
c. <u>PL-91-646</u>			<u>0</u>
d. Total Estimated Real Estate Cost			\$1,882,000

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Real Estate Cost: B-3-M Pool 4

a. Lands & Easements

	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee			
Cropland	226	\$1,130	\$ 255,380
Pasture	223	1,350	301,050
Pasture	951	900	855,900
Woods	1,295	225	291,375
Perpetual Material Disposal Easement			
Pasture	431	\$ 900 x 80%	\$ 310,320
Woods	290	225 x 80%	52,200
Temporary Material Disposal Easement (5 yrs.)			
Cropland	193	\$1,580 x 50%	\$ 152,470
Cropland	129	1,130 x 50%	72,885
Pasture	45	1,350 x 50%	30,375
Pasture	1,070	900 x 50%	481,500
Woods	806	225 x 50%	90,675
Flowage Easement			
Cropland	162	\$1,130	\$ 183,060
Pasture	912	1,350	1,231,200
Pasture	708	900	637,200
Woods	287	565	162,155
Woods	661	225	148,725

Improvements

0

Severance Damages

455,300

Total (R)

\$5,712,000

Contingencies 25% (R)

1,428,000

b. Acquisition Costs (Estimated 60 tracts)

Non-Federal 60 tracts @ \$1,400/tract	84,000
Federal 60 tracts @ \$ 700/tract	42,000

c. PL-91-646

0

d. Total Estimated Real Estate Cost

\$7,266,000

Real Estate Cost: B-3-M Pool 3

a.	<u>Lands & Damages</u>	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
	Perpetual Rights-of-Way & Fee			
	Cropland	396	\$1,130	\$447,480
	Pasture	634	900	570,600
	Woods	380	225	85,500
	Perpetual Material Disposal Easement			
	Cropland	28	\$1,130 x 80%	\$ 25,312
	Pasture	45	900 x 80%	32,400
	Woods	172	225 x 80%	30,960
	Temporary Material Disposal Easement (5 yrs.)			
	Cropland	31	\$1,580 x 50%	\$ 24,490
	Pasture	195	900 x 50%	87,750
	Woods	446	225 x 50%	50,175
	Flowage Easement			
	Pasture	243	\$1,350	\$328,050
	Woods	212	565	119,780
	Improvements			0
	Severance Damages			<u>377,300</u>
	Total (R)			\$2,180,000
	Contingencies 25% (R)			545,000
b.	<u>Acquisition Costs</u> (Estimated 70 tracts)			
	Non-Federal 70 tracts @ \$1,400/tract			98,000
	Federal 70 tracts @ \$ 700/tract			49,000
c.	<u>PL-91-646</u>			<u>0</u>
d.	Total Estimated Real Estate Cost			\$2,872,000

Real Estate Cost: B-3-M Pool 2

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Residential Lands	170	\$4,000		\$ 680,000
Pasture	68	1,350		91,800
Pasture	995	900		895,500
Woods	789	225		177,525
Perpetual Material Disposal Easement				
Residential Land	120	\$4,000 x 80%		\$ 384,000
Pasture	241	\$ 900 x 80%		173,520
Woods	32	\$ 225 x 80%		5,760
Temporary Material Disposal Easement (5 yrs.)				
Residential Land	6	\$4,000 x 50%		\$ 12,000
Cropland	10	1,130 x 50%		5,650
Pasture	537	900 x 50%		241,650
Woods	454	225 x 50%		51,075
Flowage Easement				
Woods	16	\$ 225		\$ 3,600
Improvements				75,000
Severance Damages				<u>616,200</u>
Total (R)				\$3,413,000
Contingencies 25% (R)				853,000
b. Acquisition Costs (Estimated 70 tracts)				
Non-Federal 70 tracts @ \$1,400/tract (R)				98,000
Federal 70 tracts @ \$ 700/tract (R)				49,000
c. <u>PL-91-646</u>				<u>55,000</u>
d. Total Estimated Real Estate Cost				\$4,468,000

Real Estate Cost: B-3-M Pool 1

a. <u>Lands & Damages</u>		<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee				
Cropland	342	\$1,580		\$540,360
Cropland	113	1,130		127,690
Pasture	950	900		855,000
Woods	543	225		122,175
Perpetual Material Disposal Easement				
Cropland	180	\$1,580 x 80%		\$227,520
Cropland	200	1,130 x 80%		180,800
Pasture	78	900 x 80%		56,160
Woods	26	225 x 80%		4,680
Temporary Material Disposal Easement (5 yrs.)				
Cropland	218	\$1,580 x 50%		\$ 172,220
Cropland	141	1,130 x 50%		79,665
Pasture	362	900 x 50%		162,900
Woods	138	225 x 50%		15,525
Flowage Easement				0
Improvements				5,000
Severance Damages				<u>800,000</u>
Total (R)				\$3,350,000
Contingencies 25% (R)				838,000
b. <u>Acquisition Costs</u> (Estimated 60 tracts)				
Non-Federal 60 tracts @ \$1,400/tract				84,000
Federal 60 tracts @ \$ 700/tract				42,000
c. <u>PL-91-646</u>				<u>0</u>
d. Total Estimated Real Estate Cost				\$4,314,000

Real Estate Cost: B-3-M Lands below Pool 1

a. Lands & Damages

	<u>Acres</u>	<u>Unit Value</u>	<u>Total Value</u>
Perpetual Rights-of-Way & Fee			
Pasture	200	\$900	\$180,000
Woods	61	225	13,725
Perpetual Material Disposal Easement			
Pasture	60	\$900 x 80%	\$ 43,200
Woods	21	225 x 80%	3,780
Temporary Material Disposal Easement (5 yrs.)			
Cropland	201	\$1,580 x 50%	\$158,790
Pasture	85	900 x 50%	38,250
Woods	35	225 x 50%	3,938
Flowage Easements			0
Improvements			0
Severance Damages			0

Total (R) \$442,000

Contingencies 25% (R) 111,000

b. Acquisition Costs (Estimated 30 tracts)

Non-Federal 30 tracts @ \$1,400/tract	42,000
Federal 30 tracts @ \$ 700/tract	21,000

c. P1-91-646

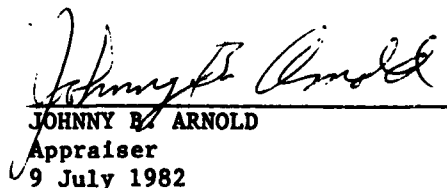
0

d. Total Estimated Real Estate Cost \$616,000

Flowage easement acreage based on Map H-4-28680, dated April 1978. Acreage of other easements and fee is same as that shown on appraisal estimate dated 5 November 1980.

APPROVED:


 WARREN deSAMBOURG
 Review Appraiser
 12 July 1982


 JOHNNY B. ARNOLD
 Appraiser
 9 July 1982

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX M
GROUNDWATER

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
GROUNDWATER STUDIES

Appendix M

PREFACE

The following tables are taken from a groundwater impact study prepared by D'Appolonia Consulting Engineers, Inc. The study was prepared using a 58 foot pool elevation for Pool 2 for the B-3M plan. The tables have been modified to reflect a 64 foot elevation. The results of the study are summarized in the main text of this report.

TABULAR LISTING OF TABLES

APPENDIX M

Summary of Annual Net Return and Costs		Summary of Urban Impact Assessments
Lock & Dam No. 1	Table 1, Page M-1	N, A
Lock & Dam No. 2	Table 2, Page M-2	Table 3, Page M-3, Alexandria, La. Table 4, Page M-4, England Air Force Base.
Lock & Dam No. 3	Table 5, Page M-7	Table 6, Page M-8, Boyce, La. Table 7, Page M-10, Colfax, La. Table 8, Page M-12, Natchitoches, La.
Lock & Dam No. 4	Table 9, Page M-14	Table 10, Page M-15, Compti, La. Table 11, Page M-17, Clarence, La. Table 12, Page M-19, Coushatta, La.
Lock & Dam No. 5	Table 13, Page M-21	Tables 14 & 15, Page M-22, Barksdale Air Force Base, Plans B-1 & B-3M. Tables 16 & 17, Page M-26, Bossier City, La., Plans B-1 & B-3M. Tables 18 & 19, Page M-30, Shreveport, La., Plans B-1 & B-3M.
	Table 20, Page M-36	Percent decrease in capacity of deep pile foundations.

Table 1
SUMMARY OF ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS
LOCK AND DAM NO. 1

TIME	DRAINAGE PROJECT STATUS	NAVIGATION PLAN	NET RETURNS (DOLLARS)					COSTS INDUCED BY NAVIGATION PROJECTS (DOLLARS)	
			BASED ON PRECONSTRUCTION LAND USE		BASED ON ECONOMIC LAND USE CHANGES			BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES
			INSIDE CHATLIN LAKE CANAL AND AVOUELLES- ST. LANDRY WATERSHEDS	OUTSIDE CHATLIN LAKE CANAL AND AVOUELLES- ST. LANDRY WATERSHEDS	TOTAL L/D 1 STUDY AREA	INSIDE CHATLIN LAKE CANAL AND AVOUELLES- ST. LANDRY WATERSHEDS	OUTSIDE CHATLIN LAKE CANAL AND AVOUELLES- ST. LANDRY WATERSHEDS		
Present	Without Drainage Projects Constructed	Preconstruction B-3 Modified and B-1	174,500	4,284,900	4,459,400	291,000	4,351,500	-126,000	-122,900
	With Drainage Projects Constructed	Preconstruction B-3 Modified and B-1	158,100	4,175,400	4,333,400	287,800	4,231,800		
Future	Without Drainage Projects Constructed	Preconstruction B-3 Modified and B-1	360,500	6,304,900	6,665,300	399,700	6,359,900	-165,300	-159,200
	With Drainage Projects Constructed	Preconstruction B-3 Modified and B-1	340,400	6,159,500	6,500,000	392,700	6,207,700		
			911,400	6,304,900	7,216,300	911,400	6,359,900	-175,300	-180,400
			881,400	6,159,500	7,041,000	883,300	6,207,700		

Table 2
SUMMARY OF ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS
LOCK AND DAM NO. 2

	DRAINAGE PROJECT STATUS	NAVIGATION PLAN	NET RETURNS (DOLLARS)						COSTS INDUCED BY NAVIGATION PROJECTS (DOLLARS)	
			BASED ON PRECONSTRUCTION LAND USE			BASED ON ECONOMIC LAND USE CHANGES			BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES
			INSIDE CHATLIN LAKE CANAL WATERSHED	OUTSIDE CHATLIN LAKE CANAL WATERSHED	TOTAL L/D 2 STUDY AREA	INSIDE CHATLIN LAKE CANAL WATERSHED	OUTSIDE CHATLIN LAKE CANAL WATERSHED	TIME TOTAL L/D 2 STUDY AREA		
Present	Without Drainage Projects Constructed	Preconstruction	1,403,700	4,054,800	5,460,500	1,568,000	4,116,900	5,684,900		
		B-3 Modified and B-1	1,385,500	3,988,900	5,374,400	1,554,800	4,041,700	5,596,500	-86,100	-88,400
	With Drainage Projects Constructed	Preconstruction	2,486,300	4,056,800	6,541,000	2,495,400	4,116,900	6,612,400		
		B-3 Modified and B-1	2,460,800	3,988,900	6,449,700	2,472,600	4,041,700	6,514,300	-91,300	-98,100
Future	Without Drainage Projects Constructed	Preconstruction	2,206,000	5,897,800	8,103,800	2,263,300	5,935,300	8,198,600		
		B-3 Modified and B-1	2,183,900	5,681,600	7,865,500	2,243,900	5,713,000	7,956,900	-238,300	-241,700
	With Drainage Projects Constructed	Preconstruction	3,466,300	5,897,800	9,382,100	3,493,000	5,935,300	9,428,300		
		B-3 Modified and B-1	3,456,200	5,681,600	9,137,800	3,465,900	5,713,000	9,178,900	-244,300	-249,400

TABLE 3
SUMMARY OF URBAN IMPACT ASSESSMENTS
ALEXANDRIA, LOUISIANA (1)

POOL 2

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Distribution Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	13,000 feet of sewer line impacted resulting in increased infiltration of 62,000 gallons/day; associated increased treatment costs approximately \$18,000 per year.	13,000 feet of sewer line impacted resulting in increased infiltration of 62,000 gallons/day; associated increased treatment costs approximately \$18,000 per year.
	Minimal change in current conditions for lift stations.	Minimal change in current conditions for lift stations.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Airport located outside of study area in Pineville.	Airport located outside of study area in Pineville.
Sanitary Landfills	City landfill located outside of Alexandria urban study area.	City landfill located outside of Alexandria urban study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 3
(Continued)

POOL 2

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	See Table 20	See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in ultimate bearing capacity. Areas of 50% groundwater rise: 25% decrease in bearing capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in ultimate bearing capacity. Areas of 50% groundwater rise: 25% decrease in bearing capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Moderate increased dewatering costs due to probable need for additional wellpoints for deep excavations.	Moderate increased dewatering costs due to probable need for additional wellpoints for deep excavations.
Sand and Gravel Sources	No impact as sand and gravel operations are not active within the city.	No impact as sand and gravel operations are not active within the city.
Groundwater Quality	Minimal changes in current conditions.	Minimal changes in current conditions.
Vegetation	Mild impact to 147 acres of mature urban trees, and 73 acres of intermediate urban trees.	Mild impact to 147 acres of mature urban trees, and 73 acres of intermediate urban trees.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 4
SUMMARY OF URBAN IMPACT ASSESSMENTS
ENGLAND AIR FORCE BASE, LOUISIANA⁽¹⁾
POOL 2

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Postconstruction ground-water levels not expected to affect runway due to in place subsurface drainage below runway and overall runway design.	Postconstruction ground-water levels not expected to affect runway due to in place subsurface drainage below runway and overall runway design.
Sanitary Landfills	Landfill not located on base.	Landfill not located on base.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	See Table 20	See Table 20

TABLE 4
(Continued)
POOL 2

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in ultimate bearing capacity. Areas of 50% groundwater rise: 25% decrease in bearing capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in ultimate bearing capacity. Areas of 50% groundwater rise: 25% decrease in bearing capacity.
Underground Structures	No impact, underground facilities currently designed for uplift.	No impact, underground facilities currently designed for uplift.
Excavation Dewatering	Moderate increased dewatering costs due to probable need for additional wellpoints for deep excavations.	Moderate increased dewatering costs due to probable need for additional wellpoints for deep excavations.
Sand and Gravel Sources	No impact, sand and gravel operations inactive within AFB.	No impact, sand and gravel operations inactive within AFB.
Groundwater Quality	Minimal to none.	Minimal to none.
Vegetation	Minimal change in current conditions.	Minimal change in current conditions

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 5
SUMMARY OF ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS(1)
LOCK AND DAM NO. 3

TIME	NAVIGATION PLAN	NET RETURNS (DOLLARS)		COSTS INDUCED BY NAVIGATION PROJECTS (DOLLARS)	
		BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES	BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES
Present	Preconstruction	7,257,800	7,272,400	--	--
	B-3 Modified	7,170,200	7,184,900	- 87,600	- 87,500
	B-1	7,148,200	7,165,200	-109,600	-107,200
Future	Preconstruction	9,706,600	9,710,100	--	--
	B-3 Modified	9,591,800	9,591,800	-114,800	-118,300
	B-1	9,565,400	9,568,500	-141,200	-141,600

(1) Complete net return data based on preconstruction land use (i.e. without economic land use changes) is presented in Appendix C.

TABLE 6
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
BOYCE, LOUISIANA
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway not located within study area.	Runway not located within study area.
Sanitary Landfills	Landfills not located within study area.	Landfills not located within study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 6
(Continued)
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Minimal change in current conditions.	Minimal change in current conditions.

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 7
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
COLFAX, LOUISIANA
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Minimal change in current conditions.	Minimal change in current conditions.
Sanitary Landfills	Landfills not located within study area.	Landfills not located within study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 7
(Continued)
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within urban study area.	Active sources not within urban study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Minimal change in current conditions.	Minimal change in current conditions.

(1)Based on SUPERMOCK groundwater predictions for the area.

TABLE 8
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
NATCHITOCHES, LOUISIANA
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway located outside of study area.	Runway located outside of study area.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 8
(Continued)
POOL 3

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within urban study area.	Active sources not within urban study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Minimal change in current conditions.	Minimal change in current conditions.

(1)Based on SUPERMOCK groundwater predictions for the area.

TABLE 9
SUMMARY OF ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS⁽¹⁾
LOCK AND DAM NO. 4

TIME	NAVIGATION PLAN	NET RETURNS (DOLLARS)		COSTS INDUCED BY NAVIGATION PROJECTS (DOLLARS)	
		BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES	BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES
Present	Preconstruction	5,273,800	5,340,500	--	--
	B-3 Modified	5,023,500	5,091,500	-250,300	-249,000
	B-1	5,118,400	5,195,800	-155,400	-144,700
Future	Preconstruction	7,255,100	7,312,700	--	--
	B-3 Modified	6,940,200	6,998,400	-314,900	-314,300
	B-1	7,062,400	7,128,100	-192,700	-184,600

(1) Complete net return data based on preconstruction land use (i.e. without economic land use changes) is presented in Appendix C.

TABLE 10
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
CAMPTI, LOUISIANA
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	8,870 feet of sewer line impacted resulting in increased infiltration of 15,720 gallons/day and associated increased treatment costs of \$1,100/year.	6,450 feet of sewer line impacted resulting in increased infiltration of 9,100 gallons/day and associated increased treatment cost of \$650/year.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway not located within study area.	Runway not located within study area.
Sanitary Landfills	Landfills not located within study area.	Landfills not located within study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 10
(Continued)
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Mild impact to 78 acres of mixed vegetation types. Moderate impact to 18 acres of mixed pine hardwoods.	Mild impact to 23 acres of mixed pine hardwoods.

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 11
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
CLARENCE, LOUISIANA
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway not located within study area.	Runway not located within study area.
Sanitary Landfills	Landfills not located within study area.	Landfills not located within study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 11
(Continued)
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within urban study area.	Active sources not within urban study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Minimal change in current conditions.	Minimal change in current conditions.

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 12
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
COUSHATTA, LOUISIANA
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Soils	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	11,800 feet of sewer line impacted resulting in increased infiltration of 11,600 gallons/day and associated increased treatment costs of \$825/year.	15,940 feet of sewer line impacted resulting in increased infiltration of 15,700 gallons/day and associated increased treatment costs of \$1,100/year.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway located outside of study area.	Runway located outside of study area.
Sanitary Landfills	Landfills not located within study area.	Landfills not located within study area.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.
Deep Foundations, i.e., piles, drilled shafts, and precast concrete shafts	Minimal change in current conditions.	Minimal change in current conditions.
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in bearing capacity. In areas of 50% groundwater rise: 25% decrease in capacity.

TABLE 12
(Continued)
POOL 4

URBAN CHARACTERISTICS	IMPACT MAGNITUDE/COSTS	
	PLAN B-3M	PLAN B-1
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Moderate change in current conditions.	Moderate change in current conditions.
Sand and Gravel Sources	Active sources not within urban study area.	Active sources not within urban study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Mild impact to 21 acres of mature pines and hardwoods; Moderate impact to 18 acres of mature pines and hardwoods.	Mild impact to 12 acres of mature pines and hardwoods.

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 13

SUMMARY OF ANNUAL NET RETURNS AND COSTS
INDUCED BY NAVIGATION PROJECTS⁽¹⁾
LOCK AND DAM NO. 5

TIME	DRAINAGE PROJECT STATUS	NAVIGATION PLAN	NET RETURNS (DOLLARS)					COSTS INDUCED BY NAVIGATION PROJECTS (DOLLARS)		
			BASED ON PRECONSTRUCTION LAND USE		BASED ON ECONOMIC LAND USE CHANGES			BASED ON PRECONSTRUCTION LAND USE	BASED ON ECONOMIC LAND USE CHANGES	
			INSIDE CYPRESS-BLACK WATERSHED	OUTSIDE CYPRESS-BLACK WATERSHED	TOTAL L/D 5 STUDY AREA	INSIDE CYPRESS-BLACK WATERSHED	OUTSIDE CYPRESS-BLACK WATERSHED	TOTAL L/D 5 STUDY AREA		
Present	Without Drainage Projects Constructed	Preconstruction	274,700	5,437,700	5,732,500	300,500	5,437,700	5,738,200		
		B-3 Modified								
		135 Ft. Pool El.	277,900	5,398,700	5,676,600	301,700	5,398,700	5,700,400	-55,900	-57,900
		137 Ft. Pool El.	277,900	5,381,500	5,659,400	301,700	5,381,500	5,683,200	-73,100	-75,100
Future	With Drainage Projects Constructed	165 Ft. Pool El.	225,700	5,275,700	5,551,500	301,500	5,277,400	5,578,900	-181,000	-179,400
		B-1								
		135 Ft. Pool El.	275,800	5,402,400	5,678,200	301,700	5,402,400	5,704,000	-54,300	-54,300
		137 Ft. Pool El.	275,800	5,400,500	5,676,400	301,700	5,400,500	5,702,200	-56,100	-56,100
Future	Without Drainage Projects Constructed	165 Ft. Pool El.	275,700	5,331,100	5,606,900	301,600	5,332,800	5,634,400	-135,600	-123,900
		Preconstruction	374,500	5,437,700	5,832,300	376,600	5,437,700	5,834,300		
		B-3 Modified								
		135 Ft. Pool El.	378,200	5,398,700	5,776,900	378,200	5,398,700	5,776,900	-55,400	-37,400
Future	With Drainage Projects Constructed	137 Ft. Pool El.	378,200	5,381,500	5,759,700	378,200	5,381,500	5,759,700	-72,600	-74,600
		165 Ft. Pool El.	375,700	5,275,700	5,651,500	377,700	5,277,400	5,655,100	-180,800	-179,200
		B-1								
		135 Ft. Pool El.	375,900	5,402,400	5,778,300	377,900	5,402,400	5,780,300	-54,000	-54,000
Future	Without Drainage Projects Constructed	137 Ft. Pool El.	375,900	5,400,500	5,776,500	377,900	5,400,500	5,778,500	-55,800	-55,800
		165 Ft. Pool El.	375,800	5,331,100	5,706,900	377,800	5,332,800	5,710,600	-125,400	-123,700
		Preconstruction	443,400	7,706,000	8,149,400	444,500	7,706,000	8,150,500		
		B-3 Modified								
Future	With Drainage Projects Constructed	135 Ft. Pool El.	447,200	7,628,900	8,076,100	467,200	7,628,900	8,076,100	-73,300	-74,400
		137 Ft. Pool El.	447,200	7,608,000	8,055,200	467,200	7,608,000	8,055,200	-94,200	-95,300
		165 Ft. Pool El.	444,600	7,473,100	7,917,700	445,600	7,473,100	7,918,700	-231,700	-231,800
		B-1								
Future	Without Drainage Projects Constructed	135 Ft. Pool El.	444,700	7,632,000	8,076,700	445,800	7,632,000	8,077,800	-72,700	-72,700
		137 Ft. Pool El.	444,700	7,631,400	8,076,100	445,800	7,632,000	8,077,200	-73,300	-73,300
		165 Ft. Pool El.	444,600	7,539,300	7,984,000	445,700	7,539,300	7,985,000	-165,400	-165,500
		Preconstruction	559,800	7,706,000	8,265,800	559,800	7,706,000	8,265,800		
Future	With Drainage Projects Constructed	B-3 Modified								
		135 Ft. Pool El.	564,100	7,628,900	8,193,000	564,100	7,628,900	8,193,000	-72,800	-72,800
		137 Ft. Pool El.	564,100	7,608,000	8,172,100	564,100	7,608,000	8,172,100	-93,700	-93,700
		165 Ft. Pool El.	561,100	7,473,100	8,034,200	561,100	7,473,100	8,034,200	-231,600	-231,600
Future	Without Drainage Projects Constructed	B-1								
		135 Ft. Pool El.	561,400	7,632,000	8,193,300	561,400	7,632,000	8,193,300	-72,500	-72,500
		137 Ft. Pool El.	561,400	7,631,400	8,192,800	561,400	7,631,400	8,192,800	-73,000	-73,000
		165 Ft. Pool El.	561,200	7,539,300	8,100,500	561,200	7,539,300	8,100,500	-165,300	-165,300

(1) Complete net return data based on preconstruction land use (i.e., without economic land use changes) is presented in Appendix C.

TABLE 14
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-1
BARKSDALE AIR FORCE BASE, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 14
(Cont inued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20 .	Minimal change in current conditions. See Table 20 .	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Mild impact to 15 acres of mature native hardwoods.	Mild impact to 15 acres of mature native hardwoods.	Mild impact to 45 acres of mature native hardwoods.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 15
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-3M
BARKSDALE AIR FORCE BASE, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 15
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Mild impact to 15 acres of mature native hardwoods.	Mild impact to 15 acres of mature native hardwoods.	Mild impact to 45 acres of mature native hardwoods.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 16
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-1
BOSSIER CITY, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway not located within study area.	Runway not located within study area.	Runway not located within study area.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 16
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Intermediate Urban Trees: Mild impact to 35 acres; moderate impact to 10 acres.	Intermediate Urban Trees: Mild impact to 35 acres; moderate impact to 10 acres.	Intermediate Urban Trees: Mild impact to 55 acres; moderate impact to 10 acres; severe impact to 10 acres.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 17
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-3M
BOSSIER CITY, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Runway not located within study area.	Runway not located within study area.	Runway not located within study area.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 17
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Vegetation	Intermediate Urban Trees: Mild impact to 35 acres; moderate impact to 10 acres.	Intermediate Urban Trees: Mild impact to 35 acres; moderate impact to 10 acres.	Intermediate Urban Trees: Mild impact to 55 acres; moderate impact to 10 acres; severe impact to 10 acres.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 18
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-1
SHREVEPORT, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 18
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 18
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Vegetation	Impacts to intermediate urban trees: mild impact to 265 acres; severe impact to 20 acres.	Impacts to intermediate urban trees: mild impact to 265 acres; severe impact to 20 acres.	Impacts to intermediate urban trees: mild impact to 350 acres; moderate impact to 145 acres; severe impact to 40 acres. Mild impact to 22 acres of mature urban trees.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 19
SUMMARY OF URBAN IMPACT ASSESSMENTS(1)
PLAN B-3M
SHREVEPORT, LOUISIANA
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Soils	Minimal change in soil properties.	Minimal change in soil properties.	Minimal change in soil properties.
Water Supply Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sewerage Systems	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Storm Drainage	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Roads and Streets	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Airport Runways	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sanitary Landfills	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Cemeteries	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Gas Distribution System	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 19
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Deep Foundations, i.e., piles, or concrete shafts	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20	Minimal change in current conditions. See Table 20
Shallow Foundations such as concrete mats and footings	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.	Minimal change in current conditions. In areas of 30% groundwater rise: 15% decrease in capacity. In areas of 50% groundwater rise: 25% decrease in capacity.
Underground Structures	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Excavation Dewatering	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.
Sand and Gravel Sources	Active sources not within study area.	Active sources not within study area.	Active sources not within study area.
Groundwater Quality	Minimal change in current conditions.	Minimal change in current conditions.	Minimal change in current conditions.

TABLE 19
(Continued)
POOL 5

URBAN CHARACTERISTICS	POOL ELEVATIONS		
	135 FEET MSL	137 FEET MSL	145 FEET MSL
Vegetation	Impacts to intermediate urban trees: mild impact to 265 acres; severe impact to 10 acres.	Impacts to intermediate urban trees: mild impact to 265 acres; severe impact to 20 acres.	Impacts to intermediate urban trees: mild impact to 350 acres; moderate impact to 145 acres; severe impact to 40 acres. Mild impact to 22 acres of mature urban trees.

NOTE:

(1) Based on SUPERMOCK groundwater predictions for the area.

TABLE 20
PERCENT DECREASE IN CAPACITY
OF DEEP FOUNDATIONS ASSOCIATED
WITH INCREASED GROUNDWATER LEVELS⁽¹⁾

FOUNDATION DEPTH (feet)	GROUNDWATER INCREASE (percent)		
	30	50	100
10	5 - 15	10 - 25	35 - 50
20	5 - 10	5 - 15	20 - 25
30	2 - 7	4 - 7	10 - 15
40	2 - 5	3 - 5	7 - 10
50	1 - 3	2 - 4	5 - 7
70	0 - 3	1 - 3	0 - 5

(1) Average groundwater table depths of 10 to 12 feet were employed in the analyses.

RED RIVER WATERWAY
LOUISIANA, TEXAS, ARKANSAS, AND OKLAHOMA

MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA
GENERAL REEVALUATION REPORT
AND EIS SUPPLEMENT NO. 2

APPENDIX N
DESIGN CHANGE FOR THE ELEVATION OF POOL NO. 2
FINDING OF NO SIGNIFICANT IMPACT AND ENVIRONMENTAL ASSESSMENT

DESIGN CHANGE IN THE ELEVATION OF POOL NO. 2
RED RIVER WATERWAY PROJECT,
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA, REACH

FINDING OF NO SIGNIFICANT IMPACT
(FONSI)

The US Army Corps of Engineers, New Orleans District, is constructing the Red River Waterway Project, a navigational project authorized in 1968 in accordance with Public Law 90-483. The Mississippi River to Shreveport reach of the project is located in the State of Louisiana and consists of five locks and dams and a navigational channel 200 feet wide by 9 feet deep and 236 miles in length. Lock and Dam No. 1 and associated channel alignment work are under construction.

Previous general design studies for Lock and Dam No. 2 considered several pool level alternatives ranging between 58 and 65 feet. The 58-foot pool level elevation was the design addressed in the Final Environmental Impact Statement, Supplement No. 1, filed with CEQ on 18 February 1977. Recent studies have indicated that a 64-foot elevation for Pool No. 2 would be desirable from engineering and environmental standpoints due to almost complete elimination of maintenance dredging and the costs and environmental impacts associated herewith.

An Environmental Assessment was prepared to evaluate the incremental environmental impacts associated with the increase in pool elevation from 58 feet to 64 feet for Pool No. 2. Results of the assessment revealed no difference in the acreage of terrestrial and aquatic habitat and agricultural lands that would be impacted by construction, induced woodland clearing, dredge-material disposal for new work, freeboard, bank stabilization, and recreational development. No significant differences would occur between the 58-foot and 64-foot pool elevations regarding water quality or related fisheries resources. Some increase in flow lines of various tributaries would result; but with either pool elevation, the effects of these increases would not be significant. Five drainage structures and one sewer outfall will be affected to a greater extent by the increased submergence caused by the 64-foot pool in that monitoring and access for maintenance will be more difficult. However, the operation of these facilities and the remaining drainage structures and sewer outfalls will not be adversely affected by either pool elevation. The 64-foot elevation for Pool No. 2 would theoretically eliminate the need for maintenance dredging. The 58-foot pool design would require approximately 85,000 cubic yards of maintenance dredging per annum and an estimated 291,000 cubic yards every 5 years with associated water quality and ecological impacts. The 58-foot pool would require contraction structures situated along the upper 8 miles of the navigational channel in order to maintain navigable depths. The 64-foot pool would require approximately 2 miles of these structures. Construction of either alternative would impact 21 known archeological sites. Either alternative would produce long-term benefits to cultural resources due to bank stabilization.

The 64-foot pool design would cause decreased agricultural yields on 7,240 acres as a result of increased groundwater levels. The 58-foot pool would result in 4,120 acres of agricultural lands experiencing decreased yields. The net effect on 3,120 acres of agricultural yields with the 64-foot pool results in \$20,000 additional loss in production annually. Vegetation (trees) on approximately 56 additional acres of urban lands could be affected by the 64-foot pool. Increased incremental sewage treatment cost for the City of Alexandria with the 64-foot pool elevation would be about \$7,000 annually. Environmental impacts associated with hydropower generation would be the same with either the 64-foot pool or the 58-foot pool. Potential power generation would be substantially greater with the 64-foot pool design. The 64-foot pool would require nine additional daily bridge openings of the Murray Street Bridge in Alexandria after 50 years of project operation. This increase is not viewed as significant because impacted highway traffic could use the proposed high level Fulton Street Bridge. Three additional daily bridge openings for the Kansas City Southern Bridge (Louisiana and Arkansas) and four additional daily bridge openings for the Missouri Pacific Bridge would be required after 50 years of project operation with the 64-foot pool.

Based on the evaluation of impacts on the environment presented in the Environmental Assessment, it is my determination that no significant impacts on the human environment would result from the increase in design pool elevation from 58 feet to 64 feet and that no environmental impact statement is required for this action.

Date

21 Apr 82

ROBERT C. LEE

Colonel, CE

District Engineer

ENVIRONMENTAL ASSESSMENT FOR A DESIGN CHANGE IN
THE ELEVATION OF POOL NO. 2, RED RIVER WATERWAY,
MISSISSIPPI RIVER TO SHREVEPORT, LOUISIANA REACH

I. Need for Proposed Action.

1. Study Authority and Purpose. Lock and Dam No. 2 is a feature of the navigation project authorized for construction by Public Law 90-483, 90th Congress, approved 13 August 1968. The New Orleans District has investigated alternative general designs for the lock and dam and has tentatively selected a design based upon a normal upstream pool at elevation 64 feet. This pool elevation is 6 feet higher than a previously approved pool elevation of 58 feet, for which environmental impacts are addressed in Final Supplement No. 1 to the Final EIS filed with CEQ on 18 February 1977. The purpose of this environmental assessment is to determine whether the proposed change in pool elevation will result in significant effects on the human environment that have not been addressed in the existing EIS.

2. Public Concerns. Environmental impacts related to project induced changes in groundwater levels have been a major point of concern throughout preconstruction planning studies for Lock and Dam No. 2. This point of concern was a key factor in approving pool elevation 58 for previous design studies, and it has been further considered in the tentative selection of the design based on pool elevation 64. Public concerns about the proposed changes in pool elevation related to surface drainage and highway traffic in the Alexandria, Louisiana, area have been investigated and considered.

II. Alternatives. Previous general design studies of Lock and Dam No. 2 have included consideration of alternative pool levels ranging from elevation 58 to 65 feet. Elevations 58 and 64 were selected for further detailed study in this assessment. Elevation 58 will meet all navigation needs upstream of Lock and Dam No. 2, but will require considerable maintenance dredging in the upper reach of the pool. This potential dredging is costly, it interferes with navigation traffic, and it adversely affects water quality. Elevation 64 will meet navigation needs without maintenance dredging. Accordingly, the 64-foot pool is the tentatively selected plan, not only because of its better performance in meeting navigation needs, but also because of its potential for a greater net positive contribution to the objective of National Economic Development. Working estimates of project costs and benefits strongly suggest that the first cost of the overall project using elevation 64 would be less than using elevation 58 and that there would be no quantifiable difference in the project benefits.

III. Impacts of the Proposed Action.

1. Terrestrial Habitat. Both alternatives would have the same impacts on terrestrial habitats and land use categories regarding direct construction acreage losses, project induced woodland clearing, acreages required for dredged material disposal, freeboard, and recreation development. A slightly larger amount of lands would be

inundated by the higher pool elevation, but these are too small to be readily quantified from available contour maps; the pool would remain within channel top banks with either alternative. Table 1 contains the acreages of habitat and land use types that will be affected by construction of Lock and Dam No. 2 and filling of the pool.

2. Aquatic Habitat and Fisheries. The same quantity (about 50 river miles) of natural riverine habitat would be converted to severed bendways (oxbow lakes) and navigation pool with either alternative pool elevation. The exact acreage would depend on the future siting of Lock and Dam No. 3. Since the type and magnitude of changes in the aquatic ecosystem and component habitats would be the same with either the 58-foot pool or the 64-foot pool, impacts of both alternatives would be essentially the same on sport, commercial, and forage fish populations and benthic and plankton communities in Pool No. 2. Both pools would result in an increase in fish production due to creation of oxbow lakes, increased littoral habitat, and the more lentic characteristics of the navigation pools. The higher 64-foot pool would probably have a slightly larger benefit to fisheries because of increased water depth and volume, but the small effect is not quantifiable. Most of the pool remains within top banks for both the 58-foot and 64-foot pool elevations. Towboat traffic volume and environmental effects would be the same with either alternative.

3. Water Quality. Because of the physical and hydrologic similarity of the two alternatives, no difference in effects on water quality between the 58-foot pool elevation and the 64-foot pool elevation designs is expected, except for maintenance dredging (para. 5). Towboat traffic effects on water quality would be the same with either alternative.

4. Tributaries and Outfalls.

a. Seven tributaries, seven drainage structures, and seven sewage outfalls are located in the Pool No. 2 project area, and these have been studied in detail. Increases in tributary stages and flow lines would occur with either alternative. These increases would be higher for the 64-foot pool than the 58-foot pool. However, flood flows would be contained within banks for either pool elevation design. Consequently, impacts on aquatic biota and water quality, would be approximately the same for both alternatives. The function of the drainage structures and sewage outfalls would not be adversely affected with either pool elevation.

b. The Bayou Rapides drainage structure carries the flow of Bayou Rapides to the Red River. As a result of concerns expressed by interests in the Alexandria, Louisiana, area, an investigation as to the effect of pool elevations 64 and 58 on this structure was conducted and has concluded that the operation of the pumps would not be increased because pump operation does not start until the river stage

risers to elevation 70 feet. We see no need at this time of modifying the existing pumps or constructing new pumps to accommodate pool elevation 64 or 58. Also, gravity drainage of Bayou Rapides flows through this structure to the river would not be significantly affected with either pool elevation.

5. Maintenance Dredging.

a. A 58-foot elevation in Pool No. 2 would result in a need to conduct periodic dredging in the upstream end of Pool 2 to maintain the authorized 9-foot project depth. Contraction structures are required for approximately 8 miles in the upstream end of Pool No. 2 to minimize maintenance dredging. Average annual maintenance dredging volumes for the 58-foot pool would be 85,000 cubic yards from dredging 13,000 linear feet of channel bottom. The pool stage in the extreme upstream end of Pool 2 will fall to elevation 58 feet about once every 5 years, on the average. When the pool stage recedes to elevation 58 feet, it is estimated that 291,000 cubic yards of maintenance dredging over a channel length of 24,000 feet would be required. Up to 200 acres of permanent easements will be required for dredged material disposal. Maintenance dredging would result in temporary increases in turbidity, decreased dissolved oxygen concentrations, potential resuspension and release of metals and chlorinated hydrocarbons, and other water quality effects. Benthic organisms would be severely effected at the dredging sites and fish populations would be displaced during the operation.

b. A 64-foot elevation in Pool No. 2 would not require any maintenance dredging to achieve project navigation depth. Approximately 6 less miles of contraction structures would be constructed when compared to the requirements for the 58-foot pool. Therefore, environmental impacts associated with maintenance dredging would not occur with this alternative.

6. Groundwater.

a. The formation of Pool No. 2 will result in significant increases in groundwater levels during low river flows and an associated redistribution of groundwater flow patterns. Changes in groundwater levels at or near the river will correlate with river stage fluctuations. Groundwater effects will decrease away from the river with alterations being negligible 8 to 10 miles from the channel.

b. Results of an original groundwater study were presented in the Final EIS, Supplement No. 1 filed with CEQ on 18 February 1977. For Pool No. 2 this study indicated that 14,120 acres of agricultural lands would have increased yields and 30,360 acres would have experienced some decrease in yields as a result of groundwater elevation changes induced by the project. For various technical reasons, a second and more detailed groundwater study was conducted (a copy of which is available in the New Orleans District library). The second study used

better computational techniques, a longer record of groundwater data, and more advanced nonsteady state analyses than the original study. Results of the second study showed that acreages affected by groundwater level changes would be an order of magnitude less than the original study results revealed. The following discussion is based on the outcome of the second more refined groundwater investigation.

c. The 64-foot pool will decrease yields on 7,240 acres of agricultural lands and increase yields on 1,160 acres of primarily forest lands. The estimated decrease in agricultural production would amount to an economic loss of \$86,000 annually (Table 2). Increased infiltration into the Alexandria sewerage system would amount to 62,000 gallons per day with associated increased treatment costs of \$18,000 annually. Mild impacts to 147 acres of mature urban trees and 73 acres of intermediate urban trees may occur. Mild impacts are defined as groundwater levels that could potentially slow growth, reduce rooting depth or otherwise weaken some of the trees, but death due to drowning should not result. Mature urban trees are large, old trees that provide complete shade. Intermediate urban trees are intermediate to small trees, of mixed age composition that provide partial shade. Deep excavations of more than 8 feet in the Alexandria and England AFB areas may incur increased dewatering costs.

d. The 58-foot pool will cause an estimated 4,120 acres of primarily agricultural lands to experience decreased yields and 1,280 acres of primarily woodlands to experience increased yields. The estimated decrease in crop yields would amount to \$66,000 annually. Increased infiltration into the Alexandria sewerage system would amount to 36,000 gallons per day with associated increased treatment costs of \$11,000 annually. Mild impacts to 110 acres of mature urban trees and 54 acres of intermediate urban trees may occur. Deep excavations of more than 8 feet in urban areas may incur increased dewatering costs.

e. The net increase in groundwater impacts on agricultural production with the 64-foot pool as opposed to the 58-foot pool would be decreased yields on an additional 3,120 acres of cropland and increased yields on 120 acres less of agricultural lands. The net incremental economic loss associated with the 64-foot pool alternative would be \$20,000 annually (Table 2). The additional 3,120 acres that would experience decreased agricultural yields with the 64-foot pool represents only 2 percent of the lands within the Pool No. 2 reach. Also, this acreage would be scattered along both river banks over the approximate 50 river miles encompassed by Pool No. 2. This represents on the average about 60 acres per river mile of additional agricultural lands that would be adversely affected by increased groundwater levels with the 64-foot pool as compared to the 58-foot pool alternative. Increased incremental

treatment cost for the City of Alexandria with the 64-foot pool elevation would be \$7,000 annually. Approximately 56 additional acres of urban vegetation would be affected with the higher pool elevation alternative.

7. Cultural Resources.

a. The most destructive agent affecting cultural resources and their discovery in the Red River Valley has been the river itself. Aggradation of point bars, removal of earlier deposits by meandering, changes in channel course, reoccupation of portions of old channels, log rafting, and the associated creation of extensive lakes and alternate drainage patterns in the mid-19th century have contributed to alternate burial and scouring of hundreds of floodplain sites.

b. Despite the direct, construction related impact of the proposed project to individual sites, there are long-term benefits to cultural resources from artificial maintenance of the river's present channel and prevention of future bank cutting and meandering. The low maintenance channel design should minimize future impacts to wrecks and other magnetic anomalies from maintenance dredging. Construction of either pool elevation would disturb 21 known archeological sites and 46 terrestrial anomalies by revetment construction, channel realignment, and dredged material disposal.

c. Three sites on the National Register of Historic Places are present in the area that would be affected by the construction of Pool No. 2: Fort Randolph, Fort Buhlow, and Bailey's Dam. The former two places would be included in project recreation areas while Bailey's Dam would be damaged by revetment construction. Tentative plans include development of a small museum featuring a portion of the dam. Impacts on these three places would be the same for either alternative.

8. Hydropower. Hydropower at Lock and Dam No. 2 is not an authorized project purpose, but the authorizing act directed that hydropower potential be investigated during design phases. Estimates by the Federal Energy Regulatory Commission (FERC) indicate that hydropower would be economically justified at Lock and Dam No. 2. The 64-foot pool design would result in the generation of significantly more power than the 58-foot pool design (Table 3). Environmental impacts of hydropower generation would be similar for the two pool elevation design alternatives since water volumes passed through the hydropower plant would be the same. The Corps and the FERC have recommended that minimum provisions for future hydropower be incorporated into the construction of Lock and Dam No. 2. These minimum provisions can be approved by the Secretary of the Army under the River and Harbor Act of 1945. These minimum provisions consist of modifications

of the dam structure that would neither add to nor take from the environmental impacts of the dam structure. The minimum provisions do not make necessary the future construction of a hydropower plant, but would make such construction feasible.

9. Relocation of Facilities.

a. Highway Bridges.

(1) Three highway bridges cross the Lock and Dam No. 2 pool area in the vicinity of Alexandria/Pineville, and one additional highway bridge crosses at Boyce (LA Highway 8). The Boyce bridge, which is being reconstructed, and the Alexandria highway bridge (US HWY 71) are fixed span structures and will have the necessary vertical and horizontal clearances for navigation. The LA HWY 165 (Murray Street bridge) bridge at Alexandria is a swing span structure which is structurally deficient and which the LA Department of Transportation and Development (LADOTD) is planning to replace with a new lift span bridge. The other highway bridge at Alexandria is the LA HWY 3026 (Fulton Street bridge), a 4-lane lift span bridge which the LADOTD is planning to replace with either one high rise 6-lane bridge, or two parallel 3-lane bridges if the navigation project is constructed.

(2) The New Orleans District studies indicate that opening of the Murray Street bridge will be required approximately 6 times daily after 50 years of project operation for a 58-foot pool. The number of bridge openings is estimated to increase to 15 times daily with a 64-foot pool. However, this increase is not viewed as significant because the proposed new bridge at Fulton Street will provide a convenient alternate route for highway traffic when the Murray Street bridge is in an open position.

b. Railroad Bridges. Two railroad bridges cross Pool No. 2 in the vicinity of Alexandria/Pineville. The bridges are owned by the Missouri Pacific Railroad Company and the Kansas City Southern Railway Company (Louisiana and Arkansas). This district is designing new lift spans for each railroad bridge which will replace the existing swing spans. New Orleans District studies indicate that for the 64-foot pool, 23 daily bridge openings will be required for each bridge after 50 years of project operation. For a 58-foot pool, the Kansas City Southern bridge would require 20 daily bridge openings after 50 years of project operation and the Missouri Pacific bridge would require 19 daily bridge openings.

c. Utilities. The project may affect 4 pipelines and one communications line to some extent but their function will be unaffected. The impact on these facilities is the same regardless of the pool elevation selected.

10. Real Estate, P.L. 91-646 Requirements. The impacts on three residences in Pool No. 2 will be the same regardless of pool elevation selected. The residents will be relocated under the terms of P.L. 91-646.

IV. Compliance With Applicable Environmental Statutes.

The status of compliance with applicable environmental statutes is shown in Table 4.

V. Agencies, Interested Groups, and Public Consulted.

US Fish and Wildlife Service - Lafayette Field Office

Federal Energy Regulatory Commission

Louisiana Department of Transportation and Development

Concerned Citizens of CENLA

Mayor of Alexandria

Alexandria City Council

Mr. Beverly Eversull

Red River Valley Association

TABLE 1

PROJECT FEATURE

TABLE 2
SUMMARY OF GROUNDWATER IMPACTS
POOL NO. 2, RED RIVER WATERWAY

<u>Pool Elevation</u>	<u>Total Areas (Acres)</u>	<u>Areas with no Change (Acres)</u>	<u>Areas with Decrease (Acres)</u>	<u>Areas with Increase (Acres)</u>	<u>Total Value of of Crops</u>	<u>Annual Decrease in Value of Crops</u>
64	153,240	144,840	7,240	1,160	\$5,460,000	\$86,000
58	<u>153,240</u>	<u>147,840</u>	<u>4,120</u>	<u>1,280</u>	<u>\$5,460,000</u>	<u>\$66,200</u>
Net change due to 64-ft. Pool	0	-3,000	+3,120	-120	0	+20,000

TABLE 3
RED RIVER WATERWAY STUDY FOR HYDROPOWER
POOL 2

Date of Original FERC Report	L&D No.	Pool Elev. (ft.)	Plant Factor	Installed Capacity (kW)	Dependable Capacity (kW)	Average Annual Energy (MWh)	Energy Value mills/kWh	Average Annual Benefits \$1,000	Average Annual Charges \$1,000	B/C Ratio	Excess Benefits \$1,000
5/80	2	64	45	36,900	30,000	147,775	32.5	6,934.1	3,648.8	1.90	3,285.3*
	2	64	45	30,000	24,500	123,452	32.5	5,752.9	2,966.5	1.94	2,785.4
	2	64	47	27,500	21,000	117,682	32.1	5,269.6	2,719.3	1.94	2,550.3
	2	64	48	24,800	16,000	104,403	31.8	4,456.8	2,452.3	1.82	2,004.5
2/81	2	58	31	23,265	7,000	63,151	36.1	2,777.1	2,300.5	1.21	476.6
	2	58	42	17,000	7,000	63,151	33.3	2,600.3	1,681.0	1.55	919.3
	2	58	48	15,000	7,000	63,022	31.8	2,501.4	1,483.2	1.69	1,018.2
	2	58	52	13,000	7,000	59,451	31.0	2,340.3	1,285.5	1.82	1,054.8*

Assumptions:

Unit Cost \$1,600/kW
Capacity Value \$71.05/kW
Unit O&M Cost \$6.45/kW
Construction period 3 years at 3 1/4%

*-Maximum Excess Benefits for
the listed alternatives

¹ Price Level - October 1981

TABLE 4
STATUS OF COMPLIANCE WITH APPLICABLE ENVIRONMENTAL STATUTES
(Same for either alternative)

REQUIREMENTS	STATUS
<u>FEDERAL POLICIES</u>	
Archeological and Historical Preservation Act	<u>PARTIAL</u> Compliance ¹
Clean Air Act	<u>FULL</u> Compliance
Clean Water Act	<u>PARTIAL</u> Compliance ²
Endangered Species Act	<u>FULL</u> Compliance
Federal Water Project Recreation Act	<u>FULL</u> Compliance
Fish and Wildlife Coordination Act	<u>FULL</u> Compliance
Floodplain Management (E.O. 11988)	<u>FULL</u> Compliance
Land and Water Conservation Fund Act	<u>FULL</u> Compliance
National Environmental Policy Act	<u>FULL</u> Compliance
National Historic Preservation Act	<u>PARTIAL</u> Compliance ³
Prime and Unique Farmlands	<u>FULL</u> Compliance
Protection and Enhancement of Cultural Environment (E.O. 11593)	<u>PARTIAL</u> Compliance ⁴
Protection of Wetlands (E.O. 11990)	<u>FULL</u> Compliance
Rivers and Harbors Appropriation Act	<u>FULL</u> Compliance
Water Resources Planning Act	<u>FULL</u> Compliance
Watershed Protection and Flood Prevention Act	<u>FULL</u> Compliance
<u>STATE POLICIES</u>	
Air Control	<u>FULL</u> Compliance
Louisiana Scenic Streams Act	<u>FULL</u> Compliance
Water Control Act	<u>NONCOMPLIANCE</u> ⁵
<u>LAND USE PLANS</u>	
The Land Use Element of the Area-Wide Comprehensive Plan	All alternatives in <u>FULL</u> Compliance

¹Will be in full compliance when inventory surveys are completed, sites tested, eligibility to the National Register of Historic Places assessed, and negative impacts mitigated.

²The provisions of Section 404 of the Clean Water Act were complied with according to the EPA 1975 guidelines. New guidelines, applying to all Section 404 activities after 1 Oct 81 would be complied with prior to advertisement of the work.

³Full compliance will not be complete until the Advisory Council on Historic Preservation has an opportunity to comment on project impact to the National Register of Historic Places properties.

⁴Same as 1 above.

⁵Dissolved oxygen levels in the navigation pools would fall below State of Louisiana stream standards during low water periods.