The Great Trinity Forest Management Plan

Volume 29

Related Planning Documents

Related Planning Documents

Planning documents related to the Great Trinity Forest and the Trinity River

Volume 29

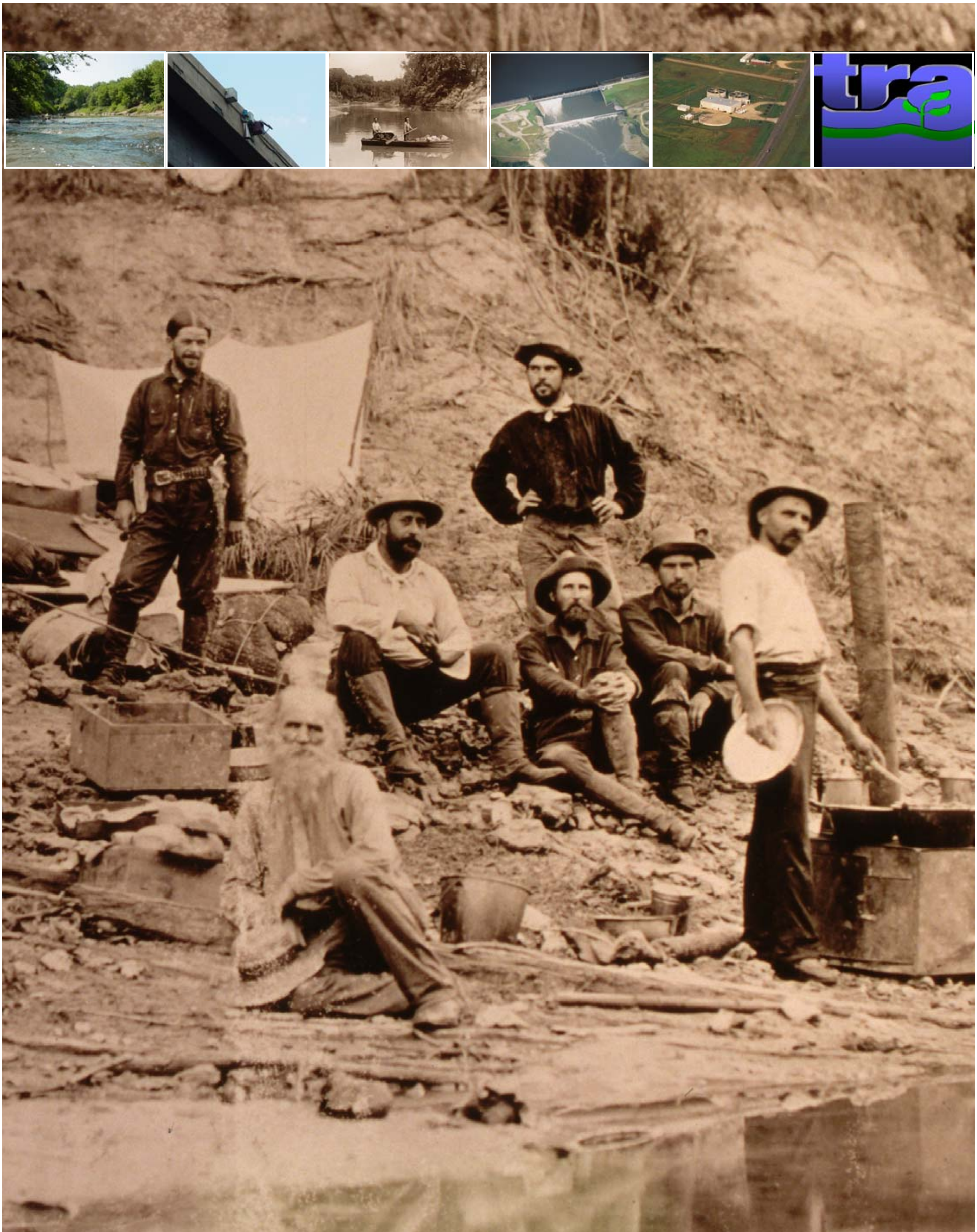
Table of Contents

Volume 29

Trinity River Basin Master Plan

Trinity River Authority of Texas
2007



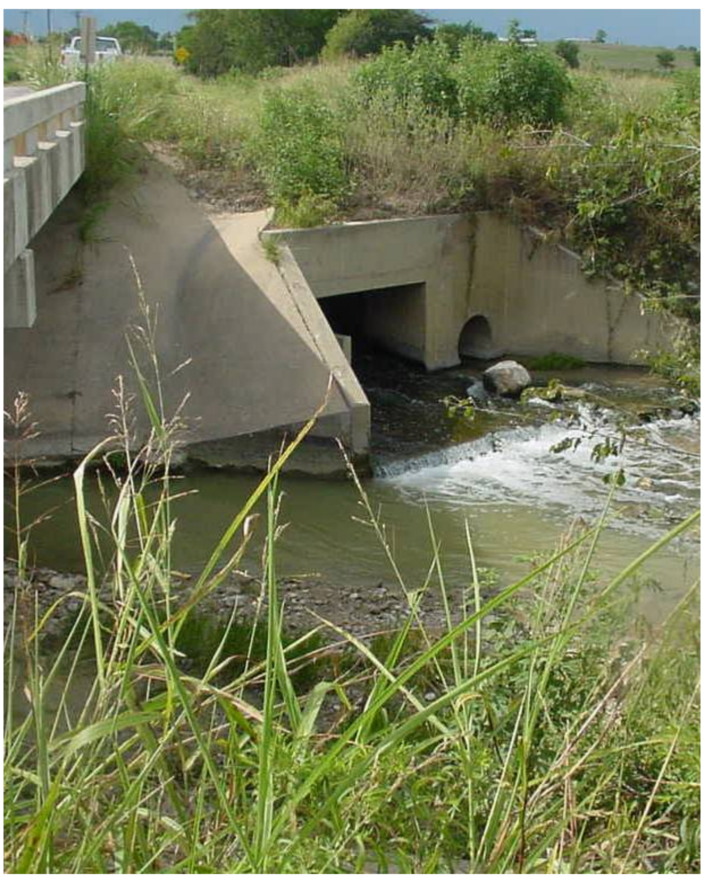
Trinity River Survey Crew, Corps of Engineers 1899

Table of Contents

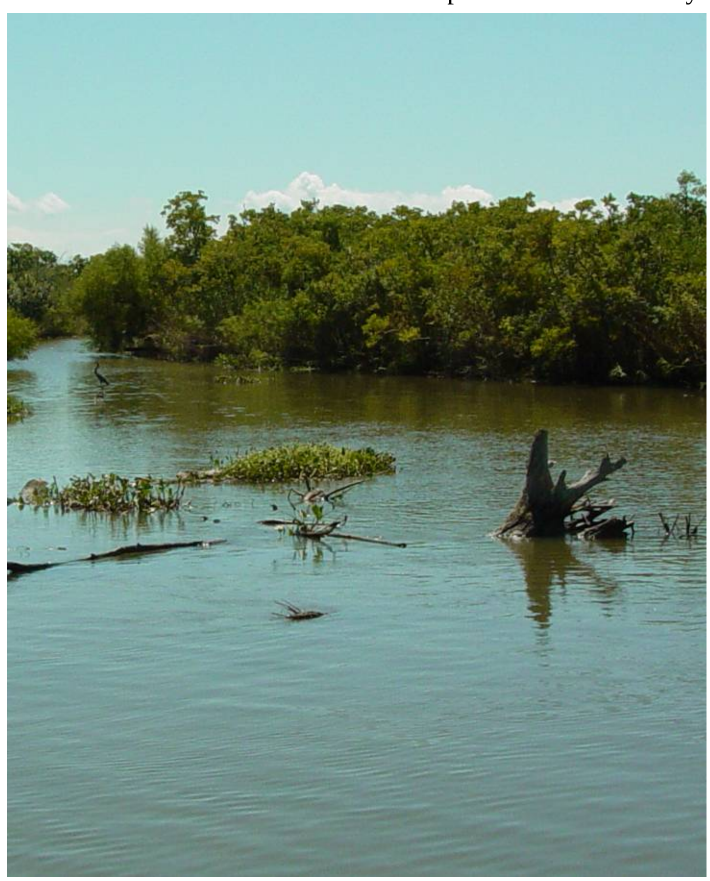
List of Tables and Figures

USGS Gage Station Trinity River at Grand Prairie

Soap Creek in Ellis County



Ten Mile Creek Outfall in Dallas County



Lower Trinity River in Chambers County

Trinity River Authority of Texas

Basin Master Plan

Forward

Message from the General Manager

This Master Plan for the Trinity River Basin succeeds and updates a series of documents promulgated by the Trinity River Authority over the past 50 years. The Authority's enabling statute calls for the Plan and clearly indicates that it should compile and reflect the plans of the various communities and agencies in the Trinity Basin, except as may be necessary to reconcile conflicts. The first Master Plan in 1958 resulted from input from a series of public meetings throughout the basin. Subsequent editions have kept up with technical, legal, environmental, and economic developments.

This revision contains updates particularly in the area of water supply planning and reuse. Those two issues plus environmental flows have been the subject of legislation proposed or passed in this year's session of the Legislature. There will continue to be a great deal of activity regarding all three of these topics, and when sufficient information is available another revision of the Master Plan will be forthcoming.

Danny F. Vance
General Manager
Trinity River Authority of Texas

Trinity River Basin Master Plan Documents

Report on Master Plan of the Trinity River and Tributaries, Texas, adopted by the Board of Directors of the Trinity River Authority	April 18, 1958
Report on Soil Conservation and Upstream Flood Prevention of the Trinity River and Tributaries, Texas approved by the Texas State Conservation Board	January 7, 1959
Supplemental Report on Master Plan of the Trinity River and Tributaries, Texas, adopted by the Board of Directors of the Trinity River Authority	October 21, 1960

Trinity River Basin Master Plan, revisions adopted:

February 22, 1977	February 22, 1989	February 26, 1997	April 23, 2003
June 27, 1984	February 24, 1993	February 28, 2001	

Trinity River Authority of Texas

Basin Master Plan

Introduction

Statement of Purpose

To plan for the conservation, management, and use of the soil and water resources of the Trinity River Basin in an efficient, economical, and environmentally sound manner so as to provide the maximum benefits for both present and future residents of the watershed.

Basin Goals

- Promote human and economic well-being.
- Foster an understanding of the complex interrelationships among the people, resources, economy and environment of the basin.
- Improve the quality of the water within the Trinity River Basin in order to provide supplies of good quality water for all beneficial purposes.
- Reduce flooding and flood damage.
- Maintain existing run-of-the-river navigation to Liberty.
- Conserve soil resources through the programs of the Soil and Water Conservation Districts of the Trinity River Basin.
- Conserve water.
- Provide facilities, and access thereto, for public water-oriented recreation.
- Promote the productivity and diversity of aquatic life in the Trinity River Basin and Trinity Bay.
- Preserve selected natural areas.

These are the goals for the Trinity River Basin regardless of the implementing agency. The order in which these goals are listed is not intended to establish priorities.

March 20, 2006. Flood at Loop 12 South of Dallas.


May 23, 2006. Freshwater Oyster. West Fork Trinity in Arlington.

Master Plan Summary

The “action” elements of the plan are listed below along with an indication of their current priority. This plan may be reviewed and/or revised by the Board of Directors of the Trinity River Authority at any time. Jurisdictional, financial, or engineering details, with some exceptions, are not a part of the plan and may vary without changing it. The “action” elements are:

- *New Reservoirs*

Twelve lakes proposed in the 1958 Master Plan are feasible and should be implemented as needed:
Tehuacana, Upper Keechi, Big Elkhart, Hurricane Bayou, Lower Keechie, Bedias, Nelsons, Harmon, Gail, Mustang, Caney, and Long King (see map in the appendix).

- *Expand Wastewater Treatment Plants*

Wastewater treatment plants must be expanded in growing service areas to avoid overloaded conditions. When more expensive treatments are required, attention must be given to cost-efficient design and operation. Regional systems should be considered in all situations in which load density permits.

- *Reuse*

Reuse of highly treated wastewater should increase as costs of wastewater treatment and conventional new sources increase. The amount of main stem return flow which is reused should be limited by water needs downstream and instream flow minima.

- *Tennessee Colony Lake*

Tennessee Colony Lake should be constructed when required for water supplies and/or flood control. It should be designed and implemented to minimize conflicts with the use of lignite resources, conflicts with existing structures and improvements, and the taking of lands for secondary purposes. Among other alternatives, a water-supply-only design with levee flood protection down-stream should be considered.

- *Flooding*

A plan for minimizing flooding problems along the main stem and major tributaries must be prepared in a manner that includes coordination of reservoir releases and flood warning systems.

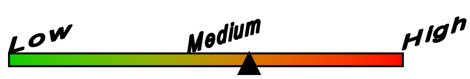
- *Water Management Policy*

Water management policies must respect and balance the values and uses of both Trinity Bay (and her estuaries) and those of the Trinity Basin.

- *Dredging to Liberty*

Maintenance dredging of the existing Channel to Liberty must be continued to assure waterway transportation existing industries.

- *Public Information/Education*



A concerted public information effort should be made to make the basin’s resources visible and understandable.

The Trinity River Authority Overview

The Trinity River Authority (TRA) was created in 1955 as a conservation and reclamation district by House Bill No. 20, an Act of the 54th Legislature[1]. TRA is governed by a twenty-four member board of directors that are appointed by the governor with the approval of the senate. Unless the board member is "at large," he/she must live and own taxable property within the area from which he/she is appointed. The political boundary of TRA is divided in to seventeen areas and includes all or part of seventeen counties.

Table 1a. TRA Board of Directors Allotments.

Area	County	No. of Directors
1	Tarrant	3
2	Dallas	4
3	Kaufman	1
4	Henderson	1
5	Ellis	1
6	Navarro	1
7	Anderson	1
8	Freestone	1
9	Leon	1
10	Houston	1
11	Trinity	1
12	Madison	1
13	Walker	1
14	San Jacinto	1
15	Polk	1
16	Liberty	1
17	Chambers	1
18	"At Large"	2

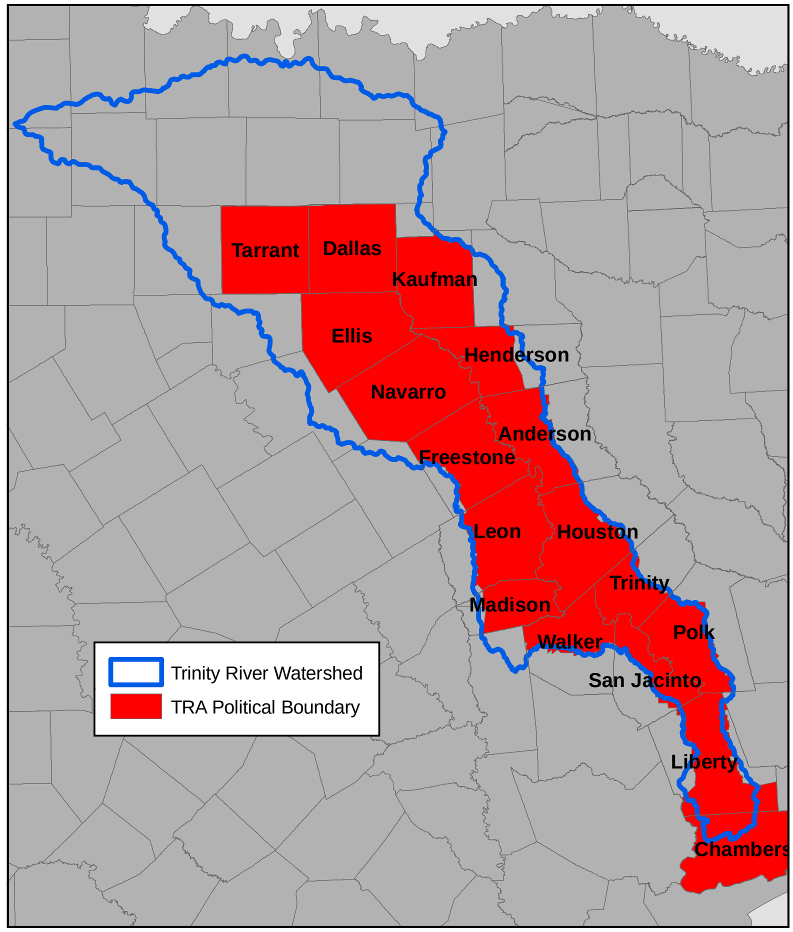


Fig. 1a. TRA Political Boundary.

By statute, Trinity River Authority is charged with:

1. Maintaining a master plan for the Trinity River basin;
2. Acting as local sponsor for federal water projects; and
3. Providing services authorized by the Texas Legislature within the Authority's territory.

The Trinity River Authority has the legislative authority to tax, but has never done so. Instead, the Authority generally provides a service to entities that wish to partner with TRA to create wastewater and water supply projects. TRA was originally tasked with overseeing the creation of a navigable waterway from Liberty to the Dallas/Fort Worth Metroplex. By the 1970's, the U.S. Army Corps of Engineers' cost vs. benefit analysis concluded that the navigation project should be postponed indefinitely. About this time, TRA began to focus its efforts towards creating and operating regional wastewater collection and treatment systems. These systems were huge improvements to the existing septic systems, small, inefficient package plants, and municipal plants which were not functioning efficiently.

House Bill 20 also authorized TRA to construct, own, and operate reservoirs and to supply and sell water. To help the City of Houston satisfy its water demand, TRA completed construction on Lake Livingston in 1969. Currently, Lake Livingston alone accounts for approximately 75% of Houston's surface water supplies. TRA funded the construction of Livingston by sales of revenue bonds that are to be redeemed with income from the sale of water.

In addition, TRA acts as a local sponsor for major water supply projects. TRA has served as a local sponsor for four major U.S. Army Corps of Engineers multiple-purpose water resource projects: Bardwell Lake, Joe Pool Lake, Navarro Mills Lake, and the Wallisville Saltwater Barrier.

House Bill No. 20 granted TRA certain powers, but did not mandate, nor fund, these powers. TRA *is not a permitting entity* and does not control permitting or water rights issues within the basin. Those functions are handled by various state agencies. TRA's primary function is to work and coordinate with other entities, mostly municipalities, to implement water related programs that serve the needs of Texas residents.

[1] *See appendix for a more in-depth explanation of the Role of the Trinity River Authority.*

Trinity River Basin Overview

The Trinity River begins in the Four Forks region in the northern portion of the basin. Just south of the DFW Metroplex, the Clear Fork, West Fork, Elm Fork and East Fork merge to form the Main Stem of the Trinity River. The Trinity River is 715 miles long and drains nearly 18,000 mi² of Texas. The climate and land type vary greatly across the basin. The watershed's character transforms from rolling West Texas plains with 29 inches of annual precipitation, through the Central Texas prairies, into the East Texas piney woods, and into the Gulf Coastal prairies which receive 53 inches of annual precipitation.

The Trinity River basin is the largest river basin in Texas that begins and ends within the state. The Trinity River provides water to over half of the population of Texas and serves two major population centers: Dallas/Fort Worth in the north and Houston to the south (fig. 1b). In addition, it is important to recognize that both major population centers drain into the Galveston Bay and Estuary System, one of the most productive ecosystems and commercial fisheries in the United States.

Because of the scarcity of groundwater availability, residents of the Trinity River basin rely on surface waters to fulfill water demand. The Trinity River contains 28 water supply reservoirs with over 5,000 acre feet of storage. Surface water comprises over 550 mi², or 3.2%, of the watershed's landcover. Because of the importance of surface water to both the upper and lower portions of the basin, water quality is a major consideration throughout the Trinity River basin.

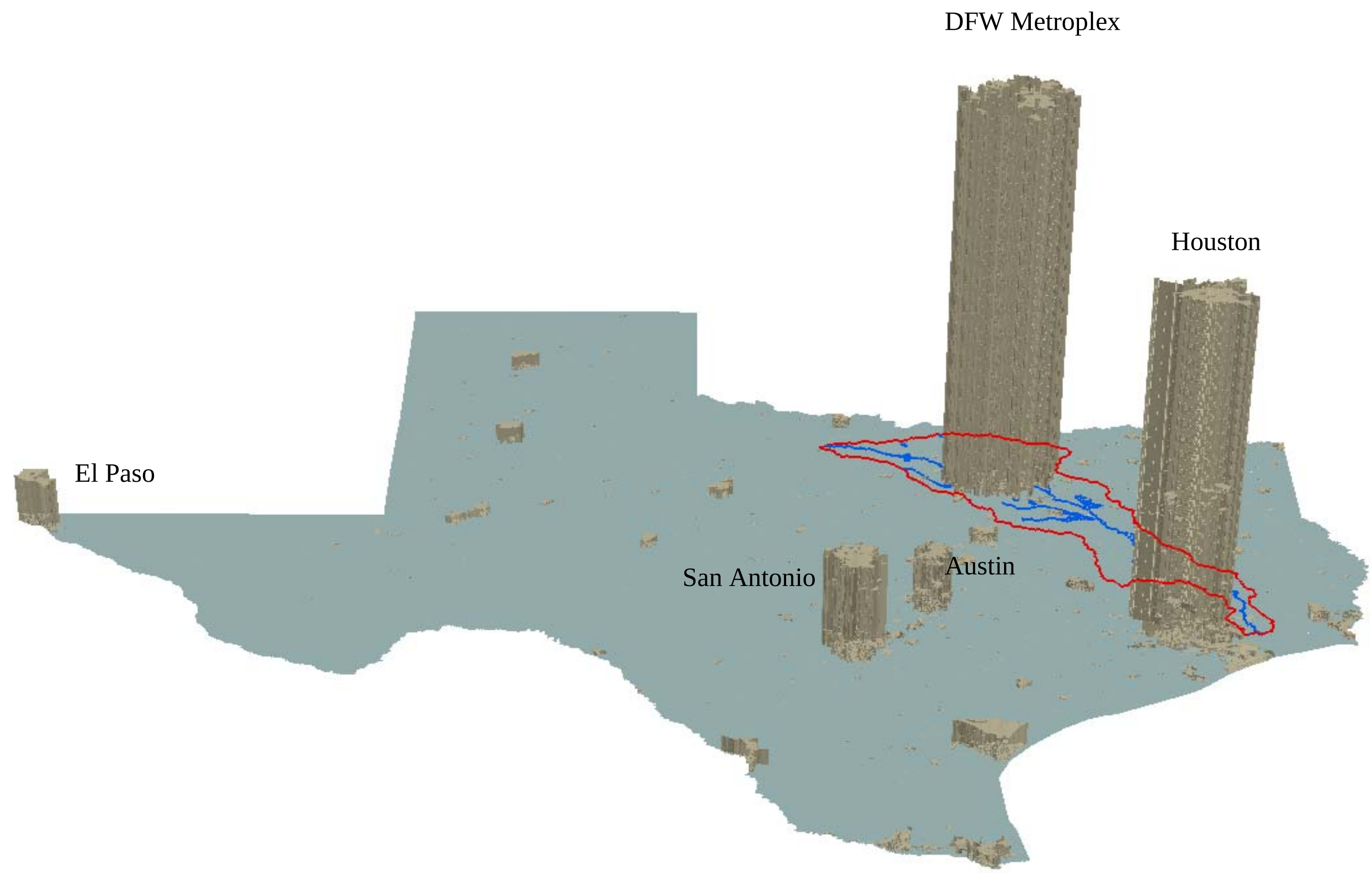


Fig. 1b. Texas Cities (Height Represents Population in 2000).

Future Review Procedures

The Master Plan may be reviewed and revised by the Board of Directors of the Trinity River Authority at any time. This revised plan has been formulated in terms of goals and priorities, without great detail, so that only major developments would require a change in the plan. However, when such developments occur, they will be promptly incorporated into the plan. Annually, the Board of Directors will receive and review a report on the status of implementation of the plan and consider any revisions that might be indicated at that time. The required annual status report has been submitted to the Board every year since 1977. Periodically there should be a comprehensive review of the plan. The most recent revision to the master plan occurred in 2003 when the Reuse section was added.

Trinity River Authority of Texas

Basin Master Plan

Water Supply

Background

To mitigate the effects of future droughts, the state created the Texas Water Development Board (TWDB) in 1957. In 1997, the TWDB, in cooperation with Texas Parks and Wildlife Department, Texas Natural Resource Commission (now Texas Commission of Environmental Quality or TCEQ), and numerous stakeholder groups, produced the last water plan *developed at the state level*. Since 1997, state water planning has been a regional and local effort that is compiled into the state water plan.

Fig. 2a. Bardwell Lake in Ellis County.

Texas Water Planning

To mitigate the challenges met during the creation of the 1997 State Water Plan, the Texas Legislature passed Senate Bill 1 in 1997. Senate Bill 1 directed the Texas Water Development Board (TWDB) to designate regional water planning entities. Some of the factors used to delineate the 16 regional water planning entities included: river basin and aquifer delineations, water utility development patterns, socioeconomic characteristics, existing regional water planning areas, political subdivision boundaries, and public comment. Each of the 16 regions create and submit a water plan to the TWDB who approves each plan and combines all regional plans into a single state water plan. The most recent state water plan, *Water for Texas 2007*, was adopted by the TWDB on November 14, 2006 and forecasts planning efforts through 2060. Each of the 16 regions is comprised of a planning group that was required by Senate Bill 1 to include representatives from the public, counties, municipalities, industries, agriculture, environmental groups, small business, electric-generating utilities, river authorities, water districts, and water utilities. Once comprised, each planning group added other members as appropriate. The Regions were required to:

- describe the regional water planning area;
- quantify current and projected population and water demand;
- evaluate and quantify current water supply;
- identify surpluses and needs;
- evaluate water management strategies and prepare plans to meet needs;
- recommend regulatory, administrative, and legislative changes; and
- adopt the plan, including the required level of public participation.

The planning groups were devised to be transparent and conduct all functions at open meetings. In addition, public meetings were held while developing the scope of work and hearings took place prior to the adoption of the regional plans. Consensus building within the planning groups was crucial to ensure sufficient support for adoption of the plan.

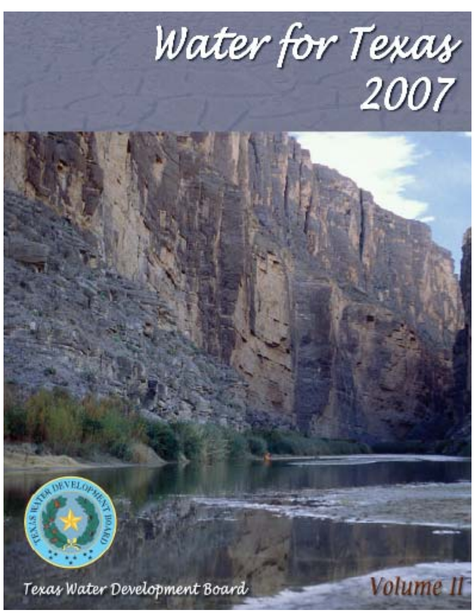


Fig. 2b. Texas State Water Plan Available at http://www.twdb.state.tx.us.

Not everyone agrees with the outcomes of the Regions' planning recommendations, and it is important to list some of the questions/concerns raised during the public comment period:

- Senate Bill 1 required the drought of record be used to determine existing supplies. Some feel that extreme drought restrictions can curb demand and prevent the need for additional reservoirs;
- Additional reservoirs are expensive, unnecessary, and destroy wildlife habitat;
- Land is acquired to build reservoirs in locations to serve the water needs of far away populations;
- Supplies do not take into account both bay/estuary and in-stream environmental flow requirements; and
- Existing reservoirs are not interconnected or used to their full potential.

Although there are many legitimate concerns about how to increase the current water supply to meet future demands, there is little disagreement that water shortages will become a reality if new supplies are not accessed.

Regional Planning

The vast majority (81%) of the Trinity River basin falls into Region C or Region H, and the Trinity River Authority's General Manager is a voting member of both boards. The Trinity River basin comprises 80% of Region C and includes Dallas/Fort Worth and the upper portion of the basin. Further to the south, the Trinity basin makes up only 28% of Region H, but accounts for more than half (52%) of Region H's 2010 water supply. By 2060, regional planning estimates project that 52% of Texas' population will live within Regions C and H. Both regions' plans were approved by the Texas Water Development Board in 2006 and overviews of the plans are included below. The entire Water for Texas 2007 report is available online from the Texas Water Development Board.

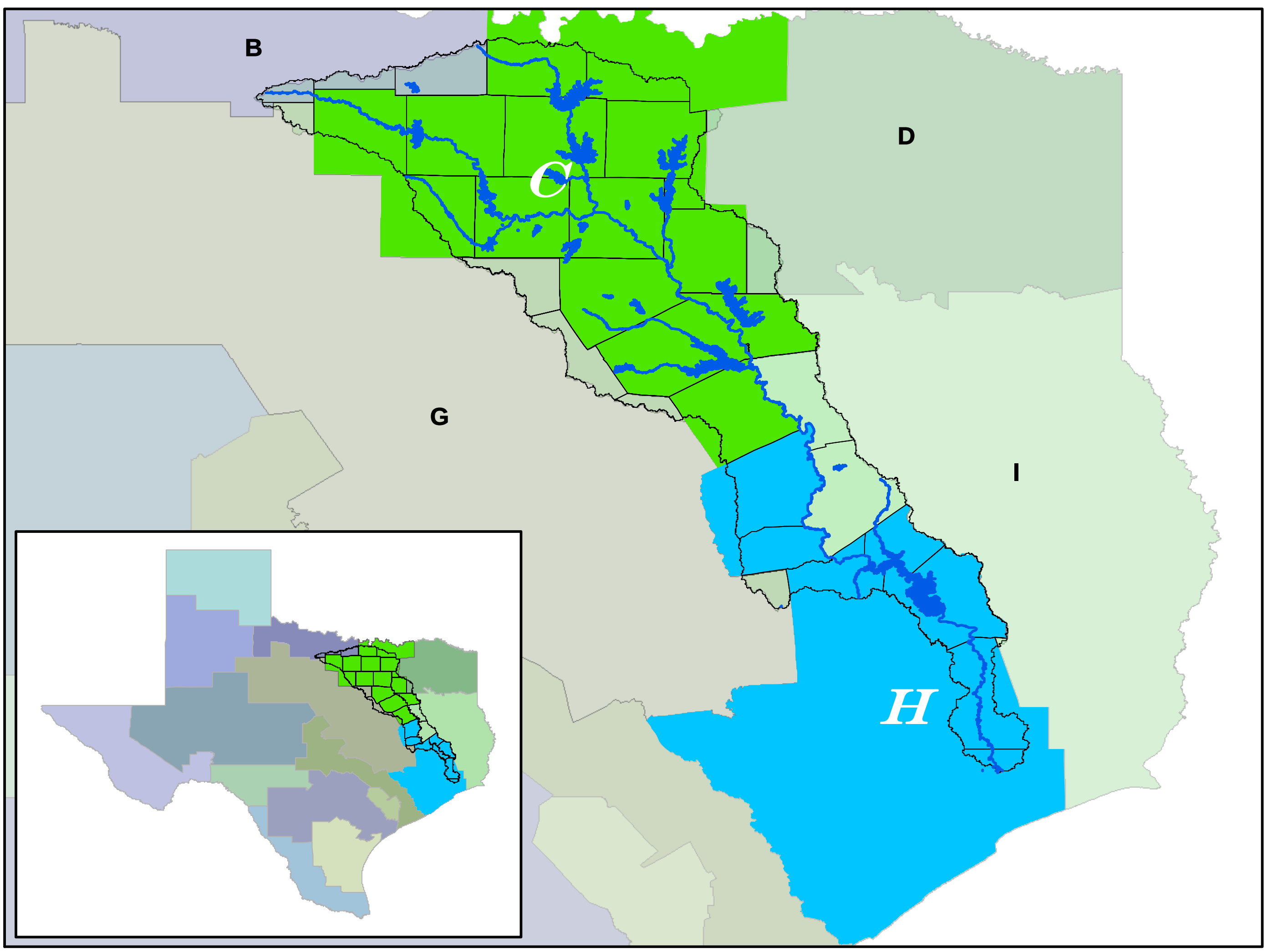


Fig. 2c. Regional Water Planning Entities.

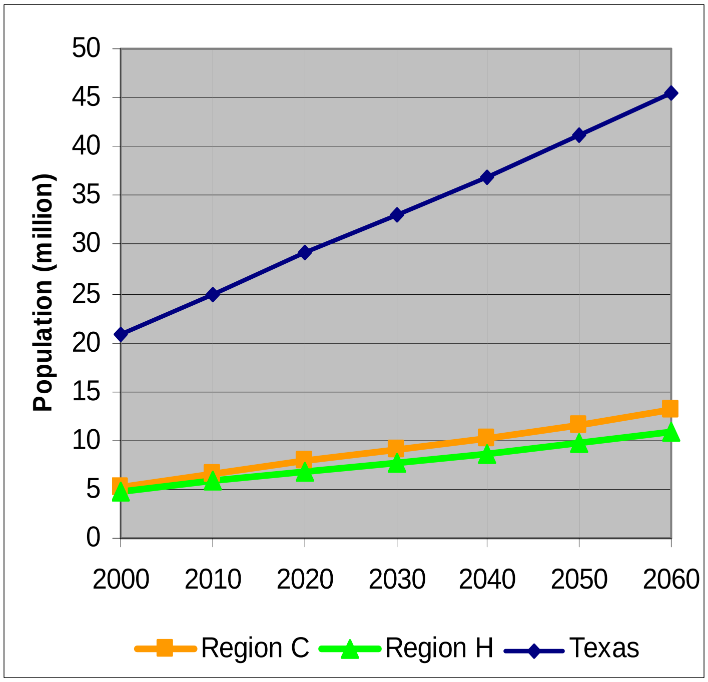


Fig. 2d. Population Estimates from Water for Texas 2007 for Region C, Region H, and Texas.

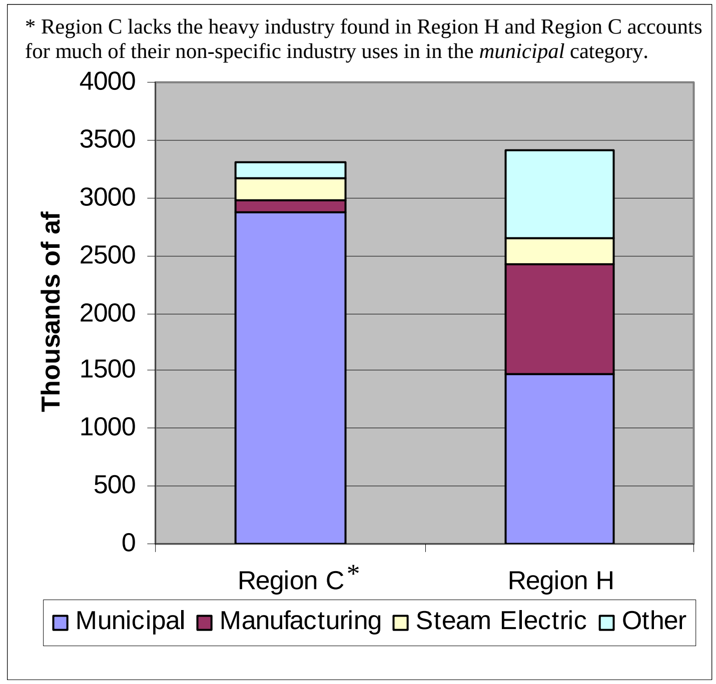


Fig. 2e. 2060 Demand for Regions C and H (By Category).

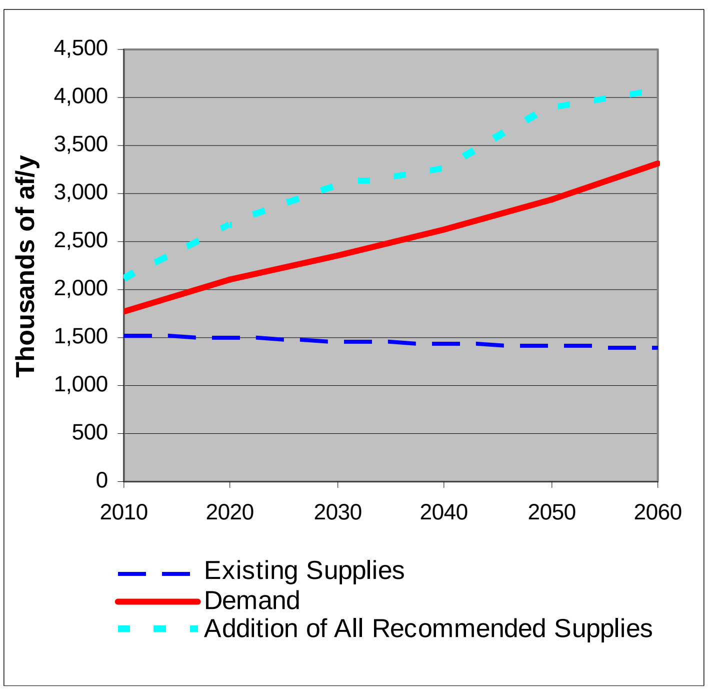


Fig. 2f. Region C Projected Water Supply, Demand, and Recommended Supplies.

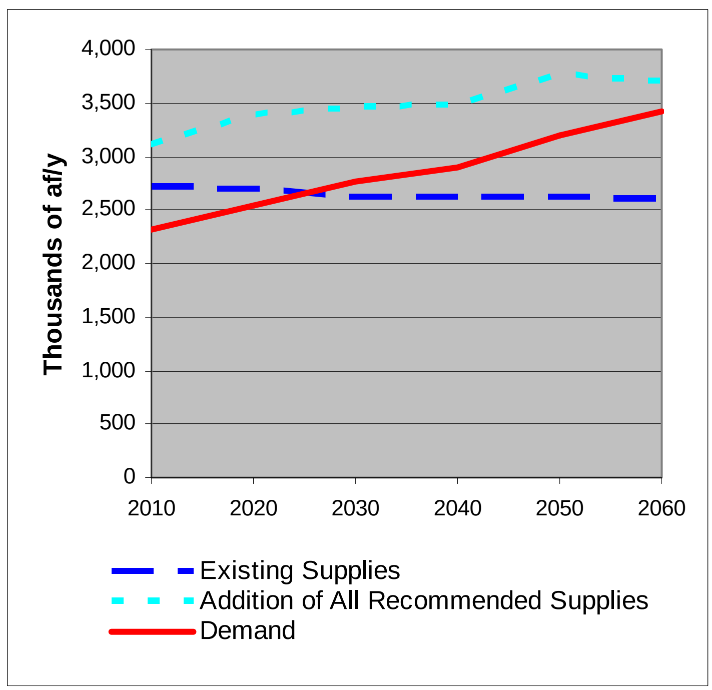


Fig. 2g. Region H Projected Water Supply, Demand, and Recommended Supplies.

Access more Region C information at:

http://www.regioncwater.org/index.cfm

Access more Region H information at:

http://www.twdb.state.tx.us/rwpg/main-docs/regional-plans-index.htm

Summary of 2006 Regional Water Plans for Regions C and H

Region C (16 counties):

Population: 6.6 million people (27% of Texas' population) are projected to live in Region C by 2010 and that number is set to almost double to 13 million by 2060 (fig. 2d).

Water Demand: Region C planners estimate that current water demand will increase to 1,768,464 af/y in 2010 and increase 87% by 2060 with municipal uses making up 92% of the water demand. The demand per capita for 2010 is projected to be 238 gal/day per person and decline 5% to 225 gal/day by 2060.

Water Supplies: Present water sources for Region C will decline from about 1.52 million acre feet/year in 2010 to 1.39 million acre feet/year in 2060 (fig. 2f). If no additional supply is created, the TWDB projects a shortage of 245,822 acre feet/year by 2010 and 1.92 million acre feet/year in 2060 (fig. 2f). Conversely, if all of the recommendations are implemented, estimates suggest that supply would be about 22% (741,000 af/y) greater than demand in 2060.

Water Sources: By 2010, over 90% of the water supply for Region C is projected to be surface water (1,340,847 af/y) and the remainder is anticipated to be groundwater (93,650 af/y) and reuse (79,342 af/y). Because there is a projected 1% loss of current groundwater sources by 2060, additional supplies must come from reuse, in/out-of-basin surface water, and conservation. The TWDB water plan for Region C is heavily dependant on out-of-basin water transfers to provide additional supply. Region C planners recommended four new reservoirs (total 746,540 af/y by 2050) to supply water to Region C at a projected cost of 3.4 billion, and none are inside the Trinity River basin (fig. 2h). Because approximately 60% of all municipal water returns as treated wastewater, reuse is an important component of the water plan and is expected to provide 5.2% of supply by 2010. The TWDB plan is for 28 % (748,872 af/y) of *new supplies from all recommended strategies* to come from reuse. For additional information on reuse, see chapter four.

Conservation: Conservation strategies like educational programs, water system audits, plumbing code changes, residential audits, and water pricing structure changes make up about 11 % (295,030 af/y) of the total volume of water associated with all recommended strategies.

Selected Planning Policy Recommendations Include:

Water Reuse	Interbasin Transfers
Conservation	Innovative Strategies
Groundwater	Alternative Mgt. Strategies

Region H (15 counties):

Population: 5.87 million people (23% of Texas' population) are projected to live in Region H by 2010 and that number is set to almost double to 10.9 million by 2060 (fig. 2d).

Water Demand: Region H planners estimate that current water demand will increase to 2,314,094 af/y in 2010 and increase 47% by 2060 with municipal uses making up 34% and manufacturing making up 27% of demand. The demand per capita for 2010 is projected to be 357 gal/day per person and decline 21% to 279 gal/day by 2060.

Water Supplies: Present water sources for Region H will decline approximately 6% from about 2.7 million acre feet/year in 2010 to 2.56 million acre feet/year in 2060 (fig. 2g). If no additional supply is created, the TWDB projects a shortage of about 150,000 acre feet/year by 2030 and 849,702 acre feet/year in 2060 (fig 2g). Conversely, if all of the recommendations are implemented, estimates suggest that supply would be about 6 % (252,026 af/y) greater than demand in 2060.

Water Sources: By 2010, 68% of the water supply for Region H will be surface water (2,051,666 af/y) and groundwater (661,078 af/y) will make up the remaining 32%. Because of subsidence concerns, existing groundwater supply resources are expected to decline by 23% (151,363 af/y) from 2010 to 2060. The reduction in groundwater availability will result in the increased need for surface water sources both in and out-of-basin. Region H planners recommended the construction of 2 major reservoirs (fig. 2h). Additionally, improving technologies and the large cost of water supply projects have made desalination of both seawater and brackish and/or saline groundwater an important part of the water plan. In addition, reuse is expected to become a significant source of supply for Region H—more than doubling that supplied by groundwater in 2060! Reuse is projected to account for 18% of the recommended new water supplies. For additional information on reuse, see chapter four.

Conservation: Conservation strategies like educational programs, water system audits, plumbing code changes, residential audits, and water pricing structure changes make up about 9% (100,987 af/y) of the total volume of water associated with all recommended strategies

Selected Planning Policy Recommendations Include:

Groundwater Districts	Interbasin Transfers
Groundwater Modeling	Alternative Mgt. Strategies
Water Reuse	

Reservoirs

The vast majority of water supplies in the Trinity River basin is from surface water reservoirs. Since 1911, 31 major reservoirs have been constructed within the Trinity River basin (fig. 2h). In addition, seven reservoirs located outside the Trinity basin are either supplying or are under contract to supply water to Trinity basin users. As of 2010, the firm yield of existing reservoirs and the currently permitted inter-basin water transfer amount shows that there will be approximately 2,994 MGD of reservoir water supply for the Trinity River basin.

Reservoirs also serve an important economic and recreation function for their communities. Major resort and residential developments adjacent to water supply reservoirs can bring tremendous increase to a city's sales revenue, tax base, and jobs. According to the Town of Flower Mound, located just north of Dallas/Fort Worth, the Gaylord Texas resort hotel, built on the shores of Lake Grapevine, employs almost 1,700 people and has an annual economic impact of more than $450 million dollars on the region.

Recreation on and around water supply reservoirs provides an important source of revenue and jobs for local residents. Anglers, boaters, camper, and day visitors support, among many others, local marinas, campgrounds, hotels, and restaurants. According to a report from the Texas Coalition for Conservation and Texas Parks and Wildlife Department, state parks can significantly contribute to surrounding economies: In 2004,

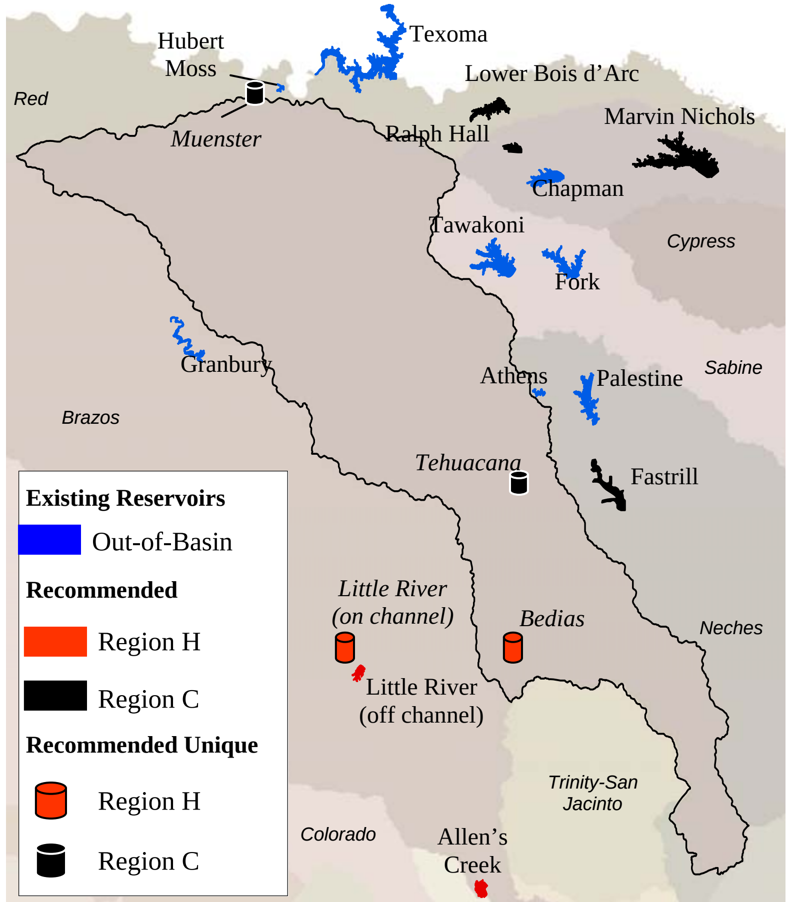


Fig. 2h. Existing Out-of-Basin and Proposed Reservoirs and Proposed Unique Reservoir Sites from Water for Texas 2007.

- Cedar Hill State Park, located on Lake Joe Pool in Dallas & Ellis County, contributed $6.4 million, 114 jobs, and $32,000 in sales tax to local economies;
- Fairfield Lake State Park, located on Fairfield Lake in Freestone County, contributed $0.87 million, 18 jobs, and $4,300 in sales tax to local economies; and
- Lake Livingston State Park, located on Lake Livingston in Polk County, contributed $5.1 million, 108 jobs, and $25,700 in sales tax to local economies.

To meet the needs of Regions C and H through 2060, the state water plan recommends constructing six additional out-of-basin reservoirs (fig. 2h). In addition, the plans recommend four "unique" reservoir sites (fig. 2h). The creation of new reservoirs are physically, politically, and administratively challenging. The Trinity River Authority will continue to work with all parties to find solutions to these issues, as the issues will not simply "go away."

Fig. 2i. TRWD Water Supply Intake Structure at Benbrook Lake in Tarrant County.

Fig. 2j. Recreation at Lake Livingston in Polk County.

Groundwater

The laws governing the pumping of groundwater stand in stark contrast to those of surface water. In 1904, the Texas Supreme Court cemented the idea of "absolute ownership" of groundwater by the landowner in Houston & T.C. Railway Co. v. East. The Court decided that landowners had the "right of capture" to groundwater in part because the "existence, origin, movement, and course of such waters, and the causes which govern and direct their movements, are so secret, occult, and concealed that an attempt to administer any set of legal rules in respect to them would be involved in hopeless uncertainty, and would, therefore, be practically impossible."

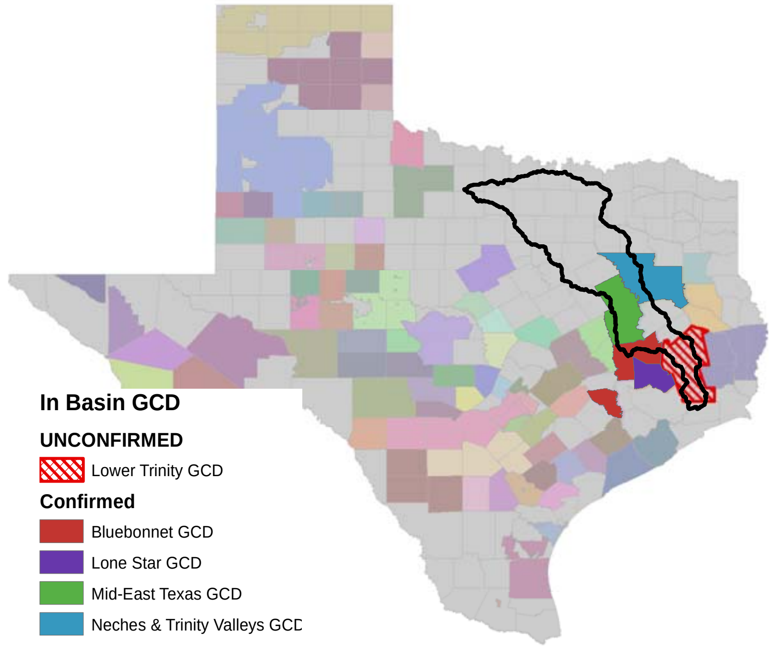


Fig. 2k. Trinity Basin Groundwater Conservation Districts.

Generally, there are no regulations regarding the drilling and operation of groundwater wells. Groundwater may be used for any beneficial use and may not be: wasted, intentionally contaminated, maliciously pumped for the sole purpose of hurting adjoining landowners, or pumped to the point of causing land subsidence. As the scarcity of water increases, more focus is being placed on the efficient uses of groundwater. Parts of Texas are creating Groundwater Conservation Districts (GCD) whose goals are to: provide the most efficient use of groundwater, prevent waste, control and prevent subsidence, address conjunctive surface water and drought issues, and address conservation, recharge enhancement brush control, and rainwater harvesting. According to the TWDB, GCD's are the "state's preferred method of groundwater management." GCD's are created by the legislature or TCEQ and have the authority to regulate the spacing of water wells and/or the production of water from wells. The Trinity River basin crosses the boundaries of one unconfirmed and three confirmed Groundwater Conservation Districts (fig. 2k).

Eighty-six percent of the Trinity River basin lies over either a major (80%) aquifer, minor (59%) aquifer, or both. Aquifers are dynamic systems and are not constant across space or time and are dependant on surface water infiltration for recharge. In some cases, water is being pumped faster than the aquifer can recharge resulting in wells having to be extended, higher pumping costs, and land subsidence. The Trinity River basin overlays three major aquifers: (fig. 2l)

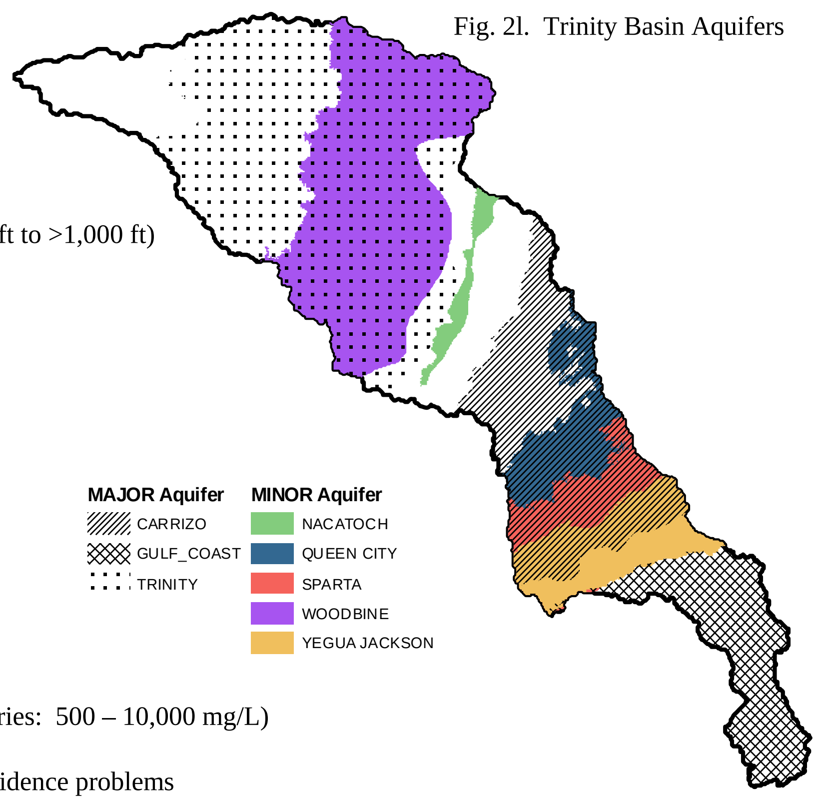


Fig. 2l. Trinity Basin Aquifers

Trinity Aquifer

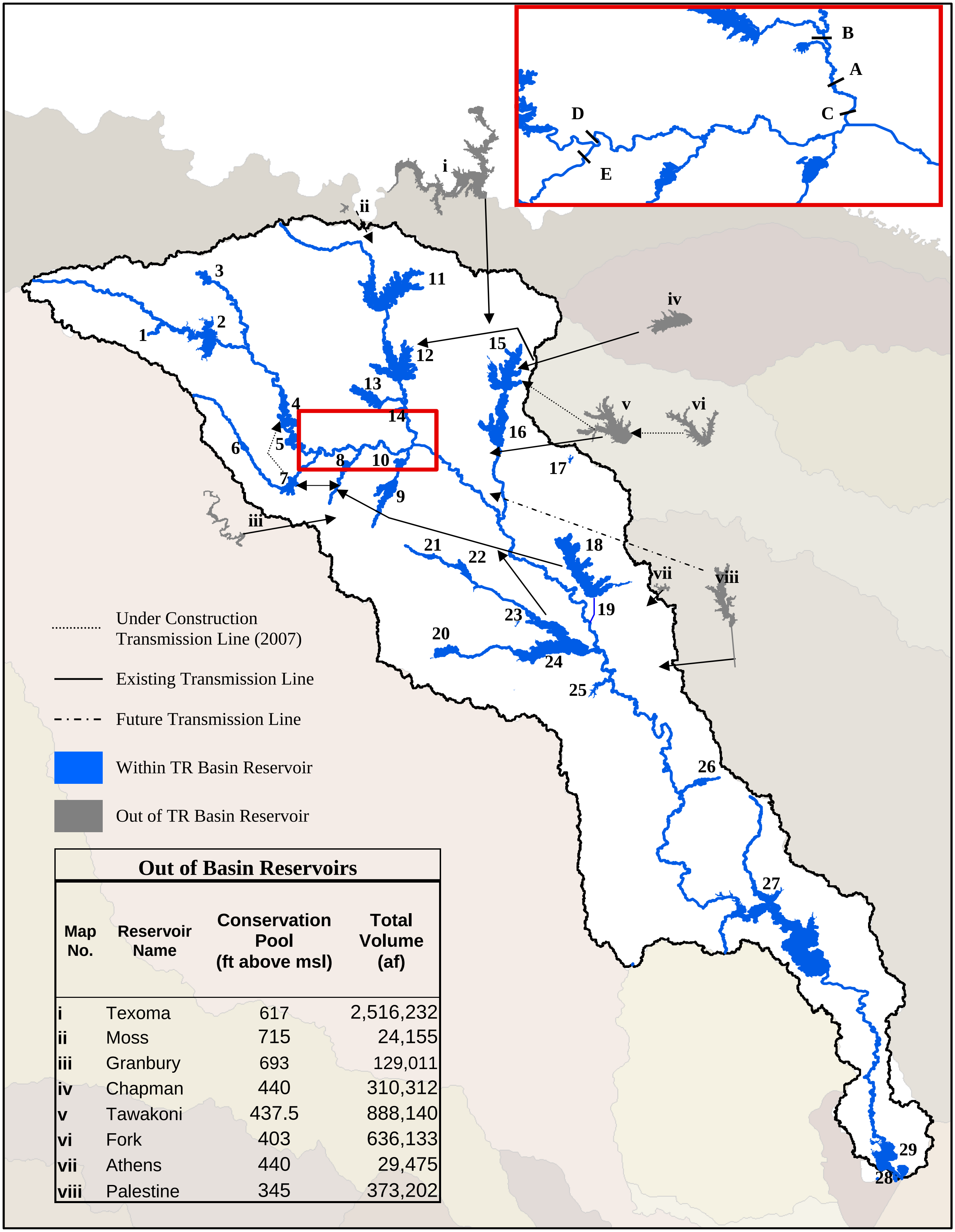
- 10,625 mi² outcrop
- 21,308 mi² in subsurface
- 2010 availability: 205,799 af/y
- Water is generally fresh but very hard
- Some of the states largest water level declines (350 ft to >1,000 ft)

Carrizo-Wilcox

- 11,186 mi² outcrop
- 25,409 mi² in subsurface
- 2010 availability: 1,014,753 af/y
- Water is generally fresh but very hard
- Desalination of brackish water and developing new wells are possibilities

Gulf Coast

- 41,879 mi² area
- 2010 availability: 1,825,976 af/y
- Water quality varies across and with depth (TDS varies: 500 – 10,000 mg/L)
- Some wells show high level of radio nucleotides
- Water level declines of up to 350 ft have led to subsidence problems



Out of Basin Reservoirs

Map No.	Reservoir Name	Conservation Pool (ft above msl)	Total Volume (af)
i	Texoma	617	2,516,232
ii	Moss	715	24,155
iii	Granbury	693	129,011
iv	Chapman	440	310,312
v	Tawakoni	437.5	888,140
vi	Fork	403	636,133
vii	Athens	440	29,475
viii	Palestine	345	373,202

Fig. 2m. Trinity Basin Major Water Supply Reservoirs (In/Out-of-Basin) and Channel Dams as of 2007.

Table 2a. Trinity Basin Major Water Supply Reservoirs and Channel Dams as of 2007. (References Available in Appendix)

2007 Major Trinity Basin Water Supply Reservoirs

Map No.	Reservoir Name	Start Date	Uncontrolled Watershed (m²)	Normal Pool Elevation (ft)	Normal Pool (af)	Owner/ Op-erator	Yield (mgd)	Primary Uses	Water Rights Permit Holder
1	JACKSBORO &	1950	26	143	2,129	Jacksboro	1	WSm	Jacksboro
	LOST CREEK	1990	4	367	11,961	Jacksboro	1	WSm	Jacksboro
2	BRIDGEPORT	1932	1,082	12,900	374,836	TRWD	a	WSm	TRWD
3	AMON G. CARTER	1956	106	1,848	28,589	Bowie	2.3	WSm	Bowie
4	EAGLE MOUNTAIN	1934	753	6,480	177,520	TRWD	70	Wsme	TRWD
5	WORTH	1912	94	3,560	37,775	Fort Worth	b	WSm	Fort Worth
6	WEATHERFORD	1951	109	1,091	16,298	Weatherford	2	Wsme	Weatherford
7	BENBROOK	1952	320	3,770	88,250	COE	6	WSm,FC	TRWD, Benbrook WSA
8	ARLINGTON	1957	143	1,939	38,785	Arlington	4.3	Wsme	Arlington, TU
9	JOE POOL	1986	232	7,470	176,900	COE	14	WSm,FC	TRA
10	MOUNTAIN CREEK	1937	63	2,710	22,840	TU	13.4	Wse	TU
11	RAY ROBERTS	1986	676	29,350	799,600	COE	c	WSm,FC	Dallas, Denton
12	LEWISVILLE	1954	968	29,170	571,926	COE	165	WSm,FC	Dallas, Denton
13	GRAPEVINE	1952	695	7,380	181,100	COE	19.1	WSm,FC	Park Cities MUD, Dallas, Grapevine
14	NORTH	1957	3	800	17,000	TU	0.4	Wse	TU
15	LAVON	1953	770	21,400	456,500	COE	93	WSm,FC	NTMWD
16	RAY HUBBARD	1968	304	21,683	413,526	Dallas	50	Wsme	Dallas
17	NEW TERRELL	1955	14	830	8,712	Terrell	0.7	WSm	Terrell
18	CEDAR CREEK	1965	940	32,623	637,180	TRWD	156	WSm	TRWD
19	TRINIDAD	1925	1	740	7,450	TU	2	WSe	TU
20	NAVARRO MILLS	1963	320	5,070	56,960	COE	14.7	WSm,FC	TRA
21	WAXAHACHIE	1956	30	690	13,500	ECWCID	2.4	WSm	Ellis County WCID 1
22	BARDWELL	1965	148	3,528	45,347	COE	9.8	WSm,FC	TRA
23	HALBERT	1921	12	650	7,420	Corsicana	0.5	WSm	Corsicana
24	RICHLAND CHAM-BERS	1987	1,432	41,356	1,136,600	TRWD	187	WSm	TRWD
25	FAIRFIELD	1969	34	2,350	50,600	TU	6.9	Wse	TU
26	HOUSTON CO.	1966	44	1,282	19,500	HCWCID	10	WSm	Houston County
27	LIVINGSTON	1969	6,764	83,277	1,741,867	TRA	1120	WSmia	Houston, TRA
28	WALLISVILLE	1998	968	0	0	COE	80	Wsmia	Houston, TRA
29	ANAHUAC	1914	199	5,300	35,300	CLCND	21.7	Wsam	CLCND
Channel Dams Affecting Major Water Rights and/or Water Supply Systems									
A	CALIFORNIA CROSSING	1912	68	180	990	Dallas	d	WSm	Dallas
B	CARROLTON	1912	104	89	666	Dallas	d	WSm	Dallas
C	FRAISER	1928	50	72	434	Dallas	18	WSm	Dallas
D	NUTT	1910	33	96	673	TU	1	WSe	TU
E	CLEAR FORK	1882	89	43	259	Fort Worth	2	WSm	Fort Worth

Water Rights

Water has been a source of life, prosperity, and conflict since settlement began in Texas. Because of the importance of water on the Texas plains, colonizers sought to secure legal rights to water and Texas water law has evolved from a mixture of Riparian Doctrine and Prior Appropriation Doctrine into what it is today.

Texas water law is based on the principle of "first in time, first in line." In other words, senior water rights holders have the authority to take their allotted portion of water before a junior water rights holder. It has been said that water does not flow downhill, it flows towards priority dates. If a senior water right holder is downstream of a junior water rights holder, the junior holder must allow the water to flow through to the senior rights holder. During a drought, the decision to shut off water pumping is made by a Texas Watermaster. Currently, only the Rio Grande River basin operates under a Watermaster. Should water demand increase as expected, a Watermaster will be appointed for the Trinity River basin to ensure the "first in time" laws are followed.

Water Rights Adjudication – The adjudication of the Trinity River Basin water rights was completed in the 1980's. It has upheld in full almost all rights which had been granted under permits and certified filings. Of the many small claims which had been based upon riparian or other rights, only a minority were acceptable under the various legal and factual tests which were applied. All water rights and priorities are now completely defined. Each water right was given a priority date that essentially sets the holders place for the "first in time" line. The earliest priority date in the basin is 1906 and the earliest in Texas is 1731.

Large Run-of-River Water Rights - In the Lower Trinity basin, there are several canal systems which supply water primarily to rice farmers, with lesser quantities supplied for municipal and industrial needs. Three of these systems entered into written agreements with the co-sponsors of the Livingston and Wallisville projects to ensure that a fixed amount of water would be made available to them. These agreements became known as the "Fixed Rights Agreements." Releases of water stored in Lake Livingston, together with available streamflow originating from downstream of Lake Livingston, are to be provided to each system in amounts shown in the table entitled "Summary of Fixed Rights Agreement."

The water rights of the "Fixed Rights" parties have been modified significantly since 1995. The San Jacinto River Authority purchased from the Devers system the rights to 56,000 acre feet per year for use in Montgomery County in the San Jacinto River basin. That water is no longer intended for irrigation use in the Trinity basin, as was the case when the fixed rights agreements were made, and is not considered to retain the claim on Lake Livingston stored water that was indicated in those agreements. The City of Houston has purchased the Dayton Canal System and is seeking water rights permit amendments to allow that water to be used in the San Jacinto River basin. Also, the Chambers-Liberty Counties Navigation District and the San Jacinto River Authority have agreed to convey 30,000 acre feet per year of the District's water to the River Authority for use in Montgomery County. In addition to the "Fixed Rights Agreement," the City of Houston holds permits totaling 40.2 MGD (45,000 acre feet per year) on the Trinity River below Lake Livingston which were formerly held by the Southern Canal Company. The trend of water rights shifting away from irrigation and towards municipal uses is expected to continue.

Small Run-of-River Water Rights – There are over 300 relatively small diversions with little or no storage to firm up the supply during low flows. These water rights total over 100 MGD. Most of these rights are for irrigation and other agricultural purposes.

Table 2b. Summary of Fixed Rights Agreements.

Summary of Fixed Rights Agreements

Canal	**Amount of Fixed Rights** *(MGD)*	*Acre Feet/Year*
Chambers-Liberty Counties Navigation District	79.3	88,820
Devers Canal System	76.3	86,000
Dayton (formerly Richmond)	29.4	33,000
TOTALS	185.4	207,820

Trinity River Authority of Texas

Basin Master Plan

Water Quality

Background

On a Federal level, the Clean Water Act (CWA) of 1972 established the basic structure for regulating discharges of pollutants into water bodies. “The Act” gave the Environmental Protection Agency (EPA) authority to implement pollution control programs such as setting wastewater standards, water quality standards, and point and nonpoint source discharge permits. For the Trinity River basin, the CWA of 1972 does not tell the whole story ...

Fig. 3a. TRA’s Central Regional Wastewater System, 2005.

In 1846, during his reconnaissance of Texas, A.W. Moore described the Trinity River as a “little narrow deep stinking affair.” Historically, many of the major tributaries, and sometimes the main stem, of the Trinity River would dry up during the long, hot summer months and periods of drought. As settlement increased, people relied heavily on the Trinity for water supply and waste removal. Drinking water was pumped directly from the main stem for Dallas’ water supply until 1896 when Record Crossing was built on the Elm Fork so that a cleaner, more reliable water supply was available. The Trinity River received large amounts of untreated and partially treated sewage from sources including small, inefficient package wastewater treatment facilities, dysfunctional septic systems, and direct discharges from citizens and industry. Consequently, in 1925, Texas Department of Health characterized the Trinity River as a “mythological river of death” because of the number of people that died from typhoid fever, a bacteria associated with polluted water sources.

In the 1950’s, the legislature granted the Trinity River Authority the power to construct and operate regional wastewater collection systems. The first of these was TRA’s Central Regional Wastewater System (CRWS). The legal groundwork and this idea of “cooperation” between municipalities, entities, and the State helped to create a blueprint that other regions of Texas soon followed.

Prior to 1967, the Texas Department of Health (TDH) reviewed wastewater treatment plant designs. TDH had few resources allocated to wastewater and no comprehensive permit system for wastewater dischargers existed. The Texas Water Quality Board was created in 1967 around the same time this concept of cooperation among dischargers (which later evolved into the “The Compact”) developed. The major dischargers and their consultants met with the Texas Water Quality Board and committed to using the best technology that was proven to work for large scale plants. In addition, prior to the Clean Water Act of 1972, permits written by the Texas Water Quality Board included permit levels of 10 mg/L biochemical oxygen demand (BOD) and 10 mg/L total suspended solids (TSS). The science and administrative base for the creation of these “10/10” permits by the Trinity River basin entities became the groundwork for other permitting issues throughout Texas.

Improvements in water quality since the 1950’s has been quite dramatic. Permit levels have greatly reduced loadings from point sources and wastewater has achieved such a high quality that it has become a commodity. For decades, the Trinity River Authority has been integral to improving water quality in the Trinity basin, and that commitment continues today.

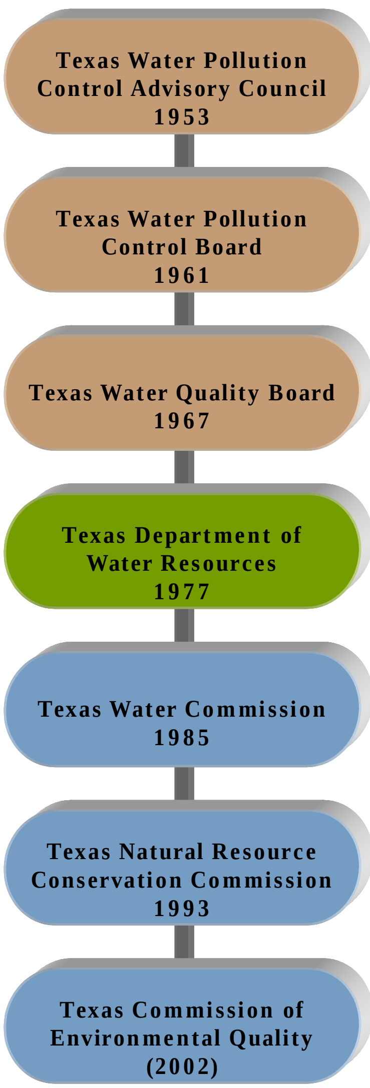


Fig. 3b. Evolution of TCEQ.

The Trinity River Basin

The natural flow in the great majority of streams in the Trinity River basin is highly variable. Most of the flow is rainfall runoff; and between rains the flow is quite low, or in many cases in the summer, dry. To combat the intermittent nature of the Trinity River, reservoirs were build throughout the basin to solidify a water supply for a growing population. The characteristics of the streams have changed over time and at present there are four distinct water body types:

Effluent Dominated Streams
Reservoir Release Dominated Streams
Intermittent Streams
Perennial Streams
Reservoirs

Effluent Dominated Streams

Wherever there is a wastewater treatment plant discharging into a stream, the flow from that plant during such dry periods constitutes a majority, sometimes all, of the flow. That situation is considered an effluent dominated stream, and it exists for some distance downstream from most wastewater plants in the basin. It is a result of the natural characteristics of the land.

Effluent dominated streams exist in all sizes from small discharges into small streams or large discharges into large streams. During dry periods, river beds upstream of discharges may be dry and the discharge could evaporate or soak into the bed and banks downstream leaving a dry channel.

The biggest effluent dominated reach is the main stem from the DFW Region to Lake Livingston. In dry weather , the flow is almost entirely wastewater effluent. Since improvements in wastewater treatment technologies and facility upgrades, the water quality in these reaches has greatly improved even as the population is increased greatly. Figure 3c shows how average annual dissolved oxygen, one of the many water quality indicators, has increased even though the population has doubled since 1970.

Dissolved oxygen (DO) in natural waters is necessary for fish and other aquatic life. The Texas Commission of Environmental Quality (TCEQ) sets the standard for high aquatic life use at 5 mg/L. In pure water, the concentration of dissolved oxygen will reach an equilibrium with the oxygen in the air at its *saturation* (100%) point. Figure 3d shows in 1971, the average saturation was about 44%, but by 2003, it averaged about 100%.

With all organisms, there is a constant competition for resources. Wastewater provides nutrients for algal growth which produces oxygen, yet also contains bacteria and certain other chemicals that consume oxygen. When consumption is greater than available oxygen, fish kills may occur.

Biochemical oxygen demand (BOD) is another measure of water quality. Due to improving technologies, wastewater discharge permit levels have been reduced from 30, to 10, and currently to 5 mg/L. It is interesting to note the inverse relationship between BOD and increased flow from wastewater treatment plants (fig. 3e).

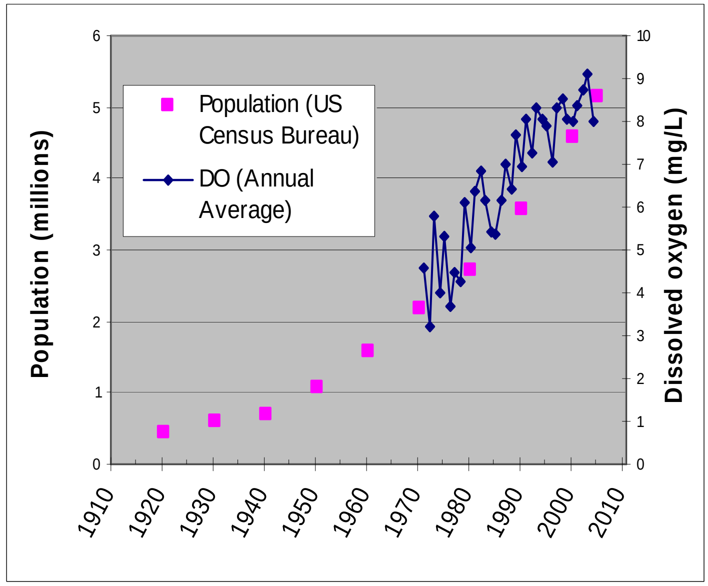


Fig. 3c. Population of Dallas, Tarrant, Ellis, and Navarro Counties Plotted Against DO Values at the Rosser Gage.

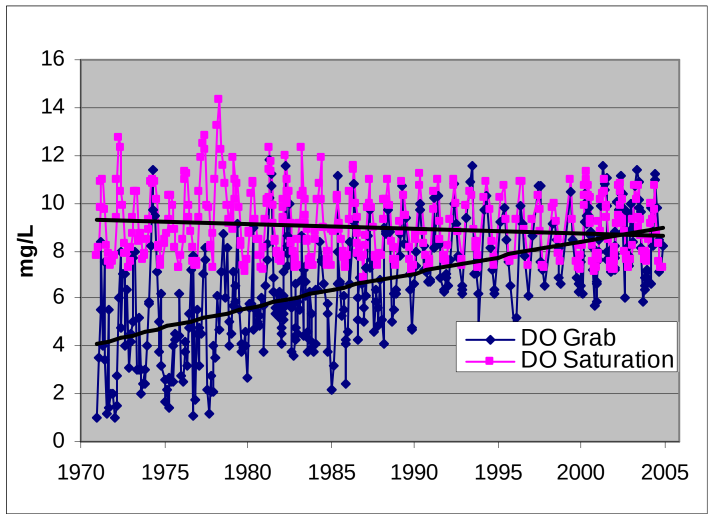


Fig. 3d. Dissolved Oxygen Plotted Against Saturation at the Rosser Gage.

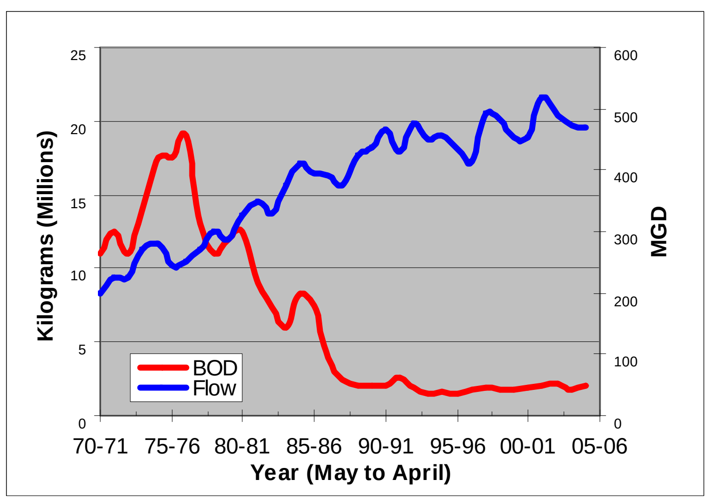


Fig. 3e. BOD vs. Flow for Major Region C Dischargers.

Reservoir Release Dominated Streams

Because of the extensive reservoir network, the majority of water in the Trinity basin is reservoir water, was reservoir water, or is going to be reservoir water. With all of the physical, chemical, and biological forces at work, reservoirs do an excellent job of cleaning water. When runoff or stream flow moves through a reservoir system, the water slows down allowing suspended sediment to settle out, nutrients to be used, and pollutants to sorb to particulates. Released water generally provides clean baseflow for streams. In general, these reaches are saturated with dissolved oxygen and have only isolated, infrequent pollution problems. There are five reaches of stream in the basin that are commonly supported at baseflow with releases from reservoirs (fig. 3f) and these segments are monitored closely by the agencies which are using them for water supply.

Fig. 3f. Map of Reservoir Supported Base Flow Segments.

Intermittent Streams

Intermittent streams throughout the basin are generally characterized by the runoff characteristics of their watersheds. Some small urban watersheds may have poor water quality during dry periods and during the “first flush” of a rain event. In addition, dissolved oxygen is occasionally low and bacteria are often high. Suspended and attached algae sometimes produce scums and odors and cloud the water. Notwithstanding these problems, fish such as shad and sunfish are often seen in numbers and recreational uses are intensive in park areas along such streams.

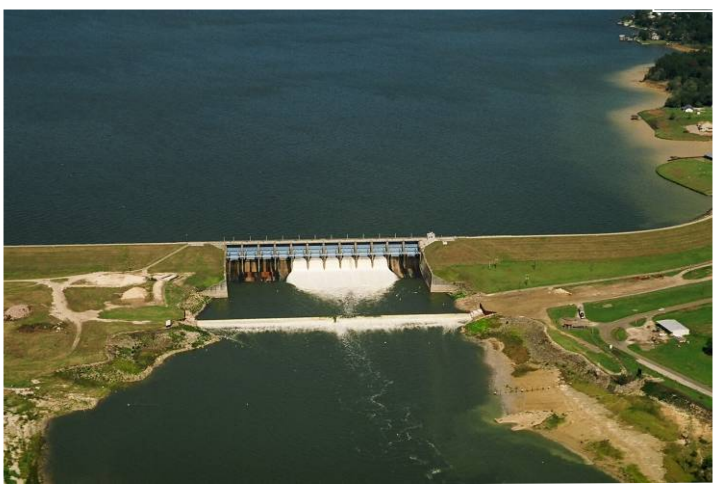


Fig. 3g. Release from Lake Livingston.

Intermittent streams with larger and less developed watersheds generally have turbid but otherwise good quality water following a rain, decreasing turbidity as the runoff decreases, standing pools which may remain clean or slowly stagnate after the flow ceases, and finally a dry channel. It is not uncommon for these streams to stay dry for months at a time. Although the data is limited, water quality parameters other than suspended solids is generally good. In some streams, occasional elevated levels of total dissolved solids, chlorides, or bacteria are noted at times of rising or peak runoff, apparently due to non-point sources.

Perennial Streams

In the eastern portion of the basin from around Cedar Creek Reservoir to Liberty, a number of the Trinity’s tributaries receive some of their baseflow from groundwater. Menard and Big Creeks in the lower basin and Catfish Creek in Anderson County are examples. These waters are clear, have a high water quality, and retain a constant baseflow even during periods of drought. The hydrograph in figure 3h shows that groundwater influent Menard Creek retains a fairly patterned flow regime and no instances of zero flow during the period of record.

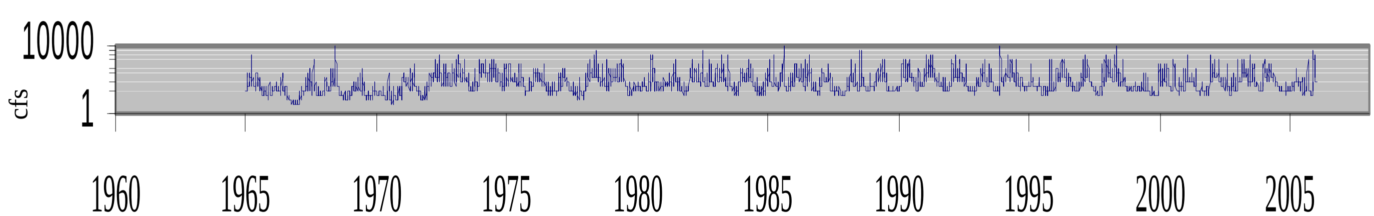


Fig. 3h. USGS Daily Flow Data at Menard Creek (Lower Basin) and Hwy 146.

Fig. 3i. Benbrook Lake.

Reservoirs

The reservoirs in the basin are fed mainly by intermittent streams. The main exception is Lake Livingston on the lower main stem. The water quality in the main pool of these lakes is generally acceptable for its intended uses. Some of the smaller urban lakes show elevated levels of toxics and are listed as impaired on the USEPA's 303d list. Lake Livingston, along with other basin reservoirs, occasionally have pH values above the 8.5 standard or have taste and odor problems in raw water supplies. In most cases these problems are not extreme and while they may represent eutrophic pressures in some lakes, there may be natural causes in others.

Water quality in the basin's reservoirs is a major concern for TRA and other controlling entities. Residential subdivisions, boat launches, marinas, and parks adjacent to lakes are capable of generating sizable amounts of domestic sewage and other wastes. Along with devising best management practices (BMPs) at Lake Livingston, TRA provides services for a fee in the operation of some sewage treatment plants, chemical analysis of treatment plant discharges, and the operation of a vacuum truck. In addition, TRA requires that on-site sewage facilities and excavation and/or construction projects be permitted through TRA's Lake Livingston Project. It is clear that a reservoir's owner/operator must take the lead in the control of lakeshore pollution.

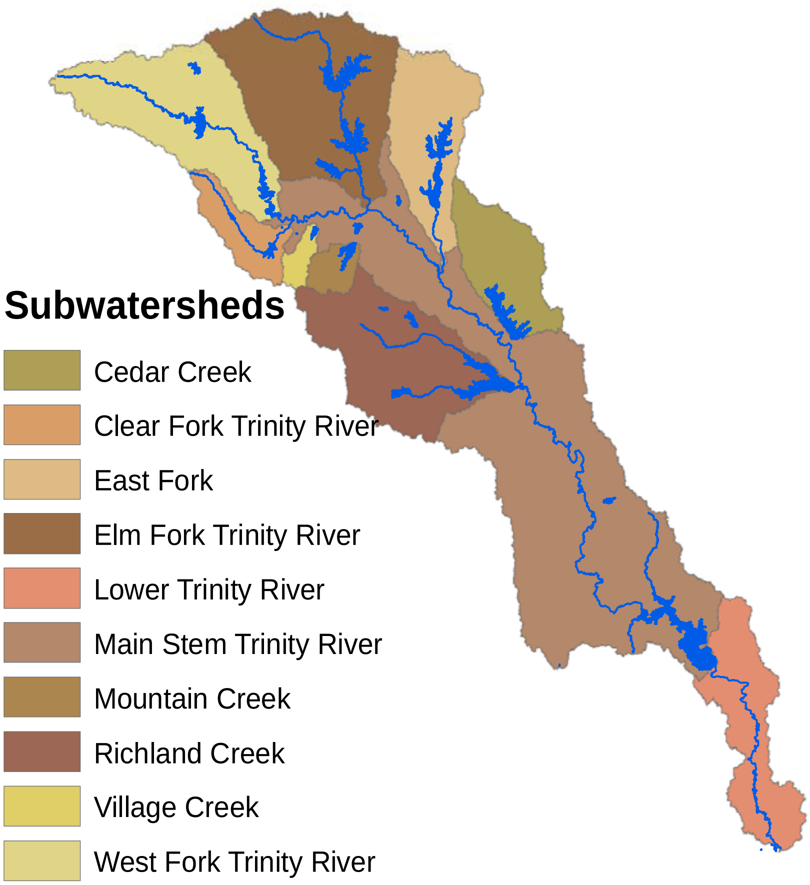


Fig. 3j. Trinity River Subwatersheds.

Watersheds

Wastewater discharge permits and standards have greatly improved water quality within the basin. Although it is no small task to regulate these point discharges, non-point sources present an even greater challenge. The Trinity River watershed is nearly 18,000 m² and has been divided into ten major subwatersheds (fig. 3j) ranging in size from 143 to 6,788 m². A river segment typically shares the characteristics of its watershed. For example, segments in the Upper Main Stem tend to be quite turbid which is characteristic of the prairie soils found in the subwatershed. Whatever happens in a watershed can have an impact on the water quality of that and any downstream river segment.

In the Trinity River basin, the constituents that contribute to non-point source pollution include: oxygen demanding material, nutrients, dissolved and suspended solids, including sediments, heavy metals, pesticides, complex compounds, bacteria, PAH's, litter, and floatables. Other potential sources of pollutants include wastewater overflows, septic system leakage, leachate from solid waste facilities, construction activities, and agricultural operations. Materials which may be contributed from agricultural sources include pesticides, nutrients, salts, and sediments in runoff and return flows. Non-point pollutants have been associated with low dissolved oxygen concentrations, algae blooms, periodic toxicity to aquatic life, and sediment accumulations of toxic and organic substances.

To aid in controlling pollutants entering waterways throughout the United States, the EPA has initiated a stormwater permitting program for cities with populations exceeding 100,000 residents. At present, the major cities in the Dallas-Fort Worth area have joined in a cooperative approach to the stormwater permitting process. The North Central Texas Council of Governments (NCTCOG) coordinates these efforts. The cities, NCTCOG, and their consultants are working on a watershed based approach to classifying the *instream water quality* during wet weather, "first flush" events. This instream sampling method is quite a shift from the previous "end of pipe" sampling required in the past.

Fig. 3k. Intersection of Park Row and Fielder in Arlington, TX. (Note how urbanization has changed the watershed).

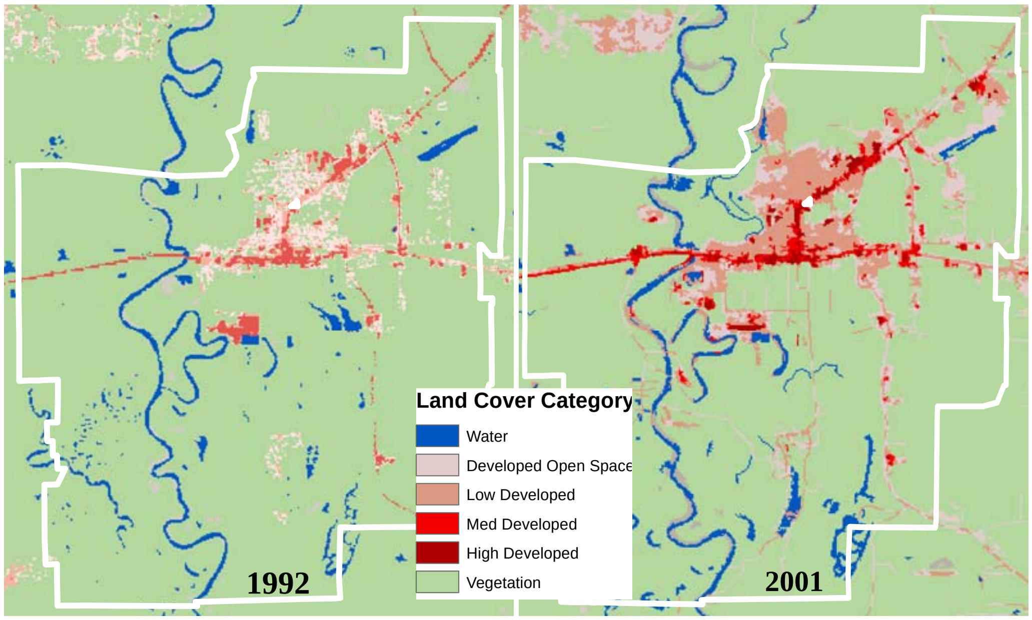


Fig. 3l. City of Liberty, TX Land Cover Change (USGS).

In the Dallas/Fort Worth area, subdivisions and mobile home parks have grown along the leading fringes of the rapid urban expansion. These developments are beyond the economic range of existing collection systems and are frequently beyond any city limits or extraterritorial jurisdictions. They provide sewage treatment with either septic tanks or small package plants. Maintenance, operations, and sometimes the system designs, are often not very good. There is concern and interest on the part of the water supply agencies to begin taking reasonable and prudent steps toward good wastewater management as these areas grow. Of greatest interest are the geographic areas within about ten miles of the regions major water supply lakes: Arlington, Benbrook, Eagle Mountain, Worth, Grapevine, Lewisville, Lavon, Ray Hubbard, and Joe Pool. Although the scale is smaller, the lower basin is facing some of the same issues as development and population increase (fig. 3l).

Dallas, Fort Worth, Mansfield, Arlington, along with the Trinity River Authority, the Tarrant Regional Water District and the North Texas Municipal Water District have been studying, separately and together, ways to encourage and assist with water quality management in these areas. The most likely approach is to make available quality wastewater services, such as are now provided by the Trinity River Authority around Lake Livingston and the North Texas Municipal Water District in the East Fork watershed, and to urge their use. When justified by the amount of development in an area, eventual connection to a regional system would be encouraged.

The Denton Creek Regional Wastewater System is an example of this approach. It serves an area of northern Tarrant County and southern Denton County at the upstream end of Grapevine Lake. In its service area are a growing residential population, Alliance Airport, and The Texas Motor Speedway. Mountain Creek Regional Wastewater System came online in 2004 and was developed to serve the expanding populations of Midlothian, Grand Prairie, and Venus.

Water Quality Planning and Assessments

As the commitment to improving water quality picked up speed throughout the 1960's it was apparent that a system of collecting organizing, and analyzing water quality data was needed. Entities throughout the basin began stream and reservoir sampling programs that ranged in size from single event sampling to systematic basin-wide collection efforts. Evolution has been a major factor in every aspect of the water business. On the political side, agencies are constantly changing their priorities and goals. On the science side, technological improvements are re-shaping how samples are collected and analyzed. In addition, the importance of database creation and management cannot be overstated.

From the 1950's to the 1990's, entities throughout the basin collected water quality data with oversight and some coordination with the various state agencies. The Texas Legislature created the Clean River Program (CRP) in 1991 in response to concerns that water resource issues were not being addressed in a holistic manner. The CRP is funded by fees paid by wastewater dischargers and the program is implemented by TCEQ contracting with 15 partner agencies. Because of its basin-wide scope, TRA was selected to implement the CRP for the Trinity River basin.

TRA partners with several other cities and regional entities to collect quality assured water quality data that is used in the biannual state surface water assessment. The CRP promotes coordination and communication so that a comprehensive sampling program can ensure the highest quality data with little overlap and/or duplicated effort. The Clean Rivers Program has become an essential source of routine water quality data.

Water Quality Reports

Many water quality reports are completed in and on the Trinity River basin each year and the scale and scope of these reports varies drastically. Taken as a whole, the reports indicate that the three major water quality topics in the Trinity River basin are legacy pollutants, bacteria, and nutrients.

Every two years, the state completes a water quality assessment that is submitted and approved by the EPA. This assessment separates sections of the river basin into assessment units and uses water quality data to determine if that sections water quality meets the predetermined standard. For example, segment X is determined that it should be able to support a great deal of aquatic life, aka "High Aquatic Life Use." The quantative standard associated with that qualitative designation is 5mg/L of dissolved oxygen. If the data shows that the samples meet that criteria, then the designated assessment unit is determined to be supporting its use.

Although this process seems straight forward, care must be taken when reviewing the state report. All segments that have not been specifically studied are assigned a default "High Aquatic Life Use." In reality, some of these streams may be slow moving, shaded, and full of organic debris. The natural conditions suggest that it should not be held to the same standard and may become listed inappropriately. Efforts are currently underway at both the state and regional level to address this issue of inappropriate standards. In addition, TCEQ is focusing on creating designated assessment units with site specific water quality criteria. The shift to this assessment unit approach represents an evolution of water quality monitoring programs and demonstrates a commitment to constantly improving the water quality of the basin.

Legacy Pollutants

Pollutants that have been banned for decades, yet are still found in the environment in concentrations deemed to be detrimental for humans. The sources of these are typically unknown or contaminated sediment that, were it to be removed, could cause greater harm.

Bacteria

Samples continue to show high levels in highly urbanized portions of the basin (fig. 3m). (Note the range of values for the Trinity River at Rosser site).

Nutrients

Aquatic organisms need nutrients to survive, however, In some segments of the basin, excess nutrients may contribute to algal blooms that could lead to low DO levels and fish kills.

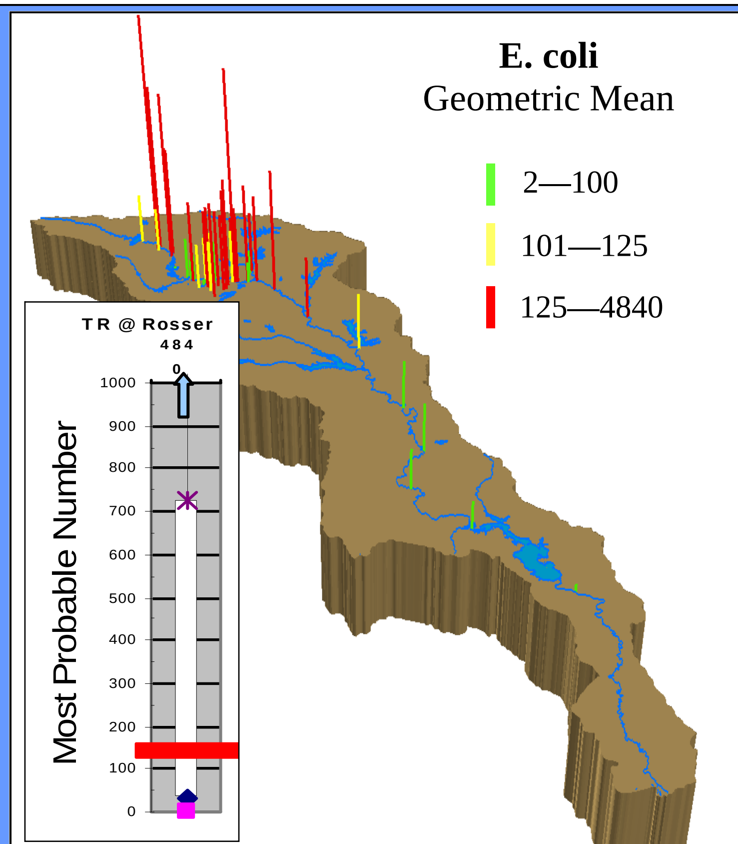


Fig. 3m. E. coli. Values at the Trinity River at Rosser USGS Gage.

Discussion

Water Quality Assessment under the Clean Rivers Act – The 1992 assessment, though performed within three months, was able to review the water quality indicators which have been studied for years and also to examine more recent data. Most important among the latter are toxics and non-point sources, excerpted from the assessment report below. Since 1993, TRA has investigated these topics more and performed relevant special studies and pilot projects.

Toxics – Toxic substances are receiving increased attention in the Trinity Basin, especially in the upper main stem. Throughout the Trinity Basin, wastewater discharges, urban runoff, and agricultural runoff have been identified as potential contributors of toxics. Diazinon has been identified as causing biomonitoring compliance problems in wastewater effluents. Measured levels of chlordane in fish tissue have caused fishing bans to be imposed in several urban segments.

In recent years, numerous studies have been carried out in the Trinity River Basin, particularly in the Dallas-Fort Worth area. These studies have been performed by the TWC, TRA, consultants and universities. The following toxic chemicals have been documented to exceed water quality criteria levelss: cadmium, chlordane, chromium, copper, dieldrin, endrin, heptachlor, lead, lindane, and PCB's. Other toxics which have caused concern because of elevated levels in water and sediments include: aldrin, arsenic, DDT, hexachlorocyclopentadiene, mercury, selenium, silver and zinc. It is important to note that the water quality criteria are used only as a point of comparison. If a parameter exceeds a water quality criteria, it does not mean that the value is in violation of a water quality standard. Oftentimes, the value is measured at a location where the water quality standard does not strictly apply, such as in the hypolimnion of a reservoir, an intermittent, nondesignated tributary, or a high flow condition.

Fig. 3n. TRAD Trash Clean Up.

Fig. 3o. Trinity Clean Up.

Non-point sources – Non-point sources from urban and non-urban areas contribute dissolved and suspended materials to the Trinity River Basin. These materials include oxygen- demanding material, nutrients, dissolved and suspended solids including sediments, heavy metals, pesticides, complex organic compounds, bacteria and litter. Other potential sources of non-point pollutants include overflows from wastewater collection systems, septic system leakage, leachate from solid waste facilities, construction activities, and agricultural operations. Materials which may be contributed from agricultural sources include pesticides, nutrients, salts, and sediments in runoff and return flows. Non-point pollutants have been associated with low dissolved oxygen concentrations, algae blooms, periodic toxicity to aquatic life, and sediment accumulations of toxic and organic substances.

To aid in controlling pollutants entering waterways throughout the United States, the EPA has initiated a stormwater permitting program for cities with populations exceeding 100,000 persons and for many industries. At the present time, the major cities in the Dallas-Fort Worth area have joined in a cooperative approach to the stormwater permitting process. NCTCOG is coordinating these efforts. The cities, NCTCOG and their consultants, and the USGS have established wet-weather monitoring stations in residential, commercial and industrial areas of Dallas, Fort Worth, Arlington, Irving, Garland, Mesquite and Plano for stormwater sampling of seven storm events at each site. NCTCOG expects that approximately 300 runoff events will be sampled by the time the program is complete. Once the pollutant-generating mechanisms have been characterized, Best Management Practices will be developed for control of stormwater pollution.

Bay and Estuary Inflow Quality – Inflows to bays and estuaries are important in establishing a salinity gradient and in providing nutrients to the biological systems of bays and estuaries. However, the natural quantity and quality of inflow is highly variable, and there is not a consensus regarding the exact amounts which are necessary for the bays and which changes would make a difference.

Water Quality Goals in Effluent Dominated Reaches – The federal Clean Water Act requires that all waters in the United States be suitable for fish and wildlife and for recreation in or on the waters by 1983. Even though these criteria do not include provisions for drinking water for human consumption, they are in many respects more stringent, inasmuch as the requirements for fish, wildlife, and recreation must be high enough to exclude toxic conditions or disease-bearing organisms even without any treatment of the water. Fortunately, as noted above, most of the waters in the Trinity River Basin satisfy these criteria.

The effluent dominated reaches, described above, do not entirely satisfy the federal criteria. While it is desirable to pursue the prescribed conditions of high water quality, they are extremely difficult to achieve, if not impossible, so long as dry weather flow consists entirely of wastewater effluent, even with the best possible treatment. Moreover, the river is affected by runoff and other factors quite removed from the wastewater treatment plants. The better the wastewater treatment, the more radically the river quality will be affected by rises. Such changes are very damaging to stable and desirable communities of fish and other wildlife.

As described above, the emphasis of regulatory agencies is now on finding and regulating toxicity in wastewater plant effluents. However, the runoff or rise condition is the limiting factor in the quality of receiving waters, and no improvements have occurred in that area. In order to reduce such problems, the Environmental Protection Agency has required all cities over 100,000 population to obtain permits governing the quality of stormwater in those cities. At present, stormwater is being analyzed to determine what the contaminants are. Then steps are to be devised by EPA and the permittees to control the contaminants. Concurrently, under the Clean Rivers Act, methods are being developed to include runoff in the calculations which are presently used by regulatory agencies to determine permit limits for point sources.

Also, in the Fort Worth-Dallas area there are several park areas being developed next to the river which will bring people into contact with the river in unprecedented numbers. Fort Worth is expanding its parks from the Clear Fork through the West Fork. Arlington has opened a large park on an effluent dominated section of the West Fork. Dallas has one park in the floodway of the river, and voters have approved funds for additional parks in the floodway. These are definite, and some additional developments are planned. The idea of a continuous park, or "Greenbelt," along the river between Fort Worth and Dallas has been promoted from time to time for many years. The idea was incorporated into a specific plan as part of the Trinity River Project in the early 1970s. The idea is now being discussed in coordinating committees of the North Central Texas Council of Governments.

The safety of the river from infectious organisms is an issue which requires attention, where there is increasing recreational contact with the river. This problem is also made more difficult by the recent dechlorination of wastewater effluents.

Lakeshore Water Pollution Control – Certain activities which are common near lake shores may cause pollution in the adjacent part of the lake. Residential subdivisions, boat launches, marinas, and parks are capable of generating sizable amounts of domestic sewage and other wastes. The TCEQ is the primary state agency with jurisdiction and enforcement power in water quality matters. Other governmental entities have some legal powers, but their staff and other resources are much more limited.

When Lake Livingston was being constructed, it was apparent that there was going to be extensive residential and other development around the lake, and that much of the initial facilities to handle wastewater would be septic tanks and drainfields. Much of the soil around the lake is clay and is poorly suited for drainfields. The Authority provides services for a fee in the operation of some sewage treatment plants, the chemical analysis of treatment plant discharges, and the operation of a vacuum truck. The Authority, through the Livingston Recreation Fund, owns and operates a sewage treatment plant to serve its Wolf Creek Park, on the lake's shore. A long-range plan for sewering most of the developed shoreline of Lake Livingston was prepared in 1974 and updated in 1978.

The lakes owned and operated by the Tarrant Regional Water District (TRWD), especially Cedar Creek Lake, and the city of Dallas' Lake Ray Hubbard, are similar to Lake Livingston in the kind of shoreside development that has taken place, and similar steps have been taken to deal with the problems.

In conclusion, it is clear that the owner/operator of a lake must take a strong role in the control of lake shore pollution problems. The TCEQ can provide support in enforcement. Still, the owner/operator is often best suited, especially on a large lake, to take the lead in organization, planning and in certain services.

Water Supply Lake Watershed Management – In the past few years the rate of development in the watershed of the water supply lakes of the Dallas-Fort Worth area has accelerated greatly. This is development over and above that which has occurred in the immediate shoreline area of these lakes. It consists generally of subdivisions and mobile home parks in the leading fringe of suburban growth. These developments are beyond the economic range of existing collection systems and are frequently beyond any city limits or extra-territorial jurisdictions. They provide sewage treatment with either septic tanks or small package plants. Maintenance and operations, and sometime designs, are often insufficient to assure continuous, high-quality treatment.

The lakes of interest at present are Arlington, Benbrook, Eagle Mountain, Worth, Grapevine, Lewisville, Lavon, Ray Hubbard, and Joe Pool. The quality of water in these lakes is quite adequate at present, but there is a concern and interest on the part of the water supply agencies to begin taking reasonable, prudent steps toward good wastewater management as these areas grow. The geographic area of greatest interest is that within five to ten miles of the lake shores.

A historical case study is that of Lake Arlington. About 1970, there were about a dozen medium-to-small wastewater plants in the watershed. The quality of operation was fair-to-poor. The City of Arlington decided to try to have all those discharges diverted, treated, and discharged outside the lake watershed. It extended necessary collection mains and exercised what legal power and persuasion was available to it and largely succeeded by about 1974. The city was pleased with certain improvements in algae concentrations and taste-and-odor problems in the lake water. The actions taken in the Lake Arlington watershed are not necessarily feasible in other cases, and even now some new development is occurring beyond the presently sewered areas.

The cities of Dallas, Fort Worth, Mansfield and Arlington, along with the Trinity River Authority, the Tarrant Regional Water District and the North Texas Municipal Water District have been studying, separately and together, ways to encourage and assist with water quality management in these areas. The most likely approach at present is to make available quality operating services, such as are now provided by the Trinity River Authority around Lake Livingston and the North Texas Municipal Water District in the East Fork watershed, and to urge their use. When justified by the amount of development in an area, eventual connection to a regional system would be encouraged.

The Denton Creek Regional Wastewater System, located at the upstream end of Grapevine Lake, is one example of this approach. DCRWS serves one of the fastest growing residential populations in Texas (fig. 3p).

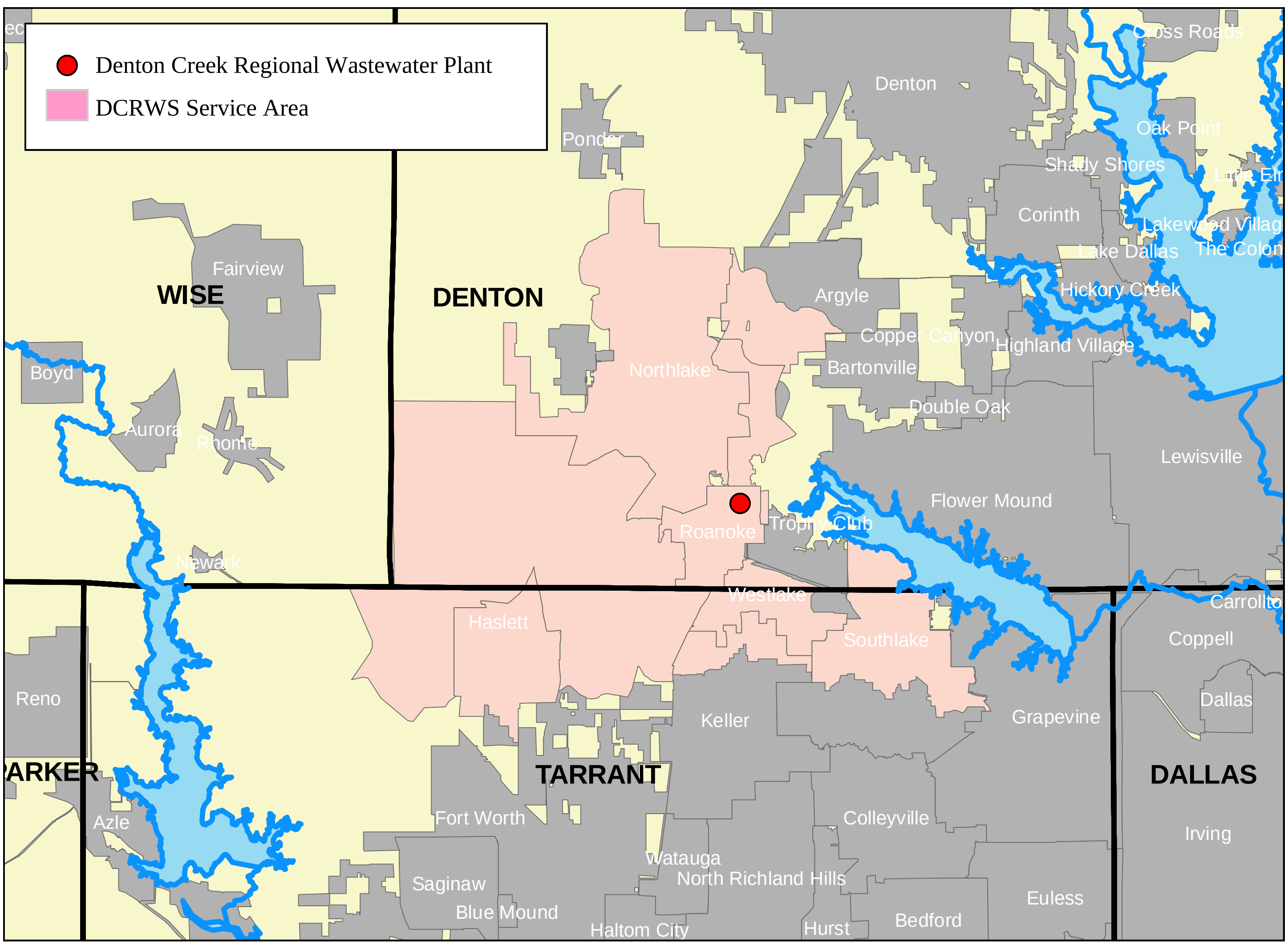


Fig. 3p. Denton Creek Regional Wastewater Service Area.

Trinity River Authority of Texas

Basin Master Plan

Water Reuse

Background

When reuse was considered after the drought in the late 1950's, the standard for municipal wastewater treatment was called "secondary" treatment. It was designed to produce water with a biochemical oxygen demand (BOD) and total suspended solids (TSS) of approximately 30 mg/l each. The quality was suitable for some irrigation purposes, but very little of it was used that way in the Trinity basin. Almost all of it was discharged to streams, where in most cases it produced a distinct reduction in dissolved oxygen and some toxicity due to ammonia and chlorine residuals. Moreover, a lack of enforcement and public interest resulted in many plants not performing even as well as they were designed.

When the environmental movement began in the mid-1960's everything changed. Under the Texas Water Quality Act (1967) the major permit limits in the Dallas-Fort Worth area were lowered to 10 mg/l for BOD and 12 mg/l for TSS. That required improved biological treatment and sand filters. The federal Clean Water Act (1972) adopted those requirements and over time continued to require more improvements. BOD limits were lowered further and ammonia limits were added, requiring complete nitrification. Treatment to remove chlorine residuals were added. Moreover, since the permit limits are the limits of what is legally allowed, the plants must perform even better than those limits almost all the time in order to still meet them under the most adverse conditions. The result is consistently high water quality.

The Trinity River Basin has moderate rainfall and runoff on average but it is notoriously erratic: floods at times and drought at other times. Even a normal year has much of the rain and streamflow in the late spring, followed by very hot dry weather from mid-June through August. Population growth and economic activity in the Trinity basin has required extensive development of water supplies to get through the dry periods. On average, about 60-65% of the water supplied in a municipal system is subsequently discharged into the wastewater system. The return flow is fairly constant and therefore has a characteristic that is essential for water supply, i.e., it is always there, known in water supply terminology as firm yield (fig. 4a). However, the quality of treated wastewater for many years was not good enough to be attractive for most forms of reuse. It was discharged to a stream and natural processes gradually purified and diluted it. In many cases, the water entered and supplemented another water supply downstream. It was not done intentionally to supplement a water supply, but as a practical matter it was *de facto* reuse.

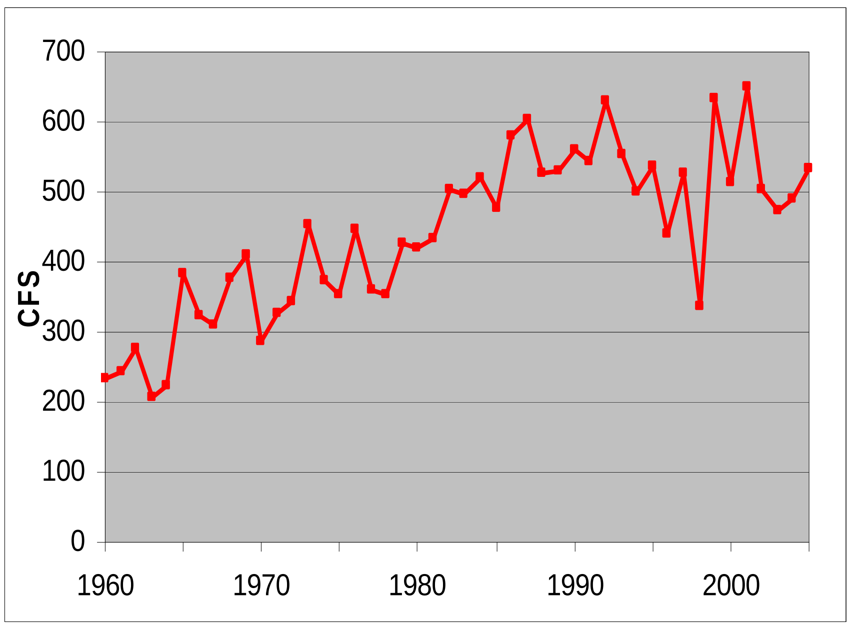


Fig. 4a. Minimum 7-Day Flow at Trinity River Below Dallas.

It does not appear that it will ever be possible or desirable to reuse all reclaimed water. Some flows need to remain in the stream to support the natural environment and to protect downstream water rights and supplies. Moreover, repeated cycles of reuse become progressively more difficult and expensive. Reuse will be an important part of water supplies, but there will be limits.

Reuse Explained

What is Reuse? In the Trinity River basin, the same parcel of water is reused several times over before being discharged into Trinity Bay. For example, runoff collects in Lake Lewisville, then pulled out of Lake Lewisville and pumped north to be used by the City of Denton. Denton treats the water and discharges the water back into Lake Lewisville. The same water could then be pumped out of Lewisville and used as Dallas water supply. Dallas treats the water and discharges it back into the Trinity. Continuing south, the same water could be pumped out by the City of Huntsville, cleaned, and discharged into Lake Livingston. Once in Lake Livingston, the water could be pulled out by Houston and used again. Finally, Trinity River water could be discharged from Houston into the San Jacinto and arrive into Galveston Bay from a different river basin altogether.

Two types of reuse exist: direct reuse and indirect reuse. Direct reuse is using water that is pumped directly from a treatment plant to another location without ever entering a receiving surface water stream. Currently, direct reuse does not require a water rights permit because the original user still controls the water. Indirect reuse is using treated water after it has been discharged into a receiving stream. For example, a treatment plant discharges water into the stream and that water is later pumped from the stream to irrigate a golf course. Because the water is being diverted from Texas surface waters, the golf course must own a bed and banks permit. Currently, the legal intricacies are still being debated.

Past and Present Issues

Reclaimed Water – In 1959, the quality of treated wastewater did not make it attractive for reuse, but over the next four decades, improvements in wastewater treatment by all parties in the basin have made it very feasible, and new treatment technologies increase the possibilities every year. The word "wastewater," as applied to water produced by a wastewater treatment plant, is now out of date in several respects:

- It is not "waste" in the sense of "poor quality." It is good quality and getting better. Most "waste" has been removed.
- It is not "waste" in the sense of "unusable." It is suitable for many uses and there is an increasing demand for it.
- It is not "waste" in the sense of "cheap." A large amount of money has been spent to remove the waste.
- It is not "waste" in the sense of "without value." There is a market of buyers willing to pay a price for it.

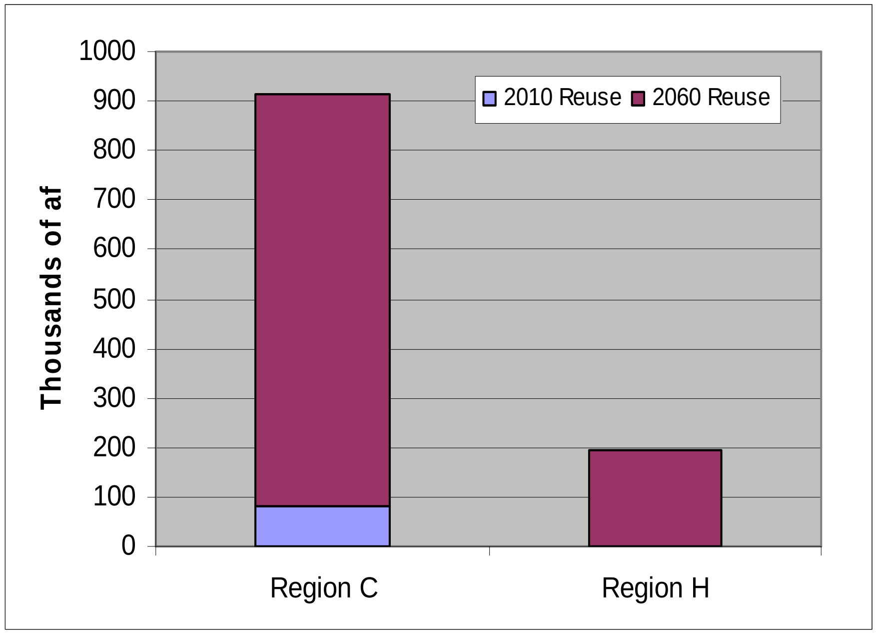


Fig. 4b. 2010 and 2060 Reuse Estimates for Regions C and H.

Today a more appropriate term is "reclaimed" water. It may be wastewater when it enters the plant, and what happens there may be considered wastewater treatment. But after treatment, it is no longer "waste" water. Even "treated wastewater" is ambiguous and fails to convey the radical cleanup that has occurred.

Fig. 4c. Effluent from TRA's Denton Creek Outfall.

Quantity of Reclaimed Water - The great majority of reclaimed water in the Trinity basin comes from municipal plants (approximately 95%). According to Water for Texas 2007, Region C anticipates that the reuse portion of the water supply will increase 950% from 79,342 af in 2010 to 833,623 af in 2060. In addition, reuse is projected to make up 28% of all new 2060 water supply (fig. 4b). Currently, Region H has no reuse. By 2060, that number is expected to increase to 196,600 af and make up 18% of projected new water supplies (fig. 4b).

New Treatment Technologies – A number of treatment technologies have advanced dramatically in recent years. For example, membrane technology has been known for over twenty years, but until recently it was not cost effective except in the most extreme circumstances. Now, however, there are a variety of types of reliable membranes, which can produce almost any desired level of purity, including the removal of all cysts, bacteria, viruses, organics, metals and inorganics. Membrane treatment is rapidly increasing in in both wastewater treatment and drinking water treatment. Other technologies are also being widely developed and applied for removal of nutrients.

Carbon is also widely used to remove organics, disinfection byproducts, and tastes and odors. In addition, many treatment plants are using ultraviolet light or ozone instead of chemicals to sterilize effluent.

New Regulations that may require New Treatment Technology - State and federal regulatory agencies are developing new regulations for both drinking water and wastewater treatment which will likely require one or more of the above new technologies. For example, the Enhanced Surface Water Treatment Rule under the Safe Drinking Water Act focuses on the removal of the smallest solid particles in order to exclude infectious organisms such as *Cryptosporidium* that are resistant to disinfection, or to reduce organic substances that can form carcinogens during disinfection. Such requirements apply regardless of any reuse that may be involved, but they may result in the use of requiring membrane technology, which in turn addresses a wide range of contaminants and constitutes a broad barrier to contamination. The Disinfectants / Disinfection-Byproduct Rule and the Total Trihalomethane MCL, which address mainly potential carcinogens, and the Arsenic MCL, among others, may also require membrane or carbon treatment. Also, under the Clean Water Act, the Environmental Protection Agency is currently requiring all states to develop new numeric stream standards for nutrients. Numerical nutrient criteria are currently undetermined, but initial proposals would require many wastewater treatment plants to add nutrient removal processes.

"Emerging Concerns" that May Require New Treatment Technology – There is concern about various pharmaceuticals that are taken by people, excreted, and make it through the wastewater treatment plant. Antibiotics in the receiving stream might create an environment that selects and propagates new antibiotic-resistant pathogens. Hormones such as estrogen might affect fish or water supplies downstream. These are mere possibilities that are being studied by scientists at present, but if they are determined to be a real problem, advanced treatment of the type discussed above would be called for. Advancements in detection technologies have allowed scientists to study these emerging contaminants and it is anticipated that the next decade will bring better understanding of their importance.

Reclaimed Water as a Commodity with Several Stakeholders – The steady, reliable flow of reclaimed water, its high quality, the cost of producing it, and increasing demand make reclaimed water a commodity, in some respects. At the same time, it is a resource in which several stakeholders have an interest, especially in the upper basin (fig. 4d). The ratepayers of the utilities have paid for both the water supply and wastewater treatment and they have an interest in how it is reused. There are environmental needs and requirements to maintain flow in the stream. Prior water rights need to be protected. Reuse will have to be implemented in ways that are consistent with its characteristics as both a commodity and a public resource.

Existing Markets and Uses for Reclaimed Water – Various reuse markets and uses have developed in the last few years. TRA implemented a reuse project with the Las Colinas development in Irving in 1985, in which reclaimed water is purchased by Las Colinas to maintain the level of scenic lakes and for watering landscaping and several golf course. A number of sales of reclaimed water have been made in the Trinity basin, and elsewhere in Texas, for cooling water for commercial electric generating plants and for watering golf courses. The North Texas Municipal Water District twenty years ago located a major new wastewater treatment plant so that its discharge would supplement the District's water supply.

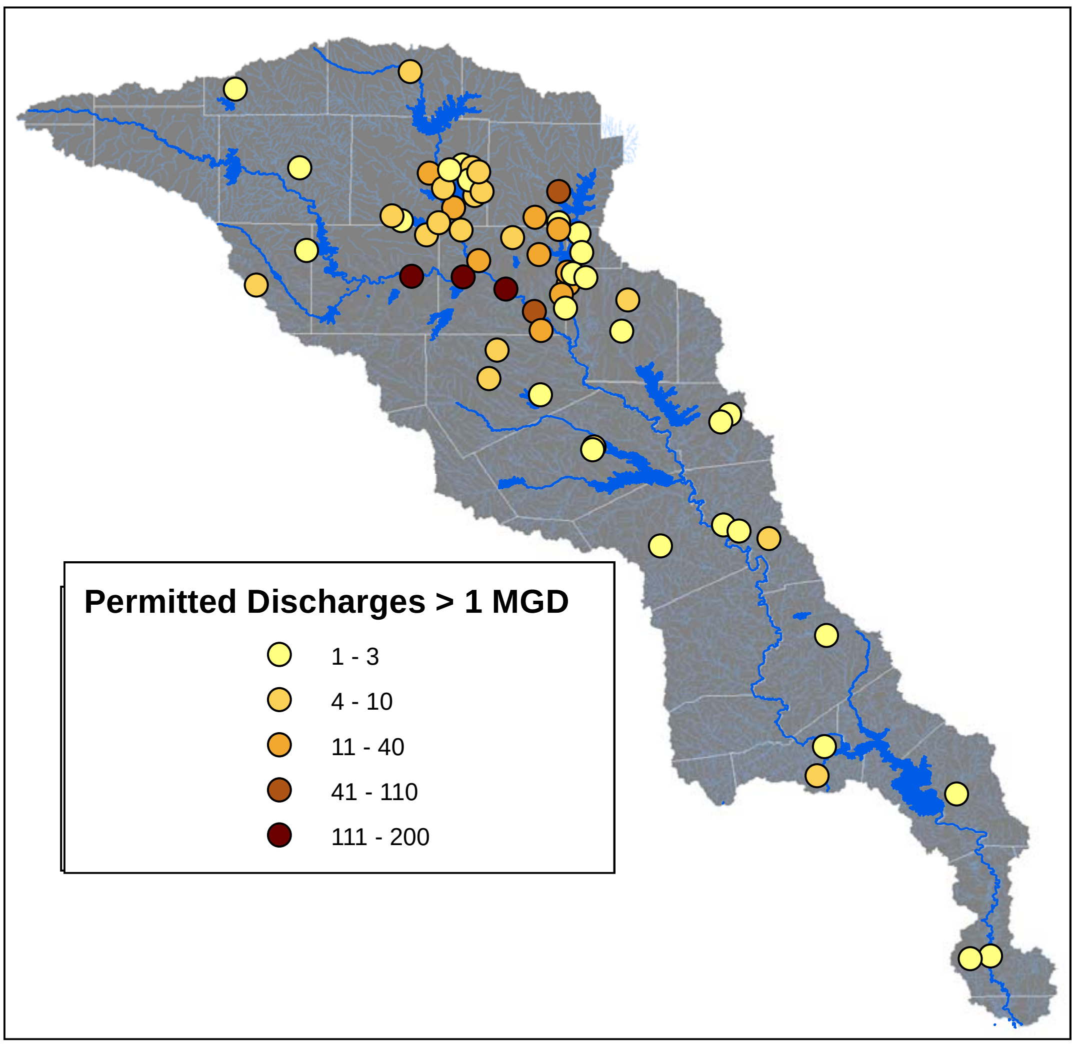


Fig. 4d. Dischargers Permitted Above 1 MGD.

That supplement has now grown to 32 MGD. In addition, there are numerous pending proposals to purchase or trade reclaimed water.

The Tarrant Regional Water District (TRWD) has created a reuse project that will divert Trinity River water into constructed wetlands. The wetlands serve a cleaning function and then deliver the water into the Richland–Chambers or Cedar Creek Reservoir. The North Texas Municipal Water District (NTMWD) is currently building a similar system south of Lake Ray Hubbard on the East Fork with plans on capturing some of their return flows and pumping them back into Lake Lavon. Dallas is also planning to reuse some of their reclaimed water in Ray Hubbard and Lewisville reservoirs.

Fig. 4e. Air photo of Las Colinas Reuse Project.

Reuse and Lake Livingston – At the time of TRA's founding in 1955, there were already many *de facto* cases of reuse, but it was not called reuse and the amounts of water were relatively small. However, it was a time of historic change. TRA's enabling statute empowered TRA to do many things as circumstances permitted but only absolutely required TRA to do one thing: prepare a Master Plan for the water resources of the basin. It was the climax of the 1950-57 drought. All water suppliers were seeking new sources, near-term and long-term. The Legislature's purpose in requiring a Master Plan was to combine all the separate plans with an overview and to reconcile differences.

The most controversial proposal was for a large lake on the lower Trinity River to supply the Houston area. TRA and its Master Plan became the vehicle of the Trinity basin interests to ensure that the lake did not damage their interests in the river. The result was that TRA became a partner with the city of Houston in the development of the lake, which became Lake Livingston, and many assurances were incorporated into its operation to provide water to the mid- and lower-Trinity basin and protect upstream supplies as well. During the development of Lake Livingston, the unusual step was taken in the process of acquiring water rights for the lake to specifically recognize that wastewater discharges from upstream made a significant portion of the drought period inflow, firm yield, and resulting appropriation. An engineering report in 1959 noted that, "Although the two principal cities in the Upper Basin so far do not seem to contemplate the reuse of Trinity waters, the Trinity River Authority does consider that possibility." Consequently, the Lake Livingston water rights recognized a right of reuse of upstream water.

Fig. 4f. Lake Livingston Spillway.

Legal Issues

Water Rights Permits Involving Reclaimed Water – Several permits have been issued for water rights involving reclaimed water since 2000. They are all quite different from

For more information about water reuse, visit the Water Reuse Association at:

www.waterreuse.org

each other as to physical scheme and legal basis. They include the Tarrant Regional Water District for 195,000 af/y, the Trinity River Authority for the reclaimed water from its four wastewater treatment plants, the city of Dallas for all but 114,000 af/y from its two wastewater treatment plants and two additional wastewater treatment plants, the Upper Trinity Regional Water District for reclaimed water associated with water imported from the Sulphur River basin, and the city of Irving for reclaimed water associated with water imported from the Sulphur River basin. As of early 2007, a major permit for the North Texas Municipal Water District is pending.

Sequential Ownership and Control in Regional Systems – Many small cities and districts in rural areas own and operate their entire water supply and wastewater systems. In such cases the city or district can design and implement a reuse project in whatever way is most efficient for them without concern about ownership or control because they own the entire cycle. Regional systems, however, which provide almost all service in urban areas and even some rural areas, are completely different. There are eight steps through which water passes in a water supply and wastewater system: raw water, raw water transmission, drinking water treatment, distribution system, users' homes and workplaces, primary collection system, secondary collection system and wastewater treatment. The water and facilities at each step may be owned and controlled by a different party. Moreover, each owner may acquire water from more than one entity at the prior step and convey it to more than one entity at the next step. In fact, the water utilities of the Dallas-Fort Worth Metroplex are made up of many networks of this type. Notwithstanding the complexity, it works and adapts efficiently to the constantly changing requirements of the area.

Wastewater Plants as Key Locations for Reuse Decisions – In the above-described sequence through which water passes, the wastewater plant is the focal point for decisions regarding reuse. Prior to the retail users, reuse is not relevant because the water has not even been used the first time. Afterward it is too dirty to reuse until it is reclaimed. At the wastewater plant, when treatment is complete, the water is of known, consistent quality and quantity. If it needs further treatment to be suitable for a certain potential reuse, or transport to reach the point of reuse, it is at the wastewater plant that the fullest range of options exists, from which the best alternative can be chosen. Among the options are further treatment at the plant, or treatment at the point of use; it can be transported by pipeline or discharge downstream.

Water Rights – Many different doctrines, guidelines, and legal theories have been advocated and applied regarding water rights involving treated water from wastewater plants. Historically, most calculations of yields and water rights have not included wastewater flows, but some have, and for some the records do not show whether they were considered or not. Wastewater is a small fraction of the total appropriation in some cases, but in some it is large. In some cases the wastewater source is specifically acknowledged, and in others not. There are distinctions and debates about "direct" and "indirect" reuse, the "four corners" of water rights, "bed and banks" permits, the "seniority" of reuse, "reclaimed," "developed," and "surplus" water, "return flows" and other matters.

There is no settled and consistent approach to water rights involving reuse that adequately comprehends 1) the great variety of arrangements regarding water ownership and liabilities among municipalities, users, and regional water utilities, 2) the developing markets and competition for water supplies, 3) the requirement by law of progressively more advanced treatment by both wastewater and drinking water treatment plants, 4) the advanced treatment technologies which enable the production of extremely purified water at progressively lower costs, and 5) the state's need to manage and monitor the use of its water.

Conclusion

Reuse will steadily grow into an important component of water supply in the Trinity basin. It is important that certain criteria and principles be followed:

- Develop reuse in ways that can adapt to new technologies and markets
- Develop projects that are efficient in their use of resources
- Negotiate equitable arrangements among stakeholders
- Treat reclaimed water as a commodity with value
- Wastewater treatment plants are focal points for planning reuse systems
- Maintain the health and safety of water supplies
- Protect existing water rights and supplies
- Protect the natural environment.

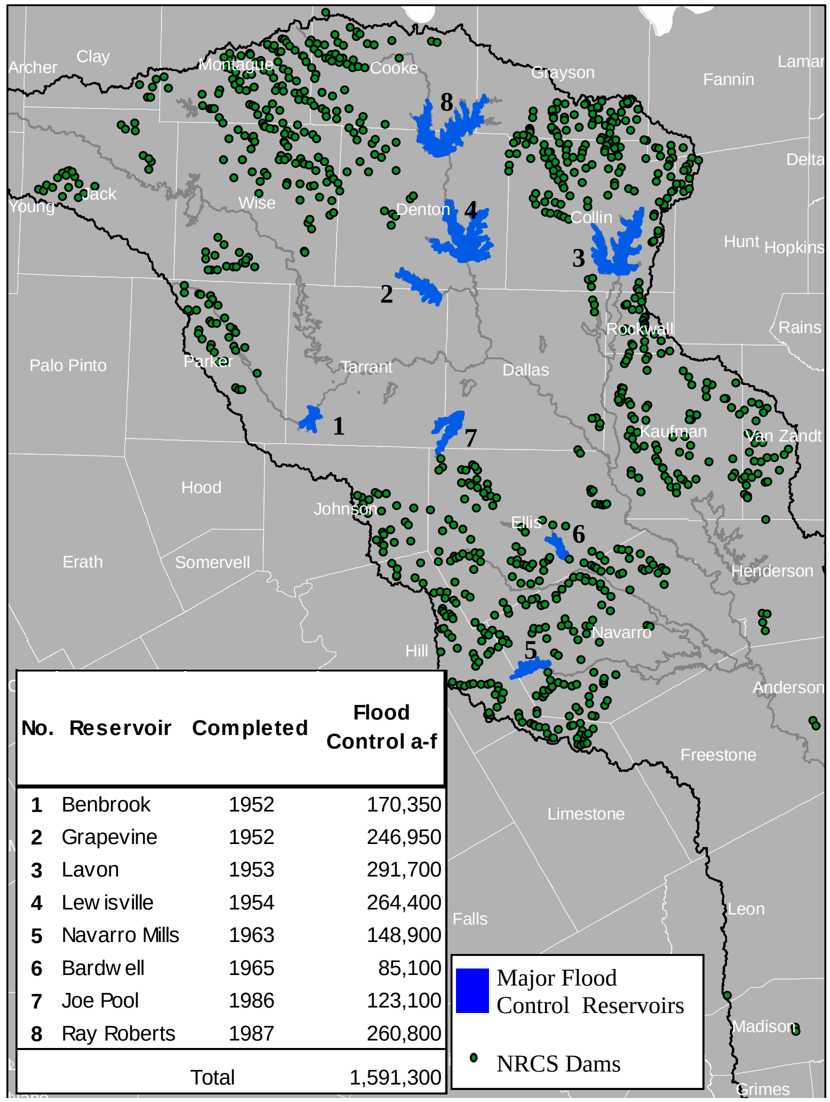
Flooding

Background

Role of the Trinity River Authority in Flood Control – The original Master Plan dealt only lightly with the problem of flood control throughout the basin. The federal government assumed the primary role in flood control planning for the watershed when the Corps of Engineers prepared its Comprehensive Survey Report of the Trinity River Basin in the early 1960s.

Major Flood Control Reservoirs – Since 1950 the Corps of Engineers has completed eight major reservoirs, all of which have incorporated flood control as a primary purpose (fig. 5a).

Soil Conservation Service Program of Floodwater Retarding Structures – Under the Flood Control Act of 1944 and PL 83-566, the Soil Conservation Service prepared plans for numerous small floodwater retarding reservoirs to control flooding problems in upstream areas. The geographical extent of the SCS program begins in the upper reaches of the West, Elm and East Forks, and ceases for all practical purposes at U.S. Highway 79-84 in the mid-basin. The SCS program presently calls for the construction of 1,074 such floodwater retarding reservoirs (a reduction from earlier plans for over 1,300 structures), of which 933 have been constructed (fig. 5a). SCS plans also included the construction of 503 miles of channel improvements, of which 91 miles have been completed. Some 300 miles of the planned 503 miles will be deleted from SCS plans. The following table summarizes the SCS program for floodwater retarding structures in the Trinity River Basin.



No.	Reservoir	Completed	Flood Control a-f
1	Benbrook	1952	170,350
2	Grapevine	1952	246,950
3	Lavon	1953	291,700
4	Lewisville	1954	264,400
5	Navarro Mills	1963	148,900
6	Bardwell	1965	85,100
7	Joe Pool	1986	123,100
8	Ray Roberts	1987	260,800
		Total	1,591,300

Fig. 5a. Major Flood Control Reservoirs and NRCS Dams Since 1950.

Levee Districts – There are 38 water districts, levee districts, or floodwater districts in the Trinity River Basin which have been involved in levee construction and improvements. Twenty-two of these are situated at least partially in the floodplain of the Trinity River. These levee and floodway districts provide varying degrees of protection for more than 134,000 acres of land along the Trinity River. Between Dallas and the proposed Tennessee Colony Lake site, about 80 percent of the river has a levee on at least one side, and about 63 percent has a levee on both sides. Between the proposed Tennessee Colony damsite and Lake Livingston, about 25 percent of the river has a levee on at least one side.

Table 5a. NRCS Structures.

NRCS Program for Floodwater Retarding Structures	Planned	Constructed
Floodwater Retention (Acre-Feet)	751,817	534,326
Drainage Area Controlled (Square Miles)	2,741	1,958
Total Sediment Storage (Acre-Feet)	175,636	126,949
Beneficial Use (Acre-Feet)	24,311	14,587

Dallas Trinity River Corridor Project & Floodway Extension

This part of the Trinity River project was found "feasible" in the Corps of Engineers 1979 reports. While the Corps proceeded with more detailed designs, the City of Dallas assumed the local obligations for the project, consisting primarily of land, relocations, and maintenance for the project. The city has subsequently made this project part of a comprehensive *Trinity Corridor Project*, along with recreational and aesthetic development of the existing floodway through downtown Dallas, a new tollway paralleling the river, and other planning and zoning adjacent to the river. Currently, the U.S. Army Corps of Engineers is working on projects to restore 800 year flood protection to downtown Dallas and the populated areas downstream. When complete, the project will be made up of the 5.5 mile Cadillac Heights and Lamar Levees, 270 acre wetland chain, and a river realignment at I-45. In addition, several choke points along the river are being cleared and/or modified to help floodwaters move downstream.

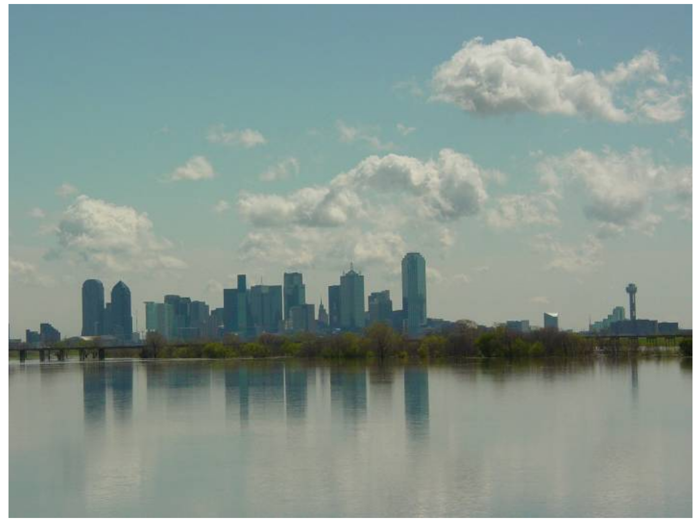


Fig. 5b. Trinity River Flooding at Mockingbird in Dallas.

More information on the entire Trinity River Corridor Project can be found at http://www.trinityrivercorridor.org/

Fort Worth Trinity River Vision

The Trinity River Vision Master Plan was adopted by the Fort Worth City Council in 2003. The plan addresses issues such as the environment, ecosystems, recreation, access to the waterfront, preserving green space, urban revitalization, and flood protection. The levee system protecting the downtown Fort Worth area was built in the 1950's to serve the needs of the 1960's population. Because of the increased runoff from urbanization, Fort Worth wants to increase its level of protection. In 1990, The U.S. Army Corps of Engineers found that potential flooding risks were present in the Fort Worth Floodway. The flood control portion of the project plans to raise the level of protection back to the 800-year flood level of 120,000 cfs.

The project involves creating an oxbow lake just west of downtown Fort Worth that is protected by levees from flooding in the West Fork. The plan is expected to allow for substantial greenspace and both residential and commercial development.

Fig. 5c. Lake Worth in Fort Worth.

More information on the entire Trinity River Vision can be found at http://www.trinityrivervision.org/index.asp

Successes and Failures of Existing Flood Control Measures

To the credit of the existing flood control measures, several statements may be made. Completion of the major flood control reservoirs has reduced the catastrophic damages to downstream interests, particularly in the reaches immediately downstream from the flood control reservoirs. Second, no failure of a major urban levee has occurred.

Environmental and cost-sharing rules have made federal flood control projects extremely difficult to implement. The Elm Fork Floodway, which was authorized in 1965, became impossible to implement because of such rules and a lack of agreement among local cities. However, since the late 1970s, large parts of the project have been built by private parties. Their designs have been similar to the Corps design, particularly regarding flood capacity. The West Fork Floodway, which was a part of the Trinity River Project, but was found "economically unfeasible" by the Corps in 1979, may follow a course similar to the Elm Fork Floodway. Private levee projects in Irving, Fort Worth, and Grand Prairie are examples.

Multiple-purpose Channel to Liberty

This is also a part of the Trinity River Project which was reported favorably by the Corps in 1979. The Trinity River Authority has asked local interests in Liberty and Chambers Counties to determine their ability to provide the local obligations for this project. A commitment has not yet been made, and further work by the Corps is on hold.

Non-Structural Flood Control Measures

These measures usually include one or more of the following three procedures. Floodplain acquisition is the purchase in fee simple by some public agency or agencies of land known to be subject to flooding. The second is the purchase of a flood easement on such flood-prone lands by some public agency or agencies. The third is the imposition of land use controls, such as local zoning ordinances and/or building codes. These three alternatives simply provide three different degrees of control of the use of the flood-prone lands by a governmental agency or agencies. Once the control is obtained, the possibility of flood losses on such lands is reduced by reducing the presence of things of value which can be damaged by floods in the area. While plans have been drawn for non-structural measures in various situations around the country, few have been implemented. One instance in the Trinity River basin has been action by the City of Dallas to purchase homes in flood-prone residential areas adjacent to urban streams rather than implement structural measures such as channelization or levees. Federal law specifically requires the Corps of Engineers and other federal agencies to include an assessment of non-structural measures in the planning of all flood control projects.

Discussion

The Federal Flood Insurance Act

The Flood Disaster Protection Act of 1973 requires that all communities which contain flood-prone areas establish a program which will limit any types of construction which would be damaged by flooding. Residents of flood-prone communities cannot purchase federal flood insurance unless the community has established such a program. Furthermore, federally regulated banks and savings and loan associations are not permitted to make mortgages on property located in flood-prone areas unless the community has enacted suitable regulations.

The federal act does not categorically prohibit flood control measures, nor does it prohibit the construction of habitable or other dwellings in the floodplain so long as such dwellings are built in such a way as to minimize their susceptibility to damages for flooding. Under appropriate circumstances levees, flood control reservoirs, or other structural flood control measures can be implemented. The federal flood insurance program is, therefore, compatible with both structural and non-structural flood control measures, and it gives local communities the discretion to decide which of the two methods to use.

Corps of Engineers Section 404 Regional Impact Study

Section 404 of the federal Clean Water Act requires that a permit be obtained from the Corps of Engineers for a wide range of construction activities in or around rivers. Several years ago the Corps received several applications for permits for major developments along the West Fork between Fort Worth and Dallas and decided to evaluate their impact together rather than separately. The result was a study of possible development impacts along the West Fork between Fort Worth and Dallas, the Elm Fork from Lewisville Dam to the confluence with the West Fork, and the main stem from the confluence of the West and Elm Forks to south Dallas. The study concluded that certain future development scenarios could make the existing floodways in downtown Fort Worth and Dallas insufficient to contain a maximum flood. In response local interests requested an additional investigation to refine the flood analysis. Congress in 1988 directed the Corps to conduct such an investigation, and it is now underway. Throughout the Corps' work, the North Central Texas Council of Governments has attempted to evaluate the results and try to develop local policies on the subjects involved. That effort is still going on.

For more information about major flood control projects, visit:

http://www.usace.army.mil/

Flood control projects in the Trinity Basin have been very valuable and successful. In recent years, however, they have become much more difficult to develop because of their costs, environmental conflicts, and other factors. This has especially affected levee and channel-type projects which do not have multiple purposes to help share the cost. The Trinity River Authority has served as local sponsor for most federal projects in its territory since it was created, and it remains willing to do so. However, the higher cost-sharing and other requirements now make it more important than ever for any local sponsor to be sure it can perform before formal commitments can be made to the federal government.

Recent major levee projects have been implemented by private and local parties. Even in these cases the federal role has been of value in providing a high-quality unified design. Such an approach may be useful along the West Fork and along the mid-Trinity River. The deferral of Tennessee Colony Lake leaves that area for which flood protection has been a high priority without a unified plan. There are a number of local levees for protection of agricultural land along the mid-Trinity River. However, it is not possible to have many such projects without major conflicts unless they are designed by common standards and methods. Future consideration will be given to the development of a unified design, within which local implementation could occur. This should not preclude or interfere with future development of a Tennessee Colony Reservoir.

Trinity River Authority of Texas

Basin Master Plan

Conservation and Preservation

Background

Need for Water Conservation – Most of the more desirable sites for surface water development have been, or soon will be, utilized to meet the intra-basin and extra-basin water supply needs. This fact, in addition to the increasing expense of providing water from sources located far distances from needs, places a practical limit upon the availability of surface water. In addition, even existing water supplies are gradually reduced by sedimentation in reservoirs.

Moreover, various amounts of water are wasted beyond the point of providing for basic needs. At home, lawns are watered to the point of overflowing the gutter, a faucet is left running in the kitchen or bathroom. At work and business, there are other instances of waste, sometimes enormous. When a drought strikes, these excessive uses can be stopped, and often are, by stringent restrictions and by a common awareness of the crisis. In other times, however, the tendency is not only to waste some water, but even to increase per capita consumption of water. Planning for water supplies generally attempts to provide adequate water for the minimal rates of use, plus a considerable safety factor resulting in plans for larger reservoirs at points more remote from their use.

The transportation of water over a considerable distance can become much more expensive than the construction of a reservoir to provide water. The construction of the Coastal Water Authority system to transport water from the lower Trinity River to Houston cost approximately twice as much as the construction of Lake Livingston, which provides the water to be moved.

Methods – Among the more common methods of water conservation are those metering water uses and adjustments in rate structures. The metering program of the Devers Canal System provided an example of the former method. Prior to the implementation of the metering program, water was delivered and sold to the irrigation farmers on the basis of acreage to be irrigated. Under the metering program, the farmers used much less water per acre.

A second method of achieving water conservation is through modification of rate structure. The common and current practice is to encourage consumption of water through rate structures which allow the larger user to pay for water at lower rates. A level or reversed rate structure would discourage wasteful consumption of water. The City of Dallas uses such a rate in order to lower peak water demands (which occur during summertime lawn watering), compared to average demands. It not only saves water, it saves capital expenses for treatment and transmission facilities.

Fig. 6a. Earth Day at The University of Texas at Arlington.

Fig. 6b. Texas Watch Volunteers Collecting Samples.

Recent state legislation requires any applicant for financial assistance from loan funds administered by the Texas Water Development Board to have or to prepare a conservation plan.

Fig. 6c. Soil Conservation Structure: Padera Lake in Ellis Co.

Soil and Water Conservation

The programs of the soil and water conservation districts of the basin include land management programs which are designed to control soil erosion and water runoff, the construction of small reservoirs (fig. 5a) for soil and floodwater retention (fig. 6c & 6d,) and, in the Trinity Basin, a small amount of stream channelization. The land management programs of the districts are the essence of conservation, as they are designed to make best use of water which comes as rain on the ground where it falls. Even the programs which involve structural changes in streams and waterways, the floodwater retarding structures and stream channelization, are designed for the local watershed requirements, and they also require application of conservation techniques in the watershed in advance.

Fig. 6d. NRCS Structure Padera Lake in Ellis Co. (Note Broken Pipe and Erosion).

Soil and water conservation programs are broadly supported. This plan recognizes the responsibility of the soil and water conservation districts and the State Soil and Water Conservation Board to provide the master plan for their programs in the basin. Their plans are recognized and included by reference in this Master Plan for the Trinity River Basin.

Preservation

It is desirable to preserve areas of unusual beauty and/or scientific value. When water is an important part of such areas, as it often is, it is appropriate to include them in the Master Plan.

The acquisition and protection of such areas is a function closely related to recreation, and both produce little or no revenue. However, it is sometimes possible to fund acquisitions in connection with a specific water project and sometimes there are general tax funds available. In connection with water projects, sometimes natural areas are required to be preserved as mitigation for wildlife habitat lost in the construction of the project. In these cases, preservation and management are paid for by water rates.

The acquisition, protection, and management of natural areas is looked on favorably by the public, but it is not generally considered among the highest priorities for public expenditures. Certainly no governmental entity is able to do all that might be desired. Successful acquisition programs are often a matter of being alert for favorable opportunities and acting quickly when such opportunities arise. The Nature Conservancy is a private organization designed precisely for such timely acquisitions, obtaining properties and then, usually, holding them only until an appropriate governmental entity can obtain appropriations necessary to purchase the property at cost. The Conservancy's operation illustrates two characteristics of successful preservation programs: taking advantage of opportunity, and cooperation between organizations. Acquisitions in the Trinity River basin have had these characteristics. Many entities are involved: cities, counties, special districts, state and federal agencies, and private individuals and organizations. Cooperation has been, and must continue to be the key to further success.

Discussion

To a large degree water is supplied for consumption at a direct rate to the consumer, approximating the actual cost of the water, treatment, and delivery. As new water supplies are required, at increasing cost, a cost-oriented rate structure is an appropriate and effective instrument for conservation. Other methods, especially for use in drought conditions, may be best implemented by each municipality or other retail supplier.

Galveston Bay System and Environmental Flows

Background

The Trinity-Galveston Bay system supports an important sport and commercial fishery. Almost 10 million pounds of commercial finfish and shellfish, valued at over $5 million, have been taken from the system in recent years. Over the past several years, annual finfish catches ranging in wholesale value from $640,000 to $1.5 million have been taken from the Trinity-Galveston Bay system. Similarly, oyster harvests from public reefs in Galveston Bay have ranged in value from $1.25 million to over $2.1 million, representing from 70 percent to 90 percent of the total harvest along the Texas coast. Harvesting of shrimp and crab likewise represents a valuable and important resource.

The sports fishery provided by the Trinity-Galveston Bay system is significant. On the order of a million pounds of finfish are caught annually, consisting primarily of Atlantic croaker, and sand trout, black drum, gafftopsail catfish, and others. Recreational oystering accounts for an unknown portion of the overall oyster harvest, occurring primarily along shallow-water reefs where oysters can be readily gathered by hand. The sport fishery for crabs exists primarily in areas where the public is provided access to saltwater.

Marshes and estuaries are an integral part of the Galveston-Trinity Bay ecosystem. They provide a necessary environment in the life cycles of several important sport and commercial species. The salinity gradient in the bay is important in the life of oyster reefs. The quantity, quality, and timing of inflows to the Trinity-Galveston Bay System are factors in all the above.

Among the natural factors, there are wide variations in time – every season and year are different. Some specific relationships (the salinities at which oysters and their parasites grow) are known, but there are many important relationships which are known only in general, particularly as their relationship to natural, annual variations between wet and dry years. There have been numerous studies of these subjects by universities and government agencies and more are planned. Each study sheds new light on its subject, but the complexity of this system, with the number and range of variables involved, is expected to take many more years to master.

Instream Flow

In 2001, the Texas Legislature enacted Senate Bill 2, which established a partnership between The Texas Water Development Board, Texas Parks and Wildlife, and The Texas Commission on Environmental Quality to "determine flow conditions in the state's rivers and streams necessary to support a sound ecological environment." The group created a work plan and scope that includes peer review, oversight from the National Academy of Sciences, and stakeholder input. The Draft Technical Overview was revised in 2006 and several stakeholder meetings took place throughout the state. The study is expected to he completed sometime after 2010.

Instream flows are defined as a flow regime adequate to maintain an ecologically sound environment in streams and rivers including riparian and floodplain features (considering hydrology, biology, geomorphology, water quality, and connectivity) necessary for maintaining the diversity and productivity of ecologically characteristic fish and wildlife and the living resources on which they depend. Instream flow may also be defined as those flows needed to support economically and aesthetically important activities, such as water-oriented recreation and navigation. The goal of an instream flow study is to determine an appropriate flow regime (quantity and timing of water in a stream or river) that conserves fish and wildlife resources while providing sustained benefits for other human uses of water resources. Determining adequate instream flow is quite difficult as river ecosystems are complex due to the interactions of many biological, chemical, and physical processes. The Trinity River (middle subbasin) has been designated as a priority for an instream flow study. The Trinity portion of the study began in 2003 and a report is expected to be released in 2007.

Freshwater Inflow

As early as 1985, the Texas Legislature enacted laws directing the Texas Parks and Wildlife Department and the Texas Water Development Board to jointly maintain a data collection and analytical study program focused on determining the needs for freshwater inflows to the state's bays and estuaries. Bays and estuaries are some of the most productive areas on earth, and Galveston Bay is the most productive bay in Texas and the second most productive bay in the nation. Five river basins feed Galveston Bay. The Trinity River accounted for about 54% of the total inflow of 10, 041,209 af/y between 1941 and 1990 (fig. 7a).

The initial findings were questioned by many interested stakeholders and the State's methodology is currently being studied further. The methodology generally looks at historic data from the TPWD Coastal Fisheries Database and various sources of inflow data to model how much freshwater is needed to support a productive commercial and recreational fishery. Bays and estuaries are so complex that it is difficult to place a number on what constitutes enough flow. In addition to the scientific aspects, the political and regulatory questions are difficult and must be answered before creating the regulations.

Discussion

Development of freshwater supplies and other activities affecting inflows to the bay and estuary system must consider the impact on the system and strive to avoid adverse impacts. The impact of various changes to inflow need to be understood accurately and reliably. More studies are desirable to make progress in that direction.

The health and productivity of the bay must be protected and maintained. Not only studies, but informed action based on sound science should be used in making the necessary decisions. Where there is uncertainty, decisions should be designed to keep impacts small and to provide the flexibility to adapt to new information.

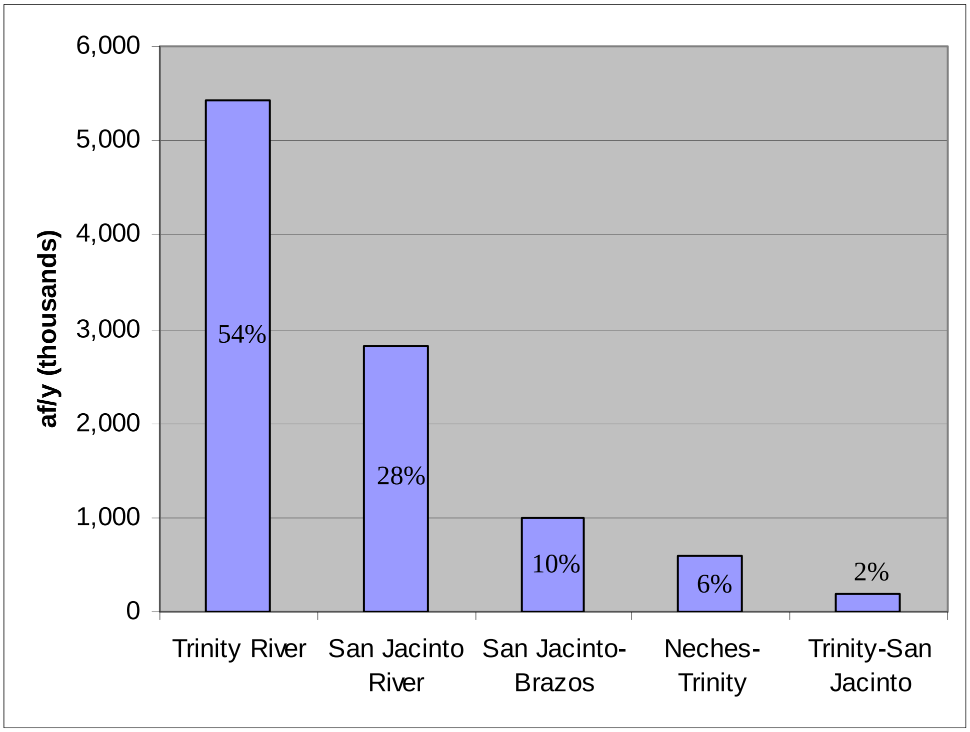


Fig. 7a. Average Inputs Into Galveston Bay per River Basin (1941—1990) as Calculated by the TWDB.

This master plan gives high priority to maintaining the health and productivity of Trinity and Galveston Bays, as it has since the twenty-two public hearings and master plan revisions of 1975-77. Both Trinity and Galveston Bays are valued state-wide. It is part of the life and livelihood of the lower Trinity Basin counties, particularly Liberty and Chambers Counties. All of Trinity Bay and a large part of Galveston Bay are within the boundary of Chambers County and within the boundary of the Trinity River Authority territory. It is necessary for all interested parties to be informed and involved in this concern.

Fig. 7b. Old Fork Anahuac Park in Trinity Bay.

Fig. 7c. Gatorfest near Trinity Bay.

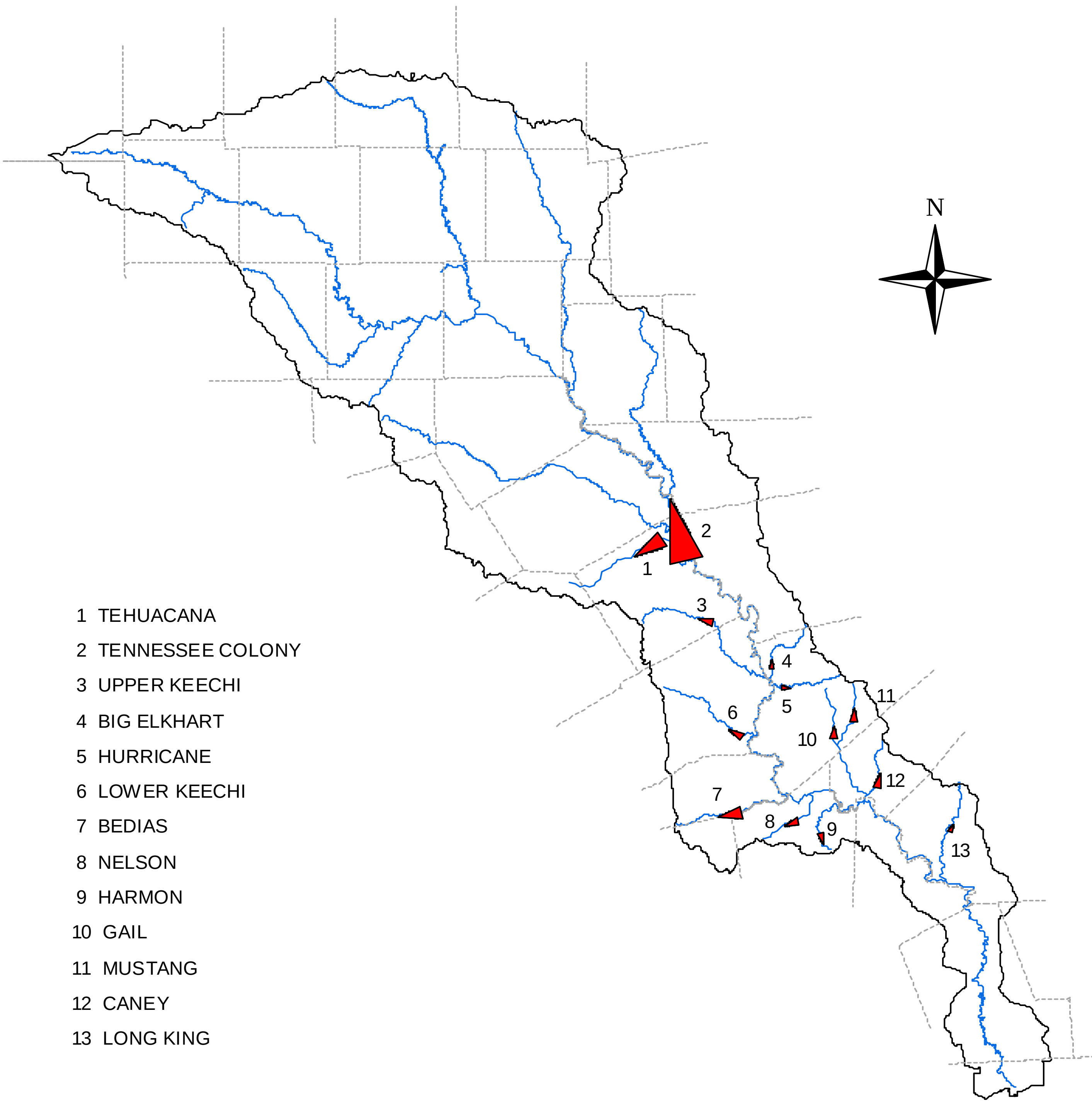
Trinity River Authority of Texas

Basin Master Plan

Appendix

Appendix 1

REMAINING MASTER PLAN RESERVOIRS



Appendix 2

Notes for Table "Water Supply Lakes and Lakes > 5,000 af in the Trinity River Basin"

Primary published sources:

TWDB. 73. Dams & reservoirs in Texas.
Turner Collie & Braden. 89. Dallas long range water supply plan.
Freese & Nichols. 90. TCWCID regional water supply plan.
TWC. 80-4. Final determinations of all claims of water rights in the Trinity River Basin.
USGS. several years. Water resources data – Texas.
Freese & Nichols/Forrest & Cotton. 74. North Central Texas water supply study.
Forrest & Cotton. 58. Trinity River Basin master plan.
TWDB. 94-5. Sediment resurveys of Arlington, Cedar Creek, White Rock.
BuRec. 91. Livingston sediment resurvey.
COE. 89. Reallocation & sedimentation resurvey report Bardwell.
COE. 89. Water resources development in Texas.
COE. 92. Lower Trinity River Basin reconnaissance report.
COE. 81. Wallisville post-authorization change report.
TBWE. 57. Transcript of hearing on app. 1990 by Southern Canal Co.
Bolding & Bolding. 81. Origin & growth of the Dallas water utilities.
Freese & Sizemore. 94. A century in the making.
COE. 49. Definite project report on Fort Worth floodway.
KSA Engineers. 96. Wortham water supply alternatives.

Yields:
Where source documentation provides a basis for yield estimates for future years, estimates closest to 1997 conditions are use.
Bridgeport yield is included in the yield shown for Eagle Mountain.
Lake Worth is considered only as a diversion point for water released from upstream lakes and is not assigned a separate yield.
Ray Roberts yield is included in the yield shown for Lewisville.
Carrollton and California Crossing yields are included in the yield shown for Fraiser. These are three within-banks impoundments on the lower Elm Fork which are used as diversion points for water released from larger lakes upstream. They have their own yield as shown, based on very senior rights in connection with the City of Dallas' early water supply facilities on the Elm Fork.
The watershed and storage of Lake Wortham are too small to yield water through the critical drought.

Primary Uses:

WS = water supply for:
- m = municipal, which includes all uses in a municipal water supply system.
- e = electrical power generation (condenser cooling)
- I = industry
- a = agriculture (irrigation)

FC = flood control

R = recreation (All the lakes are used for recreation). This notation is used only for those three lakes in the table which are used solely for recreation. White Rock was originally built and used for water supply and is now used only for recreation. Kiowa was built solely for recreation. Alvarado was built and permitted for water supply but to date has been used only for recreation

Trinity River Authority of Texas

Appendix 3

Role of TRA

Background

Description of the Trinity River Authority

Legal Basis. The Authority is a political subdivision and agency of the State of Texas created by the authority of Article XVI, Section 59 of the Texas Constitution by various acts codified as Article 8280-188, Revised Civil Statutes of Texas.

Powers.

In the acts creating and governing the Authority, the Texas Legislature has authorized the Authority to exercise fifteen powers to:

1. effectuate flood control;
2. store and conserve water;
3. supply and sell water;
4. conserve soils and other surface resources;
5. provide water for irrigation;
6. provide water for commerce and industry;
7. construct reservoirs, dams, water supply levees, and water purification and pumping facilities;
8. import water;
9. develop recreational facilities;
10. provide ingress and egress to lakes on the Trinity River;
11. preserve fish and wildlife;
12. provide for navigable water ways and ports;
13. provide sewage services;
14. prepare and maintain a master plan for the entire Trinity River watershed (basin);
15. generate electricity with hydropower facilities.

Through other acts, the Texas Legislature has authorized all river authorities, including the Trinity River Authority to:

1. provide water quality management services;
2. provide comprehensive regional plans for water quality management control and abatement of pollution;
3. provide financial services for water and air pollution control projects, and
4. provide solid waste disposal services.

Taxes could not be levied by the Authority unless approved in an election held throughout the defined territory.

Territory. The Authority's defined territory includes all of Tarrant, Dallas, Ellis, Navarro, and Chambers Counties and parts of Kaufman, Henderson, Anderson, Freestone, Leon, Houston, Madison, Walker, Trinity, San Jacinto, Polk and Liberty Counties. The Authority's defined territory is shown on page 8.

Governing Body. The Authority is governed by a 24-member Board of Directors appointed by the Governor with the approval of the Senate. Three Directors must come from Tarrant County, four must come from Dallas County, one must come from each of those parts of the other 15 counties within the Authority, and two may come from anywhere within the defined territory.

The Authority's Activities to Date.

Master Planning. After a series of public hearings, the Authority adopted the original Master Plan in April 1958. The plan was revised in 1977, 1989, 1993, 1997, and 2003.

Revenue-based Projects. The Authority has, without collecting any property taxes, implemented many service projects serving dozens of cities and communities. These projects include wastewater treatment plants, potable water plants, stormwater treatment plants, lakes, financing services, and recreation facilities.

Federal Projects. By various ordinances the Authority has agreed to serve as local sponsor of seven federal water projects. Three of these are complete and another is under construction.

The Future Role of the Authority. The Basin Goals stated on page 1 are basin-wide goals for the Trinity River Basin regardless of which agency assumes basic responsibility for the implementation of any one or all of them. The Trinity River Authority will assume primary responsibility for these activities under this revised Master Plan:

Master Planning. The Authority will carefully monitor the progress being made as to each Master Plan goal. Implementation will be encouraged by means of voluntary action by any able entity, and by cooperation among interested parties. The Authority will amend the Master Plan as needed. The Authority will continue its role in water quality planning in the basin.

Revenue-based Services. When desired by others and when an adequate revenue base and other finances are available, the Authority will exercise its powers to provide needed services in the areas of water supply, wastewater treatment, parks and recreational facilities, pollution control facilities, and solid waste disposal.

Tributary Lakes. The revised Master Plan calls for the construction, as needed, of twelve lakes on mid-basin tributaries. Of these, the Authority will serve as the planning and implementing agency for ten: Upper Keechi, Big Elkhart, Hurricane Bayou, Lower Keechi, Bedias, Nelson, Harmon, Gail, Mustang, Caney, and Long King. The other lake, Tehuacana, is to be developed by the Tarrant Regional Water District.

Federal Projects. The Authority will continue to serve as local sponsor of federal projects when there is a commitment from local beneficiaries to meet required cost-sharing and other obligations.

Public Information. The Authority will continue to encourage the public's understanding of the complex interrelationships among the people, resources, economy and environment of the Trinity River Basin.

Trinity River Authority of Texas

Appendix 4

Natural Characteristics of the Trinity River Basin

The Trinity River Basin lies in the eastern half of Texas and has an overall length of 360 miles. It extends from a 130 mile wide headwater region, located generally along a northwest-southeast axis from Archer County to Chambers County, at Trinity Bay. The total area drained by the Trinity River and its tributaries is approximately 17,969 square miles.

Formed as primordial seas gradually withdrew to the present location of the Gulf of Mexico, the Trinity River serves as a major element of an extended coastal drainage system including such other Texas rivers as the Nueces, San Antonio, Guadalupe, Lavaca, Colorado, Brazos, San Jacinto, Neches, Sabine and Red.

Generally, stream flows in the Trinity River Basin follow the rainfall pattern of the area. In the Northcentral portion of Texas where the Trinity River rises, the annual average rainfall ranges from 27 inches in the west to about 33 inches in the east. Annual rainfall amounts increase progressively along the river's southeasterly course to 51 inches at Romayor, a short distance upstream from the tidal effect of the Gulf of Mexico. Of the average annual rainfall of 36.7 inches for the Trinity River Basin above Romayor, an average of 6.46 inches, less than 18 percent of the total, runs off and appears as flow in the stream at Romayor. The rainfall which does not appear as runoff is accounted for principally by evaporation and seepage into underground formations.

Stream flow records since 1925 at Romayor stream flow gauge show that the minimum annual runoff occurred in 1956 and the maximum flow occurred in 1945. During the drought year of 1956, only 1.00 inch of rainfall appeared in the stream, whereas in 1945, the year of greatest runoff, 13.39 inches of rainfall appeared as runoff.

The Trinity River rises in its East Fork, Elm Fork, West Fork and Clear Fork in Grayson, Montague, Archer and Parker counties, respectively. The main stream begins with the junction of the Elm and West Forks at Dallas and follows a meandering course for 500 river miles to its mouth at Trinity Bay on the Gulf of Mexico. The maximum elevation in the basin is 1,522 feet Mean Sea Level (MSL) in an area northwest of Fort Worth. From this area, which averages over 1,000 feet MSL, the land gradually slopes down to sea level along the southeasterly route of the river.

The mouth of the Trinity River is on Trinity Bay, an arm of Galveston Bay, the largest of the estuaries on the Gulf of Mexico between the Mississippi and Rio Grande Rivers. The Trinity River is the major source of fresh water inflow to Galveston Bay. Despite large volumes of pollution entering Galveston Bay from the Houston area, much of it, and particularly Trinity Bay, yields the largest commercial fish and shellfish catches of all Texas bays.

The trends in precipitation and vegetation, taken in conjunction with land slopes and some other factors, cause runoff in the upper basin to be rapid, but low in total volume. Runoff becomes progressively slower, but higher in total volume as one proceeds downstream. As a result, stream flows in the upper basin are more erratic and quite often zero. Most of the smaller streams in the basin cease to flow within a few days or weeks without rain, depending on the season and drainage area.

Several of the Trinity River's tributaries, and the river itself below Dallas, have a base or dry weather flow of sewage effluent discharged from wastewater treatment plants. Extensive sampling and monitoring have proven that more than 90 percent of the river's flow below Dallas in dry weather originates in the wastewater treatment plants of Fort Worth, Dallas, Garland and the Trinity River Authority. A limited number of smaller streams have a consistent base flow maintained by springs.

As a result of geological and climatic conditions, the Trinity River Basin is divided into eight distinctively different physical regions. These regions are discernible by their vegetation, animal life and the uses to which they have been put by man. The North Central Prairie comprises approximately seven percent of the basin. This region is characterized by the lightest average rainfall of the entire watershed, stony and steeply sloping ridges made up of dense, shallow soils, grasslands and large sections of shrubs, mesquite, noncommercial cedars and other native vegetation. Primary agricultural activities are cattle and the cultivation of limited amounts of grains, hay and feed crops.

The East and West Cross Timbers are soil groups formed during different periods of time, but are very similar in composition. The East Cross Timbers extend southward from the Red River through eastern Denton County and along the Dallas-Tarrant County boundary through Johnson County into Hill County. The West Cross Timbers is a much larger formation that extends south from the Red River through Clay, Montague, Jack, Wise and Parker Counties on to the Colorado River. The soils contained in these formations are adapted to fruit and vegetable crops; and as a result, much of these areas have been converted to croplands of significant economic value despite the moderate rainfall. Other agricultural activities include dairy and beef cattle, sheep and goats raised on improved grazing land.

The Grand Prairie region is a ten mile wide belt that separates the East and West Cross Timbers. It extends south from the Red River in an irregular band through Cooke, Montague, Wise, Denton, Tarrant, Parker, Hood and Johnson Counties. Sometimes called the Fort Worth Prairie, it has a primarily agricultural economy and largely rural population with no large cities except Fort Worth on its eastern boundary. The soil is predominantly limestone, but the terrain is generally rockier and steeper in the southern sections than in the gently rolling plains around Fort Worth. Generally treeless, this area is primarily used for livestock including beef and dairy cattle, sheep and poultry. The majority of the crops are grown for livestock feed with some cotton grown as a cash crop.

The Blackland Prairies include the largest part (38 percent) of the Trinity River Basin. Its rich rolling prairies developed rapidly as a farming cotton producing area of Texas. The region extends from the Rio Grande gradually widening as it runs northeast to the Red River. Because of its early agricultural development the Blackland Prairie is still the most populated physical region in the state, containing within it and along its borders many of the state's large and middle-sized cities, including Dallas. Primarily because of the early population concentrations, this belt has developed the most diversified manufacturing industry of the state. As a result of the fertile soil and adequate rainfall, agricultural activity abounds in this area with cotton serving as the principal crop.

The East Texas Timberlands, which cover 25 percent of the Trinity River Basin, may be divided into two distinct sections. The Post Oak Savannah is a transitionary region between the Blackland Prairie on the west and the true East Texas Timberlands or "Piney Woods" on the east. This area has characteristics of both regions that can be seen in its native grasses and trees. As a result of poor drainage and low organic content, the soil is not suited for extensive cultivation, but many areas have been improved for cattle grazing.

The East Texas Timberlands proper is the source of practically all of Texas' large commercial timber production and is characterized by fairly heavy rain and wider-spread, better-developed forest areas than the Post Oak Savannah. This region was settled early in Texas history and is an older farming area of the state. The area's soils and climate are adaptable to production of a variety of fruit and vegetable crops, but has experienced an increase in cattle production accompanied by the improvement of large sections of pasture land. In addition to lumber production, the area possesses large oil, clay, lignite and other mineral deposits with potential for development.

The Coast Prairie and Marsh can be seen in Chambers County and a portion of the Liberty County area of the basin and characterized by heavy rainfall and alluvial soil. The lower portion of the watershed is suited primarily for the production of rice and dense salt-tolerant grasses which provide excellent forage for cattle. The virtually featureless terrain of the area is poorly drained as a result of the dense soils and low elevations. Rice grown in this area of the watershed is almost totally dependent on the Trinity River for irrigation water. The lush grass grown along the Coastal Prairie supports the densest cattle population in the state. This physical region, which includes Houston, has experienced the most extensive industrial development in Texas history since World War II.

The Bottomland of the Trinity River Basin consists of the flood plain areas adjacent to the tributaries and main stream and primarily consists of alluvial soil washed from the Blackland Prairies upstream. While this region contains the most potentially productive soil resources of the basin, and possibly the state, farming is a gamble due to frequent flooding; and as a result, generally not attempted. Land on higher river terraces is routinely farmed and is notable for large-scale production of corn, cotton, feed crops, livestock and commercial hardwoods. The primary use of the river bottom area is stock grazing. The largest part of the flood plain is covered in native grasses and hardwoods similar to those found in the East Texas Timberlands.

History to 1958

One of the primary results of the distribution of the basin's physical regions was the concentration of the Trinity River basin's population in the Dallas/Fort Worth area, with smaller cities and rural populations distributed throughout the rest of the basin. While this concentration originally formed due to the feasibility of profitable agricultural activity, it has evolved and expanded since the mid 1800s to an economy dependent on transportation, fabrication, assembly, marketing, insurance, corporate and government administration and other activities.

In order to support and allow for the continued growth of the population concentration in the Dallas/Fort Worth area, which in effect is a semi-arid region devoid of natural lakes and ground water of adequate quantity and quality, it became necessary to develop numerous impoundments along tributaries. Water for the population of the most rural areas of the basin is supplied primarily by ground water resources and a limited number of impoundment. A notable exception to the use of Trinity River water within the basin is Lake Livingston which was constructed principally as a bulk supply of water for Houston.

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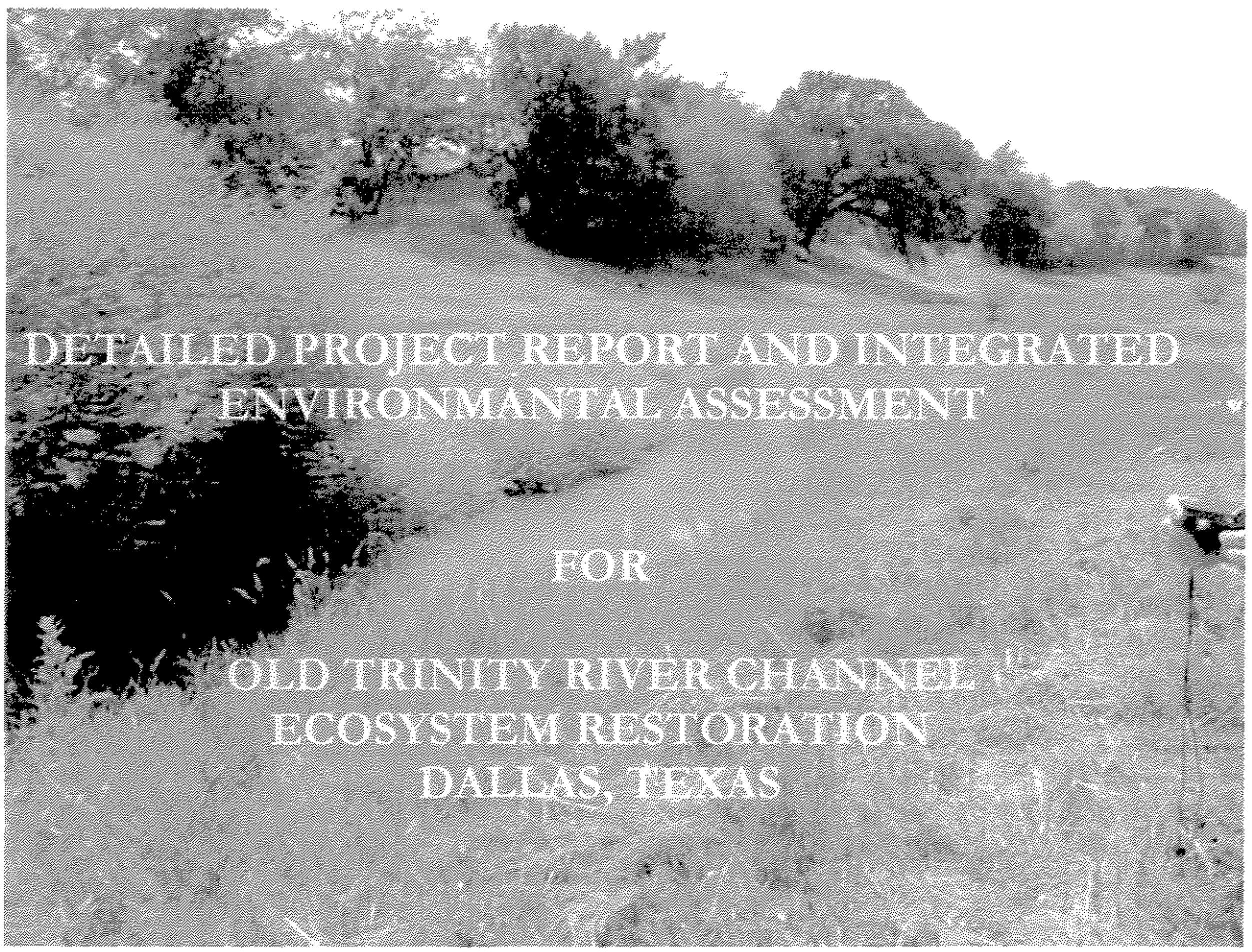
Photography

All photography provided by the Trinity River Authority.

US Army Corps
of Engineers
Fort Worth District



DETAILED PROJECT REPORT AND INTEGRATED ENVIRONMANTAL ASSESSMENT

FOR

OLD TRINITY RIVER CHANNEL ECOSYSTEM RESTORATION DALLAS, TEXAS

December 2003

in cooperation with
City of Dallas

DETAILED PROJECT REPORT
AND
INTEGRATED ENVIRONMENTAL ASSESSMENT

FOR

OLD TRINITY RIVER CHANNEL
ECOSYSTEM RESTORATION
DALLAS, TEXAS

December 2003

Prepared for

The city of Dallas

by the

United States Army Corps of Engineers
Fort Worth District
P.O. Box 17300
Fort Worth, TX 76102-0300

SYLLABUS

This Detailed Project Report (DPR) documents the results of a study conducted under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201). The purpose of the study was to identify the environmental degradation caused by the construction and operation of the Dallas Floodway project, evaluate alternatives to restore the degraded habitat, and recommend a plan for implementation, if one could be found that was technically feasible and supported by a non-Federal partner.

The study area is located in west Dallas in proximity of a portion of the Old Trinity River located downstream of the confluence of the West Fork Trinity River and the Elm Fork Trinity River, adjacent to the main stem of the Trinity River, about 8 miles west of downtown Dallas, Texas. The Old Trinity River channel is a remnant of the Trinity River that existed prior to construction of the Dallas Floodway Flood Control Project and now serves to collect local drainage. The construction and operation of the Dallas Floodway project has resulted in the loss of significant bottomland hardwood, riparian, and wetland habitat for both terrestrial and aquatic wildlife species. The recommended plan consists of the restoration of 23.93 acres of emergent wetlands, improvement of the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, and the reforestation of 53.48 acres of open space to bottomland hardwoods. The recommended plan includes a recreation trail and footbridge.

The city of Dallas is the non-Federal sponsor, and has stated their support for the recommended plan, including cost sharing. The city will provide all lands, easements, rights-of-way, relocations, and disposal areas, as well as assume responsibilities for all operation, maintenance, replacement, and repair costs. The estimated total project cost of the recommended plan is $2,996,800. The total project cost will be apportioned between the Federal Government and the city of Dallas. The respective total share is $2,180,050 and $816,750. The city of Dallas is responsible for all project operation, maintenance, repair, and replacement costs, estimated at $27,000 annually. The recommended plan was evaluated over a 50-year project life using the current Federal interest rate of 5.875 percent.

An Environmental Assessment (EA) was integrated into the DPR to assess the potential impacts of the recommended plan. Items marked with an asterisk (*), both in the table of contents and throughout the body of the DPR, indicate information required to fulfill National Environmental Policy Act requirements. Extensive coordination and input was obtained from the U.S. Fish and Wildlife Service during the development of the recommended plan and the agency is supportive of the project. The recommended plan is consistent with state and Federal government initiatives to conserve and increase declining wetland acreage. It is also consistent with the North American Waterfowl Management Plan with its goal of preserving and increasing North America's waterfowl population. Following the public comment period, A Finding of No Significant Impact was executed on November 25, 2003.

TABLE OF CONTENTS

TABLE OF FIGURES AND PLATES

TABLE OF TABLES

TABLE OF ANNEXES

DETAILED PROEJCT REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT OLD TRINITY RIVER ECOSYSTEM RESTORATION DALLAS, TEXAS

INTRODUCTION

***Authority.** This study is authorized under the authority provided to the Chief of Engineers by Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201). By letter dated August 3, 1999, Dallas County expressed support of the Preliminary Restoration Plan (PRP) and their desire to participate further in an ecosystem restoration study and Detailed Project Report (DPR). A copy of this letter is located in Annex A.

***Objectives and Scope.** The first objective of this study is to determine whether the construction and operation of the Dallas Floodway project (constructed 1959) and subsequent development have contributed to the degradation of the quality of the environment. A second objective is to evaluate the feasibility of various measures for restoring ecosystem quality and function. The final objective is to recommend a feasible plan to restore wetland, riparian forest and bottomland communities within the study area to benefit all resident and migratory wildlife indigenous to the Trinity River riparian corridor. It is recognized that restoration of the wetland habitat which existed in the mid-1800's is not possible, however, it is reasonable to expect to be able to restore and maintain the quantity and quality of wetland habitat that existed within recent history.

During the study, site visits, as well as office studies and analyses, were conducted to evaluate the overall quality of habitats in the study area for their ability to support wildlife. Meetings were held with resource agencies and the city of Dallas to determine potential initiatives for fish and wildlife habitat restoration. A multidisciplinary team approach was used to conduct the study. In addition to the Fort Worth District, study participants included the U.S. Fish and Wildlife Service (USFWS), Carter Burgess (under contract to the Fort Worth District), and the city of Dallas.

***Study Area.** The Trinity River Basin, situated in east central Texas, encompasses more than 17,900 square miles and includes all or portions of 38 counties. The main stem of the Trinity River is formed in Dallas by the confluence of the West Fork and Elm Fork. The Trinity River is considered an urban river in all aspects. It is significantly influenced by the amount of water it receives from watershed runoff, overflows from surrounding man-made reservoirs, and the controlled discharge of effluent from sewage treatment plants. The study area is located within a highly developed metropolitan area, leaving the floodplain areas adjacent to the river of major environmental concern. The portion of the Old Trinity River within the study area is located downstream of the confluence of the West Fork and the Elm Fork of the Trinity River, about 8 miles west of downtown Dallas, Texas. The Old Trinity River channel is a remnant of the Trinity River that existed prior to construction of the Dallas Floodway Flood Control Project, and now serves to collect local drainage. The specific study area is that part of the Old Trinity River within the area bounded by the Dallas Floodway project to the north, Sylvan Avenue to the east, Singleton Boulevard to the south, and Pluto Street to the west. Figure 1 is a vicinity map of the study area.

Existing Projects and Studies.

Dallas Floodway Project. This Corps of Engineers project provided for improving approximately 23 miles of existing levees (constructed by local interests 1928-1932), channel improvements, clearing the floodway channel, installation and modification of drainage structures, construction of pressure sewers and pump stations, and construction and modification of interior drainage (sump) facilities. The River and Harbor Act of March 2, 1945 and May 17, 1950 authorized construction of the project, which was initiated in January 1953 and completed April 10, 1959. The project provided flood protection to approximately 10,500 acres of land in Dallas including thousands of residential, commercial, and industrial structures. The original project was constructed at an estimated cost of $20 million; the cost of the Corps project totaled $9.8 million. As of January 2002, the project has prevented over $10 billion in flood damages.

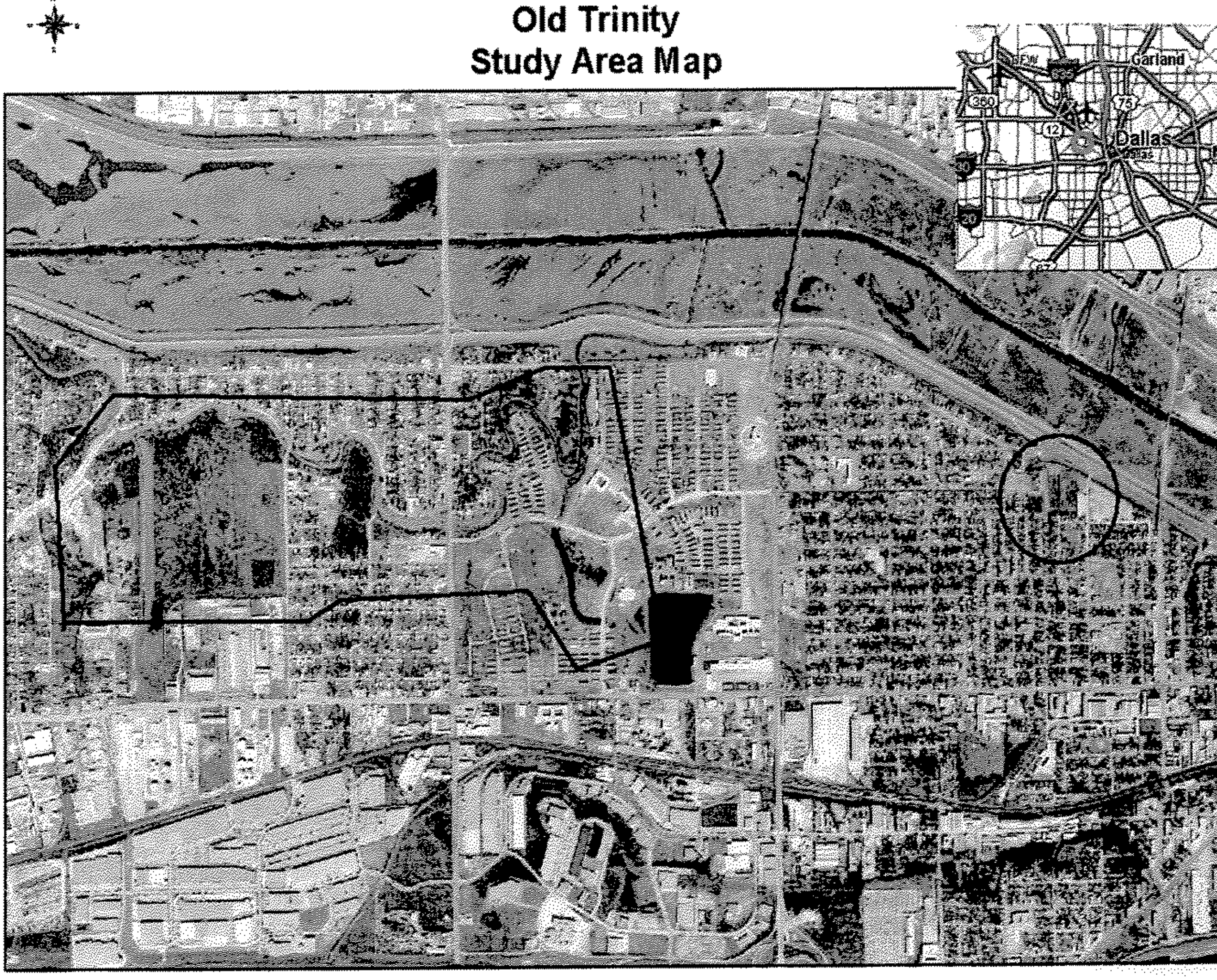
Dallas Floodway Extension. The Dallas Floodway Extension is one of five local projects authorized by Congress in 1965 as part of a basin-wide plan for the Trinity River. Portions of the original authorized project, which included channels and levees along the river and some tributaries, were never built for lack of funding and local support. Consequently, the project was placed in the "inactive" category until a series of devastating floods in 1989 and 1990, at which time the city of Dallas asked the Corps to re-evaluate alternatives to reduce flood damages.

The recommended plan consists of a 170-acre "chain of wetlands" extending from Cedar Creek to Loop 12 (a distance of approximately four miles), and 5.5 miles of protective levees along Lamar Street and Cadillac Heights. The levees will link existing levees from the downtown Dallas vicinity to the Rochester levee on the east, and will extend a levee from Cedar Creek to the Central Wastewater Treatment Plant on the west. These improvements will increase the level of protection for the Central Business District, Oak Cliff, West Dallas and vicinity from the present 300-year event to the 800-year Standard Project flood (SPF) and SPF protection to Rochester Park, the Lamar area, and Cadillac Heights. The Dallas Floodway Extension project reduces recurrent flooding for approximately 12,500 structures, and increases flood protection for the Central Wastewater Treatment Plant to the 500-year flood event. The project will also realign the Trinity channel at Interstate Highway (IH) 45 to protect the bridge structure, which is a designated national Defense Highway component. Excavated material from the wetlands will be utilized for construction of the levees. The project also provides for the purchase of 1,179 acres of land for environmental mitigation.

The Corps finalized the General Re-evaluation Report and Integrated Environmental Impact Statement (EIS) in February 1999. The Record of Decision was signed on December 1, 1999. In the Federal Budget for fiscal year 2002, the Corps received $10 million to initiate construction of the project. A supplemental EIS was filed with the Environmental Protection Agency on May 9, 2003.

Trinity River Corridor Master Implementation Plan. This plan is a joint effort between The Trinity River Corridor Citizens Committee and city staff working with numerous Federal, State, and local agencies to coordinate a multi-objective vision for the river that would preserve and restore natural resources, create access and recreational opportunities, promote economic development, and outline proposed transportation improvements and flood damage reduction activities along the entire Trinity River corridor in Dallas.

Figure 1
Old Trinity
Study Area Map



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Efforts outlined in the Master Implementation Plan to preserve and restore the areas natural resources include such actions as the chain of lakes and wetlands that are included in the Dallas Floodway Extension recommended plan and associated natural resources mitigation plans that would be required not only for the Floodway Extension plan, but also for the proposed transportation plans affecting the floodway. In addition, the Master Plan also outlines the acquisition and preservation of bottomland hardwood forest tracts (Great Trinity Forest) within the Trinity River corridor, especially upstream of the Little Lemon and Lemmon Lake (collectively known as Joppa Preserve).

Recreational opportunities identified in the Master Implementation Plan include an extensive network of trails within the Trinity River corridor, access points or "gateways" to the corridor that would link neighborhoods, provide access to amenities, and invite community use, and proposed interpretive and equestrian centers. The proposed Trinity Interpretive Center would focus on educational and environmental interests, eco-tourism activities, aquatic, archeological and historical exhibits, and theme gardens. The proposed equestrian center would be located in or near the Great Trinity Forest where equestrian trails are planned and would provide a horse riding facility for both local equestrian enthusiasts and tourists.

There are also plans to promote economic development within the corridor. The current development plan that would most closely affect the Old Trinity River study area is the development of a research facility for the Texas A&M Engineering Extension Service at McCommas Bluff. The proposed facility, the International Environmental Training and Technology Center (IETTC), would become the cornerstone of an eco-park that would attract a wide spectrum of environmentally sensitive businesses. Tenants could range from light manufacturing and assembly to environmental abatement and restoration technologies with emphasis on innovative technologies, waste minimization, and recycling encouraged.

Lastly, two major transportation improvements described in the Master Implementation Plan include a parkway identified to run along the inside of the levees within the Dallas Floodway upstream of the project, and a series of signature bridges crossing the Trinity River. The proposed Trinity Parkway is a 6-8 lane tollway reliever route extending in the south from United States Highway (U.S.) 175 to connect with State Highway (S.H.) 183 in the area of IH-35E in the north. The locally preferred alternative proposes the Parkway be constructed within the Dallas Floodway levee system. The North Texas Tollway Authority (NTTA) is currently conducting an EIS to evaluate this alternative and other additional options to determine the environmental impacts of each alternative. The second major improvement identified in the Master Implementation Plan is the need to replace the IH-30 bridge and IH-35E bridges. Based on NTTA's Bridge Inventory Inspection and Appraisal Program, the IH-30 bridge was identified for replacement over 15 years ago and the IH-35 bridges approximately four years ago. The City of Dallas' 1998 Capital Bond Program for the Trinity River corridor included partial funds for the Woodall Rodgers Extension across the Trinity River and for the Trinity Parkway, which could also include two new bridges within the Dallas Floodway. In June 1999, Dallas City Council authorized support of the concept of "signature bridges" and design enhancements for bridges across the Trinity River. The City Council also authorized the pursuit of cooperative assistance from other agencies and the identification of funding sources for these enhanced design features. It has been estimated that the Trinity River corridor transportation improvements will generate in excess of $10 billion in economic development over the next 25 years.

Preliminary Restoration Plan, Old Trinity River Channel Wildlife Restoration, Dallas, Texas - 4 January 1999. The Preliminary Restoration Plan (PRP) for Old Trinity River briefly described the ecosystem degradation caused by construction of the Dallas Floodway project, the proposed restoration activities, project benefits, costs, and the importance of project outputs.

The PRP identified measures to restore approximately 18.5 acres of shallow water and emergent wetlands and 83 acres of riparian forest. The measures included a water control structure on the Old Trinity River in order to maintain a constant pool elevation, and three separate wetland cells. One wetland cell would be constructed using an embankment and utilizing the existing topography. The second cell would replace an existing concrete channel with a terraced wetland cell fanning out and approaching the river in a delta pattern. The last wetland cell would involve the excavation of an existing sump area. Reforestation of approximately 29 acres of riparian forest would increase the habitat value of the adjacent 54 acres of existing forest. The total project cost was estimated at $1,066,700.

Table 1 below summarizes the number of acres and habitat units identified under existing-and with project conditions during the preliminary restoration plan phase.

Table 1. Preliminary Restoration Plan Habitat Data

	Existing Conditions		With Project (Target Year 0+50)	
Habitat Type	Acres	Habitat Units	Acres	Habitat Units
Riparian Forest	54.3	37.0	82.9	74.6
Wetland	8.0	4.8	26.5	25.2

EXISTING CONDITIONS OF THE STUDY AREA

***Land Use.** The study area is surrounded by residential development with some commercial and industrial activity. In addition, portions of the Dallas Floodway Project sump system, including the old remnant channel of the Trinity River, are in the study area. The Dallas Floodway provides flood protection to flood prone lands caused by upstream storm runoff in the Upper Trinity River basin. However, the levees also prevent local runoff from reaching the Trinity River. This could result in localized flooding, if not for the existing sump system. The sump system functions by collecting and conveying local runoff to sump areas where storm water is pumped through the levee to the river during flood events. The Frances Street Sump and the Trinity Portland Sump areas, including the Old Trinity River, Shadrack Channel, Delta Sumps, and Pavaho Sump are part of this sump system. The Old Trinity River and other parts of the sump system not only convey storm water but also provide a secondary flood protection function by providing for the storage of runoff during a storm event and allowing for the efficient use of the storm water pumping capacity of the sump system.

A Master Drainage Study for West Dallas was performed in 1991 by Brockette-Davis-Drake, Inc., (BDDI) for the City of Dallas. This study evaluated the flood conveyance and storage capability for the Trinity River sump areas where this restoration project is located. The study evaluated current sump conditions for 1991 and obtained updated 25-yr and 100-yr peak flood elevations within the various sump areas in West Dallas. However, the study did not evaluate duration of flooding events within the sumps and no additional evaluations of flood duration have been performed. The updated 100-yr flood elevations obtained from the BDDI study for the Eagle Ford, Trinity Portland, Frances Street, Westmoreland-Hampton, and Pavaho sumps are respectively, 414.7, 410.7, 410.7, 407.4, and 405.2 feet. The BDDI study also proposed a number of drainage improvements to enhance the flood damage reduction capability of the sump system. Most of these proposed improvements were street drainage inlets and connectors to reduce street flooding but some were additional pump station capacity and additional channels or culverts. In the event the City of Dallas desires to implement any of the BDDI proposals none would be adversely affected by any of the features of the ecosystem restoration project. Although the BDDI study did not make any proposals for additional sump volume, the system relies upon the existing sump volume to maintain adequate storage of water during a flood event. Therefore careful consideration for the preservation of sump storage volume and conveyance of flood flow was given to the design of the restoration measures to provide the same level of flood protection after the project is implemented.

***Climate.** The climate is humid with hot summers and mild winters. The climate can also be characterized as continental with a wide range in annual temperature extremes. The average winter temperature is 48 degrees Fahrenheit (^{O}F) and the average summer temperature is 84^{O}F. Mid-afternoon relative humidity is approximately 55 percent. In the winter, temperatures can suddenly drop due to the influx of modified polar air masses, but such episodes are of relatively short duration. Tropical maritime air masses from the Gulf of Mexico tend to dominate the climate of the region during the spring, summer, and fall. Total annual precipitation averages 36 inches, with 57 percent of rainfall occurring between September and April. Thunderstorms are common in the spring and occur on about 40 days per year. Between June and August, temperatures can exceed 100^{O}F with little or no expected rainfall.

***Aquatic Habitat and Species.** The aquatic habitat of the study area is severely degraded as a result of channelization, riparian forest clearing, separation from the floodplain wetlands, and overall habitat fragmentation. As a consequence of flood protection, urban development has directly and indirectly caused additional degradation. Species that have lost significant habitat include the resident wood duck and migratory waterfowl, such as mallard and several species of teal. Historically, aquatic species diversity has declined concomitantly with water quality and habitat, with fewer aquatic organisms that require pristine conditions. Consequently, a low diversity of aquatic organisms characterizes the project area. Fish species found in this reach of the Trinity River are primarily generalists such as common carp, river carpsucker, longnose gar, freshwater drum, bullhead catfish, gizzard shad, mosquitofish, and various species of sunfish and shiners.

***Wetlands.** Emergent wetlands within the project area are associated primarily with the margins of the old Elm Fork channel, tributary drainages, and the sumps of the Dallas Floodway levee system. These wetland sites contained a relatively high diversity of hydrophytic vegetation with dominant species including several varieties of sedges, cattail, rush, phragmites, water primrose, smartweed, and curly dock. Numerous species of waterfowl, wading birds, and wetland-dependent passerines were observed utilizing the wetlands.

***Terrestrial Habitat and Species.** The terrestrial habitat in the study area consists of a riparian/bottomland hardwood component and a grass-forbland component. Wildlife that lives in this study area occupies a modified habitat, which is influenced by the surrounding urban complex. Wildlife species occurring in the area are those tolerant of human activity such as rabbits, songbirds, squirrels, and small rodents. In general, the riparian/bottomland hardwood habitat is dominated by a very dense overstory of cedar elm, hackberry, and green ash. American elm, cottonwood, and black willow are abundant in some locations, with an occasional occurrence of more desirable hard mast producing trees such as pecan, walnut, bur oak, red oak, and post oak. The most common understory species is Chinese privet, which has created impenetrable thickets in some areas. More desirable native shrub species are unable to compete for resources within these thickets, and hardwood regeneration is severely limited. The grass/forbland habitat is dominated by introduced herbaceous species, such as bermudagrass and ryegrass, which are maintained year-round by mowing. Other dominant species within this cover-type include dallisgrass, crabgrass, Canada wildrye, wild oats, foxtail, Texas wintergrass, giant and western ragweed, aster, curly dock, coneflowers, clovers, and evening primrose. Some cottonwood, black willow, buttonbush, green ash, cedar elm, honey locust, and mesquite seedlings are becoming established on less frequently maintained sites.

***Threaten and Endangered Species**. The U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department were contacted to obtain a list of threatened and endangered species potentially present in the project area and to initiate informal consultations.

According to TPWD, the species listed in Table 2 have utilized the study area or similar areas, primarily as a migratory corridor during fall and/or spring migrations.

Table 2. Endangered or Threatened Species List for Dallas County

Common Name	Scientific Name	Federal Status	State Status
Black-capped vireo	*Vireo atricapillus*	Endangered	Endangered
Interior least tern	*Sterna antillarum athalassos*	Endangered	Endangered
Arctic peregrine falcon	*Falco peregrinus tundrius*	Delisted	Threatened
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Whooping crane	*Grus americana*	Endangered	Endangered
Wood stork	*Mycteria americana*		Threatened
Golden-cheeked warbler	*Dendroica chrysoparia*	Endangered	
Piping plover	*Charadrius melodus*	Threatened	
Mountain plover	*Chadadrius montanus*	Proposed as Threatened	

Source: Texas Parks and Wildlife: last revision-August 26, 1999 and personal correspondence with USFWS, March 2002..

Black-capped vireos, which nest in rangelands with scattered clumps of shrubs separated by open grassland, are known to nest on the Balcones escarpment near Mountain Creek Lake roughly ten miles west of the study area. The habitat requirements of the golden-cheeked warbler can be characterized as oak-juniper woodland, where mature Ashe junipers provide nesting substrate and materials (shredding bark) and foraging sites and various oaks also provide foraging sites. There are some bur oaks within the study area, but not in conjunction with junipers. Interior least terns and piping plovers nest on sparsely vegetated sandbars along rivers, sand and gravel pits, or lake and reservoir shorelines. The least interior terns are known to nest near a local wastewater treatment facility. It is expected that piping plover might occasionally be found there also. The mountain plover's preferred habitat consists of expansive flats of short-grass prairies where it feeds on grasshoppers, beetles, crickets, flies, and other invertebrates. In areas of tall grasses, the plover is associated with prairie dog towns. Wood storks inhabit wet meadows, swamps, ponds, and coastal shallows and migrate through Texas from the far northeast U.S. to California. They were identified at Lemmon Lake during the fall 2000 migration. Bald eagles have been spotted in recent years during the fall and winter months at some of the reservoirs in North Central Texas. Arctic peregrine falcons and whooping cranes may migrate through the project area.

Two other species found on the state's list of threatened species for Dallas County include the Texas horned lizard *(Phrynosoma cornutum)* and the timber/canebrake rattlesnake *(Crotalus horridus)*. None of the state or Federally listed threatened or endangered species were observed during numerous site visits to the study area and no evidence of suitable habitat for any of the species was found.

***Air and Water Quality.** The Trinity River reach adjacent to the study area is designated by the Texas Natural Resources Conservation Commission (TNRCC) as segment 0822. According to tests conducted every two years by the TNRCC (Draft 2002 305(b) Assessment), the aquatic life, contact recreation, public water supply, fish consumption and general uses are fully supported. Dissolved oxygen levels have historically been considered a serious problem but have shown great improvement and are now rarely lower than the standards criteria of 5.0 milligrams per liter. Low flow rates and high temperatures, typical in the dry summer months, create conditions under which water quality problems such as high algal growth and low dissolved oxygen levels may exist. There was no testing of water quality within the sump system.

Dallas County is located within the Environmental Protection Agency's (EPA) Air Quality Region (AQCR) 215 for Texas, which consists of 19 counties, including Dallas, Denton, and Tarrant. AQCR 215 is classified as a non-attainment area for ozone and attainment/unclassifiable for other National Ambient Air Quality Standards including lead, sulphur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter of aerodynamic shape less than or equal to 10 micrometers in diameter.

***Archeological and Cultural Resources.** A literature and archival search was conducted to determine if any recorded sites are present within the study area. Site records of the Texas Archeological Research Laboratory at the University of Texas at Austin and literature at the Texas Historical Commission were consulted. Although the area of anticipated impact is located near the site of a historic nineteenth century French socialist colony (called La Reunion), no previously recorded archaeological sites have been documented in the immediate vicinity of the study.

Through intensive pedestrian survey, shovel testing, test units, and geoarcheological trenches, several major recent refuse deposits were identified within the area, as well as one prehistoric archeological site, 41DL389. Only one other area is considered to have the potential to contain as yet unidentified cultural resources. The area consists of newly acquired acreage for the Pavaho Sump wetland. This area is considered to have a high potential for containing buried cultural resources.

***Hazardous, Toxic, and Radioactive Wastes.** An initial assessment was completed to identify possible hazardous, toxic, or radioactive waste and/or other environmental concerns within and adjacent to the study area. The assessment relied on the use of existing documents, and also involved site reconnaissance and environmental records search. The purpose of the visual inspection was to ascertain the existence, if any, of seeps, discoloration of soil and water, dead vegetation, signs of dumping and/or filling, strange odors, and any other general indication of the presence of hazardous waste conditions. Environmental Protection Agency, TNRCC, and city of Dallas records were reviewed to obtain any information on violations, litigation, history of chemical releases, nearby legal or illegal landfilling and dumping, and past and present land use, including treatment, disposal, and storage of hazardous waste. The site reconnaissance included a walk-through of the project limits and observations of adjacent properties. Databases of facilities registered or documented with the EPA or TNRCC were obtained and reviewed to identify facilities in the study area. No areas of concern were identified within the study area.

***Socio-Economic Characteristics.** Dallas County, 908.9 square miles in size with a population of 2,244,768 (estimated population as of 1 January 2001), has an economy centered on agricultural interests in the rural areas and the city of Dallas and its suburbs. The city of Dallas, with an estimated population of 1,199,809, serves as the county seat. Dallas is a city of commerce, transportation, banking, retail and wholesale trade, and conventions and trade shows. Dallas is a favorite destination of tourists and has become one the nation's busiest transportation hubs, being served by one of the world's busiest airports, Dallas-Fort Worth International.

Dallas' diversified economy began as an agricultural trade center in the 1840's and has progressed into the wholesale and retail market of the southwest United States. The economic strength fueled growth in banking, insurance, data processing, and electronic components that account for a major portion of the Dallas economy. In addition, Dallas is home to more than thirty-two Fortune 500 corporate headquarters, the World Trade Center, the Dallas Convention Center, Dallas International Market Hall, the Infomart, Reunion Arena, and the recently constructed American Airlines Center. The county has 22 colleges and universities, 34 hospitals, 22 libraries, and 68 banks.

***Recreation Resources.** The 1990 Texas Outdoor Recreation Plan (TORP), prepared by the Texas Parks and Wildlife Department identifies existing recreational facilities, usage trends, and projected recreational needs for 23 regions within the state. The study area is within a 16-county area designated in the TORP as Region 4.

Region 4 has experienced several years of rapid growth, with a current density of 350 people per square mile. Many of the small towns and rural areas in Region 4 have become part of the rapidly expanding metropolitan area as people have moved from the heavily populated cities to the suburbs. People in these urbanizing areas are finding open space increasingly scarce. The region now ranks twenty-first out of twenty-three regions in recreation land per thousands population.

Residents of Dallas County need not drive far to find recreational waters because many of the state's major reservoirs are located in the metropolitan area. A total of 232,581 surface acres gives the region more lake acres than all regions except Deep East Texas; however, the large numbers of people residing in the region make the suitable surface acres per thousands population still fall far below the state average.

With so many reservoirs in the area, the value of the free-flowing sections of the region's rivers increases as they become more rare. Public agencies with Region 4 are taking a fresh look at the valuable resources within their jurisdictions that are highly desirable for recreation. Sites within the Trinity River floodplain are among those most actively studied. Nine cities and three counties within the region, including Dallas County, are participating with the North Central Texas Council of Governments in development of a *Common Vision* to protect resources within this corridor. Goals include the development of a regional construction permit system and cooperation in the creation of a linear greenbelt of parks and trails along and adjacent to the river and its tributaries.

The most scenic wooded areas in Region 4 are often found in the stream and river corridors. Scenic corridors along the Trinity, with natural meandering water courses bordered by riparian hardwoods or dense stands of trees and shrubs, are the most desirable segments of the river and portions most intensely used by the recreating public.

Recreation providers have expressed concern over stream bank erosion, in-stream flows, and the quality of the water for contract recreation. The Trinity River and its tributaries are currently being used for a variety of recreational activities, though access is limited or restricted. In spite of these limitations, avid canoeists, kayakers, fishermen, bicyclists, and bird watchers have located points where park areas, roads, and bridges intersect with the river.

***Topography and Soils.** The study area is located within the northernmost section of the Gulf Coastal Plains, which is characterized by essentially flat lying to gently dipping unconsolidated terrace and flood plain deposits. All physiographic features within this area were formed during the Cenozoic Era. Fluvial terrace deposits and alluvial deposits of the Quaternary Age occupy the floodplain area of the Trinity River. These deposits consist of gravel, sand, silt, and clay deposits. The underlying bedrock consists of lower and middle members of the Upper Cretaceous Age Austin Chalk Formation, a chalky limestone with thin bentonitic beds scattered in the lower part. Within the study area, the Austin Formation has an estimated thickness of 300 feet to 700 feet and gently dips to the southeast.

The soils in the study area consist of Trinity clay-frequently flooded; Dutek loamy fine sand-1 to 5 percent slopes; Arents-loamy, hilly; Bastsil fine sandy loam-0 to 3 percent slopes; and Mabank fine sandy loam-0 to 1 percent slopes. Trinity clay soil is made up of deep, somewhat poorly drained soils with slopes less than one percent. The Natural Resources Conservation Service (NRCS) has identified the soil as hydric. The Trinity soils make up the majority of the soil within the study area. Dutek loamy fine sand soils are characterized as deep, gently sloping, and well drained on old stream terraces on uplands. Permeability is moderate, the available water capacity is medium, runoff is slow, and the hazard of water erosion is slight. Arents soils consist of discarded overburden of mining operations. Bastil fine sandy loam soil is deep, well drained, and nearly level to gently sloping. This soil is typically used as cropland and pasture, permeability is moderate, available water capacity is high, and the hazard of erosion is moderate. Mabank fine sandy loam soil is found along the southeast property corner and is a deep, nearly level, somewhat poorly drained soil in slight depressions on uplands. Permeability is very slow, the available water capacity is high, runoff is very slow, and the hazard of erosion is slight.

Annex B contains photographs of the study area.

ECOSYSTEM DEGRADATION

The Trinity River ecosystem has experienced significant degradation and does not support the once abundant populations of wildlife present prior to the construction and operation of the Dallas Floodway. The construction of levees, clearing of floodways, and channel realignments associated with the floodway project destroyed the majority of quality riparian habitat located along the Trinity River. The loss of this natural riparian corridor has resulted in decreased diversity and stability of the biotic community within the study area. Further, the change in hydrologic and hydraulic regime has reduced the old river meanders, oxbow cutoffs, and other types of wetland/riparian zones associated with an undisturbed waterway. Additional environmental degradation can be attributed to the direct and indirect consequences of urban development within the flood plain.

Evaluation of Existing Habitat Quality. An overall evaluation of the quality of the existing natural resources based on their value as wildlife, avian, and aquatic habitat was conducted. The evaluation procedures incorporated the Habitat Evaluation Procedures (HEP) models developed by the USFWS. HEP utilizes various habitat characteristics within sample plots to numerically define the comparative value of habitat quality based on a 0 to 1 scale, where 1 represents optimum habitat conditions and 0 represents habitat of no usable value. HEP evaluates habitat based on Habitat Suitability Index (HSI) models for wildlife species that typify a targeted habitat type (i.e., bottomland hardwoods, wetlands, etc.). Nine wildlife species were selected that best represent the communities that use the three habitat types surveyed. Raccoon, fox squirrel, Carolina chickadee, and barred owl were selected to represent those species that use riparian/bottomland hardwoods. The raccoon, green heron, and wood duck were selected to represent the wildlife community in emergent wetlands, and the eastern cottontail, eastern meadowlark, and red-tailed hawk were selected to represent the grass-forbland community.

According to the U.S. Fish and Wildlife Service, the HSI for bottomland/mixed deciduous forest indicated a moderate habitat value for the species evaluated (0.56). A major limiting factor for the forested areas is the lack of regeneration due to a dense overstory cover of cedar elm and understory cover of privet. Much of the forested area is devoid of diverse midstory canopy. Additionally, there is an insufficient number of hard mast producing trees for wildlife forage production and large mature trees for cavity refuge/nest sites. Heavy grazing by confined livestock has severely degraded one riparian area near the Canada Drive crossing of the old channel. While the current condition of the wetlands provide good habitat for the wildlife species evaluated (HSI 0.70), some limiting factors include the seasonal availability of water, absence of cavities and nest sites, and insufficient perch and roost sites for avian species. The grass-forbland habitat provided a moderate value (HSI 0.56). However, this was primarily due to the high food and cover value for the Eastern cottontail; whereas, most of the herbaceous areas were too dense or tall and lacked sufficient perch sites to provide optimal habitat for meadowlark or red-tailed hawk. Additionally, there was a lack of the more desirable native tall bunchgrass species such as switchgrass, Indiangrass, and the bluestems. Table 3 summarizes the habitat values of the existing natural resources for each major habitat type of interest in the study area.

Table 3. Existing Conditions Acres and Habitat Suitability Indices (HSI) Values

Habitat Type	Acres	HSI Values	Habitat Units
Riparian/Bottomland hardwood	28.42	0.56	15.92
Wetlands	2.82	0.70	1.97
Grass-Forbland	48.38	0.56	27.09
TOTALS	**79.62**	**N/A**	**44.98**

FUTURE WITHOUT PROJECT CONDITION

Previous studies have concluded that seedlings of heavy-seeded oaks are most prevalent in areas where floodwaters cause deposition of acorns and where duff is sufficient for regeneration. Currently, there is an insufficient number of mast producing trees within the contributing watershed to establish a forest dominated by hard mast producing species. Given the lack of mast producing trees in the study area, regeneration is limited to invader plants whose seeds are wind disseminated. Senescent trees occupy much of the forest overstory, and there is an inadequate supply of midstory trees to replace these trees as they die. This allows increased invasion by less desirable and non-native vegetation.

The lands within the study area will be subjected to increasing developmental activities. Because of the disturbed nature of the existing vegetation communities, the habitat value of these lands is minimal and would not be expected to improve through time. The upland hardwood area is subject to industrial zoning and will see a decline in size and quality across the next 25 to 30 years. Residential development will decrease the size of the Shadrack portion of the project by 50 percent within the next 10 years, and the remaining habitat will see a decrease in quality. While no loss in size is expected for the city-owned parkland, due to intense mowing, the quality of the habitat will not significantly improve. The old stream channel is subject to periodic dredging, and the sump drainages are periodically excavated. Consequently, the areas along the stream and the sump drainages may provide good habitat three out of every ten years. Periodic mowing will maintain the grassland areas, both riparian and upland, assuming no development occurs.

PROBLEMS AND OPPORTUNITIES

Based on the examination and analysis of the existing condition, a number of problems and opportunities are identified within the study area.

- Loss of emergent wetland habitat
- Loss of riparian corridor
- Loss of bottomland hardwood communities
- Fragmented nature of existing forest
- Lack of mast producing trees and shrubs
- Lack of nesting and cover for wildlife
- Unstable water regime for emergent wetlands
- Lack of emergent wetland vegetation in proximity to food and cover

- Lack of contour gradients and emergent wetland vegetation in existing sump system that reduces the quality of the wetland habitat and the diversity of the benthic, invertebrate, aquatic, and wildlife species that might be expected to utilize the area
- Concrete channel which poses a safety hazard
- Improving neighborhood aesthetics
- Improving neighborhood cohesiveness
- Increasing recreational and educational opportunities
- Improving the operational capability of sump system

PLANNING OBJECTIVES AND CONSTRAINTS

Based on the identified problems and opportunities, the following planning objectives and constraints have been established for the study area.

Objectives

- Restore wetland habitat to benefit all wildlife within the Old Trinity River study area
- Restore riparian habitat to benefit all wildlife within the Old Trinity River study area
- Restore bottomland hardwood communities within the Old Trinity River study area
- Restore a natural hydrologic regime within the study area
- Provide a sustainable level of food, nesting, and cover for all wildlife communities
- Improve the aesthetics, as well as recreational and educational opportunities, within the study area

Constraints

- No loss of sump capacity
- No loss of flood damage reduction capability
- Avoid adverse impacts to archeological or buried cultural resources
- Restoration should be concentrated on the lands located within the 100-year floodplain
- Minimize operation and maintenance effort and expense
- Recommended plan must be supported by the local sponsor

*ECOSYSTEM RESTORATION MEASURES AND ALTERNATIVES

Measures are features or activities that can be implemented at specific sites to address one or more planning objectives. The following measures were identified as promoting the planning objectives.

Wetlands. The restoration of wetlands in the study area can be accomplished through a variety of means. The measures considered to restore wetlands in the study area include the construction of embankments with water control structures. The embankments would serve to impound water and manipulate water levels to simulate a natural hydrologic cycle. Water would be captured from rainfall, local run-off and/or captured over-bank flow from the Old Trinity River or the Trinity River. The area west of Norwich Road and south of the Old Trinity River was identified as a potential site for this type of wetland construction. However, after further investigation it was determined that the soil conditions were unsuitable for a wetland.

Other potential wetland sites were identified along Old Trinity River using water control structures within the channel itself. Likely locations for these water control structures were identified at the Ledbetter gate, Westmoreland Road, Hampton Road, and Sylvan Road. Water control structures will be retrofitted to the existing culverts under the roads and serve to manipulate water levels. Further, a small amount of material would be removed from portions of the Old Trinity River upstream of the control structures to provide additional wetland area. The preliminary assessment of these four locations for wetland restoration concluded that a water control structure at Sylvan Road would result in operational difficulties of the sump system, particularly the Pavaho Sump. Similarly, a water control structure at Hampton Road was not viewed as particularly beneficial from a restoration perspective given the relatively high quality habitat that would be affected, particularly in proximity of the Delta Sump.

Modifications to the existing sumps were also considered for restoring wetland habitat. Typically, the operation of the sump as part of a flood control project is contrary to sustaining a viable wetland, given the sumps are emptied during the winter months in anticipation of rainfall events, at the exact time that water is required to sustain the wetland and provide resting and wintering habitat for local and migratory waterfowl. In order to have the ability to store the water for wetland purposes and maintain the capacity of the sump, the only option available is to deepen and/or expand the sump area. This would allow for the retention of water necessary for a wetland, while maintaining the sump capacity. Of the three sumps in the study area, Delta Sump, Ledbetter Sump, and Pavaho Sump, it was determined that Pavaho Sump and Ledbetter Sump were the best candidates for modification based on operational considerations and existing quality of habitat. A number of configurations were investigated that expanded the size (area) of the existing sump, excavating to achieve different elevations within the sump via a "tiered" or "benching" approach, or developing an island/moat type configuration.

The remaining opportunity for developing wetlands in the study was identified in the area of the Shadrack channel. The existing concrete channel provides no measurable habitat value. The first option investigated was a diversion of water from the existing concrete channel to create an adjacent wetland area. The second option is to restore the concrete channel to an earthen channel below Gallagher Street, and excavate material adjacent to the channel to allow for the flow of water to the Old Trinity River. Lastly, the opportunity to restore the historical Shadrack Channel was investigated. However the current existing habitat was assessed to be of high quality, with little restoration opportunity.

Reforestation. Another measure to restore habitat for wildlife species is reforestation. The most beneficial reforestation activity occurs when it is used to connect or expand existing forested tracts adjacent to the riparian corridor. Reforestation and habitat improvement measures were considered along the Old Trinity River from near Pluto Road to the Delta Sump, in proximity of the Pavaho Sump, and between Fish Trap Lake Park and the Delta Sump. Further, the type and the size of the trees and shrubs planted will have an impact on the level of restoration, particularly in the short term. The size of the plants can range from seeds to seedlings to containerized stock. Listed below is a sample of the different scales of reforestation used in the incremental analysis.

- 40 one-inch caliper containerized trees, 10 shrubs, and 100 seedlings per acre; or
- 10 one-inch caliper containerized trees, 5 shrubs, and 150 seedlings per acre; or
- 5 one-inch caliper containerized trees, 5 shrubs, and 200 seedlings per acre; or
- 300 tree seedlings and 150 shrub seedlings per acre.
- 10 one-inch caliper containerized trees, 7 shrubs per acre; or
- 5 one-inch caliper containerized trees, 5 shrubs per acre; or
- 2 one-inch caliper containerized trees, 2 shrubs per acre.

Identification and Incremental Analysis of Alternatives. Alternatives were identified by first optimizing the size and scale of each restoration measure or combination of measures taking into account wetland size, and reforestation area, material, and density. The wetlands were sized based on constraints related to topography and other physical characteristics. Given the relatively small increases in marginal cost compared to marginal increases in wetland size, it was determined that the optimal wetland site was in most instances the largest wetland site reasonably possible. Based on incremental analysis conducted for previous studies in similar areas, reforestation densities and materials that provided the most habitat units was already known. As a result, a number of different "optimal" alternatives were identified. Comparative analysis techniques were used to determine the most cost effective alternatives in terms of costs per habitat units gained. For each of the separate measures identified above, a "no action" measure was developed. Next, annualized habitat unit gains for each measure and the no action counterparts were computed for over a 50-year period. This time period was established as the life of the project based on the length of time it takes bottomland hardwood tree species to mature. In addition, annualized costs, including real estate and operations and maintenance costs were computed for each of the measures and their "no action" counterparts. These data were then input into a comparative analysis model. The model used to run cost effectiveness and incremental cost analysis was the IWR-Plan: Decision Support Software, Version 3.30. IWR-Plan evaluates all the alternative measures using annualized habitat unit (AAHUs) gains versus annualized cost estimates (including those for operations and maintenance) and then formulates all possible combinations of those solutions, considering user-defined relationships between solutions, to determine which combinations provide the greatest AAHU gains for the annualized costs. Each combination of solutions is then an alternative.

Nine measures with several possible scales for each measure were input into IWR-Plan. IWR-Plan analyzed 36,120 possible combinations of the measures. There were 58 cost effective alternatives with ten resulting in "best buy" alternatives. Best buy alternatives are those that are both cost effective and incrementally justified. The following is a summary of the restoration measures identified in each of the best buy plans. Annex C contains the complete incremental analysis.

Alternative 1 – No Action. The "no action" alternative is equivalent to a description of the future without project conditions. The remaining lands within the current Old Trinity River boundaries include bottomland hardwood tracts, mixed deciduous forest tracts, and maintained parklands. In the absence of any restoration action, the habitat value of the bottomland hardwoods and mixed deciduous stands might increase marginally over time, but the lack of mast-producing trees to serve as seed sources for regeneration will always limit the value of the habitat from being the highest quality that might be possible. In addition, the loss of adjacent habitat and the loss of riparian habitat along the Trinity River corridor upstream and downstream of the study area continue to cause fragmentation of existing habitat resulting in a net loss for the value of the remaining habitat as it becomes increasingly more isolated and less valuable as a contiguous corridor.

Alternative 2 – Reforestation (seedlings). Restoring 53.48 acres of riparian hardwoods using 300 tree seedlings and 150 shrub seedlings per acre. The 53.48 restored acres include 4.48 acres along the Old Trinity west of Ledbetter Gate, 22.4 acres along the Old Trinity River between Ledbetter Gate and Westmoreland Road, 1.09 acres along Shadrack Channel, 6.58 acres along Pavaho Sump, and 18.93 acres along Fish Trap Lake and the Old Trinity River east of Westmoreland Road.

Alternative 3 – Reforestation (seedlings and containers). Restoring 53.48 acres of riparian hardwoods with five one-inch caliper trees, five shrubs, and 200 tree seedlings per acre.

Alternative 4 – Reforestation. Alternative 3 plus riparian habitat improvement to 28.42 acres using five one-inch caliper trees and 5 shrubs per acre. The 28.42 acres of restored area includes 5.39 acres along the Old Trinity west of Ledbetter Gate, 17.38 acres along the Old Trinity River between Ledbetter Gate and Westmoreland Road, and 5.65 acres along Fish Trap Lake and the Old Trinity River east of Westmoreland Road.

Alternative 5 – Reforestation. Restoring 53.48 acres of riparian hardwoods with 40 one-inch caliper trees, ten shrubs, and 100 seedlings per acre, and riparian habitat improvement to 28.42 acres using five one-inch caliper trees and 5 shrubs per acre.

Alternative 6 – Reforestation and Shadrack Channel/Westmoreland Wetland. Alternative 5 plus the abandonment of the existing Shadrack concrete channel and the creation of a new combined earthen channel and wetland cell, and partial excavation and final impoundment to a depth of 5 foot for Westmoreland Channel sump and installation of a water control structure to allow for a 3-foot fluctuation in the water surface elevation.

Alternative 7 – Reforestation and Wetlands (Ledbetter). Alternative 6 plus the impoundment of the Ledbetter Channel sump to a depth of 6-foot with no excavation. A water control structure is included to allow for a 3-foot fluctuation in the water surface elevation.

Alternative 8 – Reforestation and Wetlands (Pavaho Sump). Alternative 7 plus a water control structure within Pavaho Sump to allow for a fluctuation in the water surface elevation, and the expansion of the southesatern portion Pavahoe sump for additional wetland area. The sump volume removed may be used to include island habitat in the wetland.

Alternative 9 – Reforestation and Wetlands. Alternative 8 plus acquiring real estate on the western fringe of the Pavaho sump and the excavation of both the small expansion from Plan 8 and the larger expansion would be partial for a tiered effect. The excavation material removed may be used to include island habitat in the wetland.

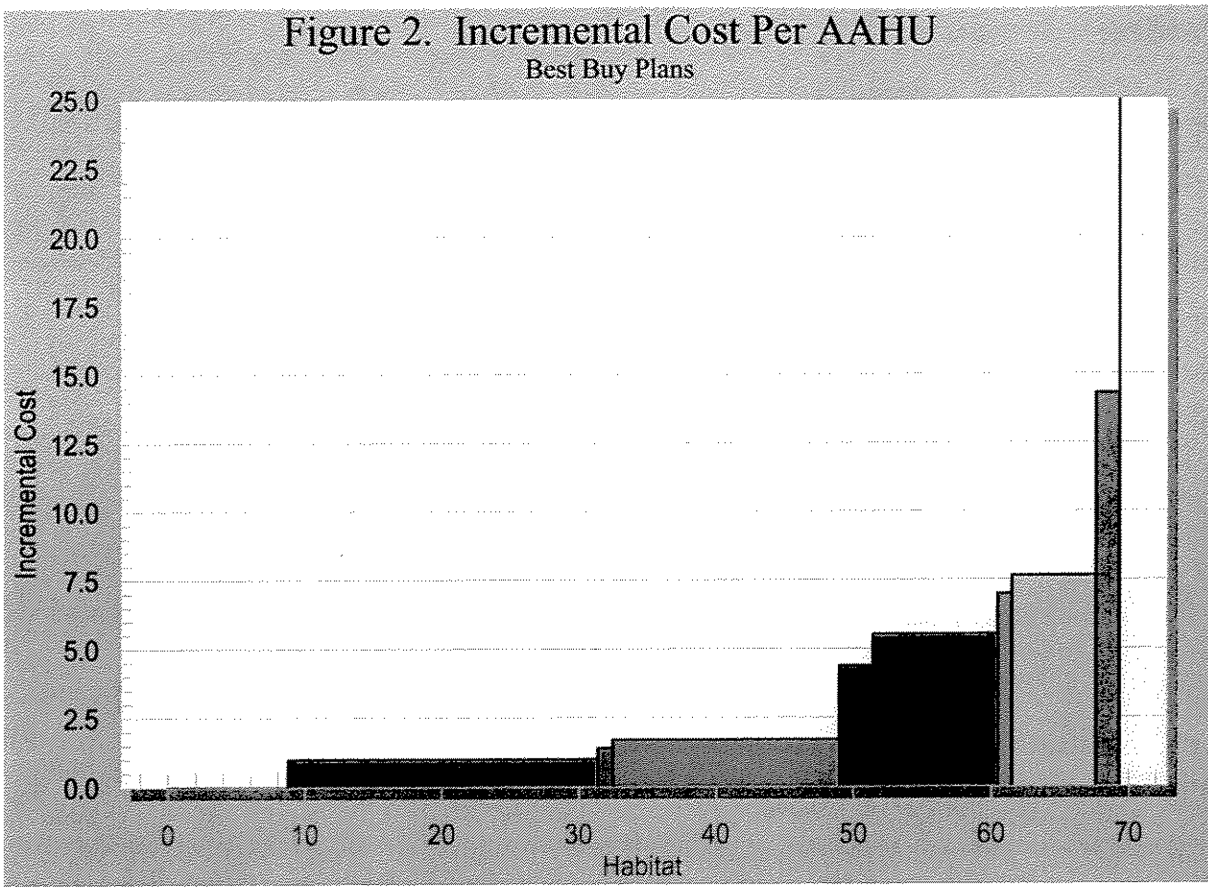
Alternative 10 – Reforestation and Wetlands. Alternative 9 except the impoundment of the Ledbetter sump would be to a depth of 5-foot with some excavation.

Table 4 identifies the average AAHUs, incremental AAHUs, annualized costs, incremental annualized costs, and incremental cost per output for each of the ten plans. Figure 2 is a graphic representation showing the AAHUs and annualizes costs for the best buy alternatives.

Of the ten alternatives analyzed, each provides the greatest amount of habitat units for the least cost possible, and therefore, all can be considered viable restoration alternatives. One method in determining which best buy plan to select as the recommended plan is to look for the breakpoints in costs. Figure 2 shows two break points, one between alternatives 4 and 5, and the other between alternatives 8 and 9. It is recognized that the incremental benefits (increase in habitat units) becomes incrementally more costly, particularly beginning with alternative 5. However, a primary planning objective was to maximize wetland habitat, and alternatives 1 through 5 do not include wetland restoration. Existing wetland habitat within an urban setting is relatively scarce, as are the opportunities to restore them, and alternatives 6 through 10 provide incrementally increasing opportunities for wetland habitat outputs. After careful consideration of the results from the incremental analysis and review of the study objectives, it was determined that alternative 8, represented by the light gray bar in Figure 2, both met the study objectives and provided enough additional wetland habitat over alternative 6 or 7 to be worth the incremental increase in cost.

Table 4. Best Buy Alternative Summary

Alternative	AAHUs	Incremental AAHUs	Annualized Costs	Incremental Annualized Costs	Average Cost Per AAHU	Incremental Cost Per AAHU
1	8.78	8.78	0.00	0.00	0.00	0
2	31.37	22.59	22.68	22.68	0.72	1.00
3	32.45	1.08	24.20	1.52	0.76	1.41
4	48.95	16.50	52.30	28.10	1.07	1.70
5	51.42	2.47	63.13	10.83	1.23	4.38
6	60.44	9.02	112.98	49.85	1.87	5.53
7	61.45	1.01	120.05	7.07	1.95	7.00
8	67.57	6.12	166.94	46.89	2.47	7.66
9	69.31	1.74	191.86	24.92	2.77	14.32
10	69.32	0.01	193.37	1.50	2.79	150.4



RECOMMENDED RESTORATION PLAN

The recommended restoration plan was designed to restore the biological integrity of the wetland and bottomland hardwood communities through a combination of measures directed at either specific habitat types or specific problems within the existing ecosystems. Collectively, these restoration measures will restore the ecological integrity, diversity, and stability of the study area. The restoration includes stabilization of existing water regimes and restoration of bottomland hardwoods and emergent wetlands. The recommended restoration plan consists of different restoration alternatives for different locations within the study area. Plates 1 and 2 display the overall project features. Annex D contains additional plates that display project features. Specifically, the recommended plan consists of the following features.

Old Trinity River West of Ledbetter Gate. This portion of the recommended plan consists of placing a gated water control structure (weir) within the channel. The weir on either side of the weir gate is to be 1-foot higher than the top of the weir gate. This will allow for increased flow over the gate in times of storm flow so that the sump water surface on either side of the weir has an opportunity to equalize prior to the weir being overtopped. This will minimize the chances of erosion on the channel banks due to overtopping of the weir. The weir gate will be used to control the water surface level and is designed to provide a maximum opening operational range of 0- to 3-feet, with a maximum impoundment depth of 6-feet. The weir structure restores

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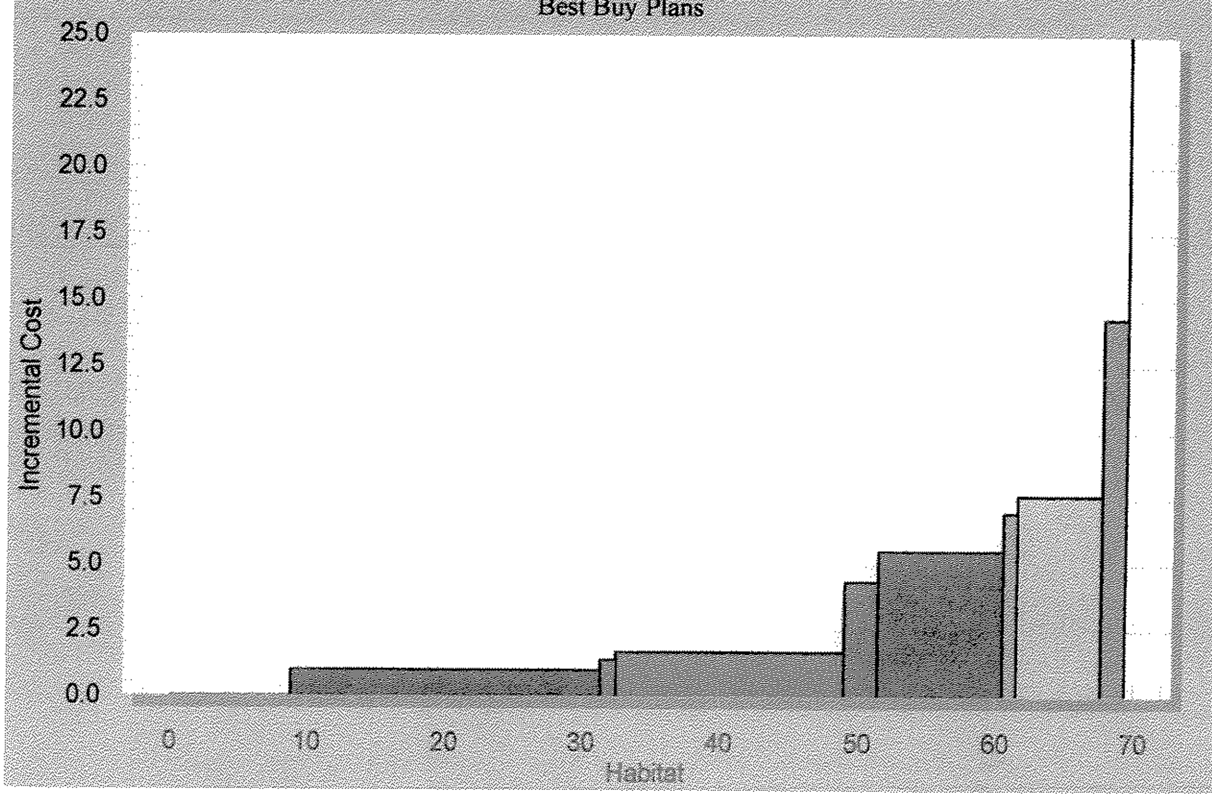
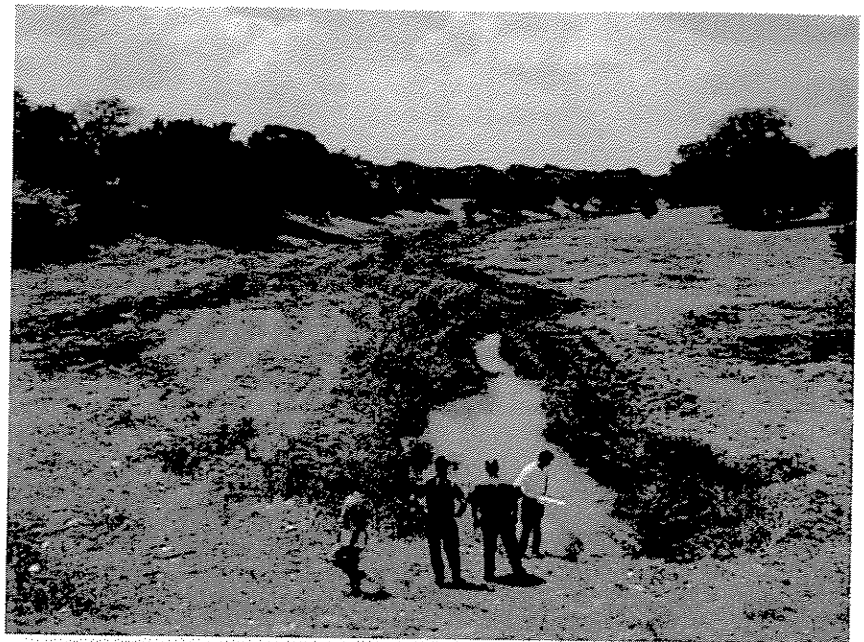
Best Buy Alternative Summary

Alternative	AAHUs	Incremental AAHUs	Annualized Costs	Incremental Annualized Costs	Average Cost Per AAHU	Incremental Cost Per AAHU
No Action	8.78	8.78	0.00	0.00	0.00	0
2	31.37	22.59	22.68	22.68	0.72	1.00
3	32.45	1.08	24.20	1.52	0.76	1.41
4	48.95	16.50	52.30	28.10	1.07	1.70
5	51.42	2.47	63.13	10.83	1.23	4.38
6	60.44	9.02	112.98	49.85	1.87	5.53
7	61.45	1.01	120.05	7.07	1.95	7.00
8	67.57	6.12	166.94	46.89	2.47	7.66
9	69.31	1.74	191.86	24.92	2.77	14.32
10	69.32	0.01	193.37	1.50	2.79	150.4

Figure 2. Incremental Cost Per AAHU

Best Buy Plans



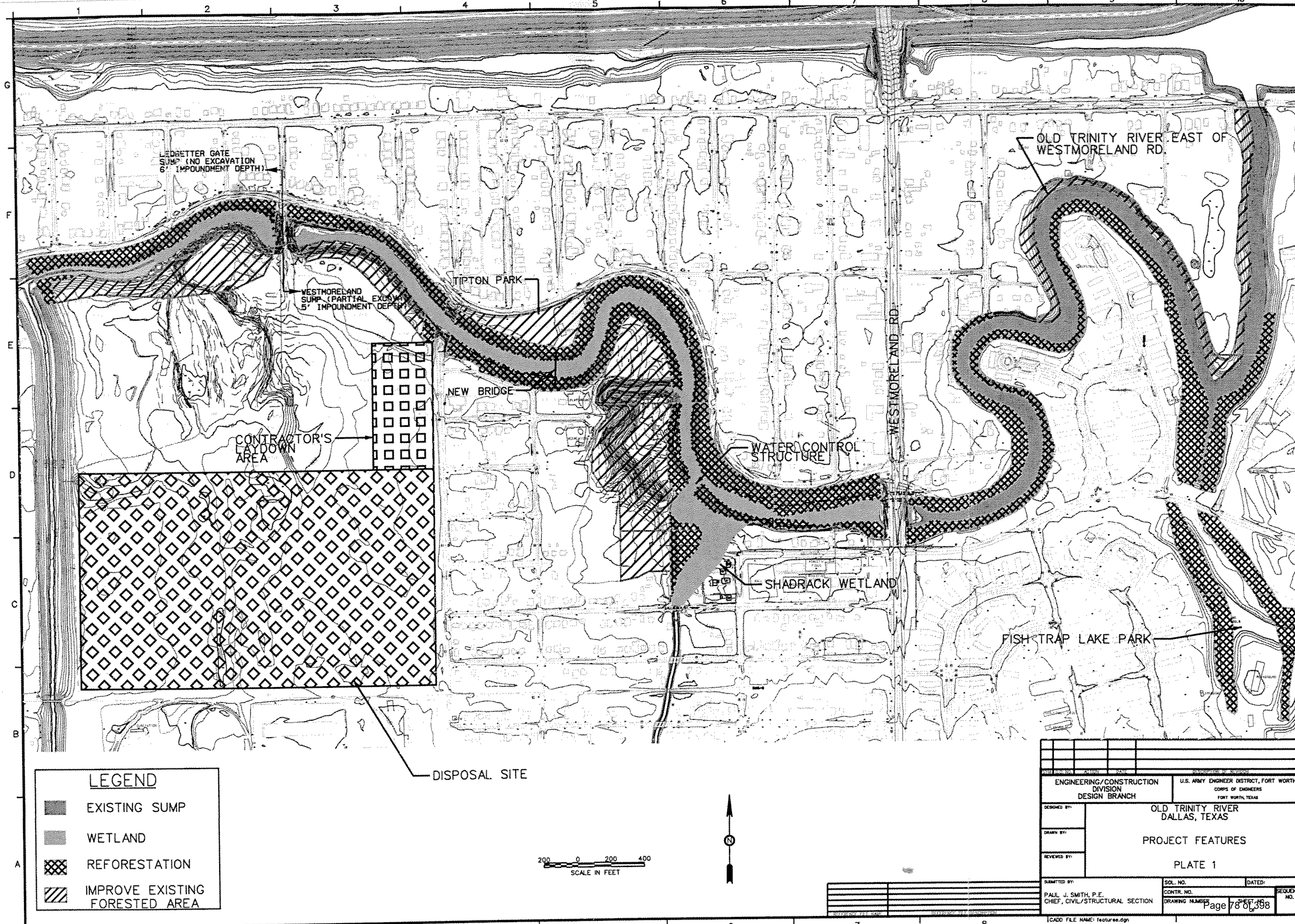


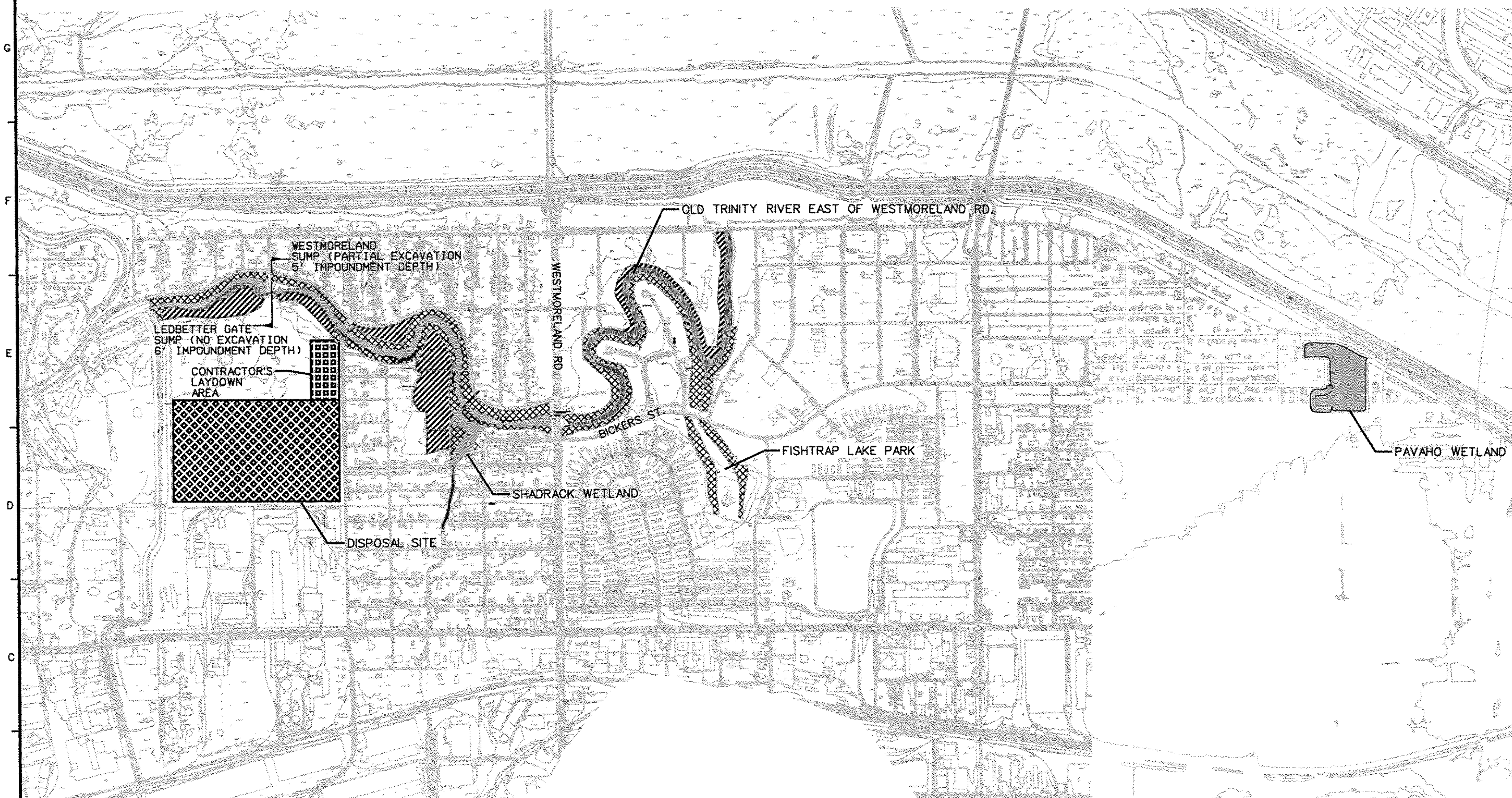
Photograph 1: View of Old Trinity River Channel

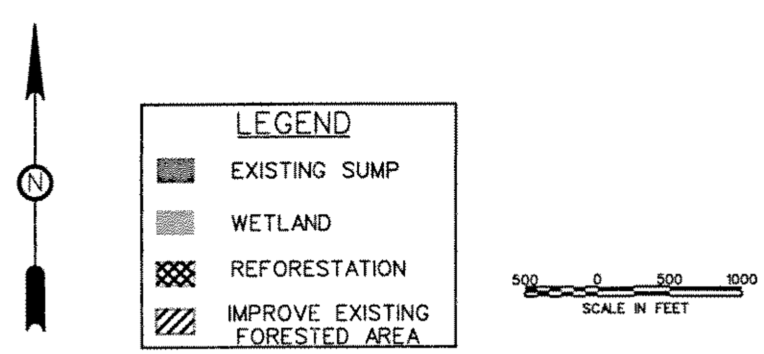
Photograph 2: View of Old Trinity River Channel

Photograph 3: View of Pavaho Sump

Photograph 4: View of Shadrack Channel


LEDBETTER GATE SUMP (NO EXCAVATION 6' IMPOUNDMENT DEPTH)
WESTMORELAND SUMP (PARTIAL EXCAVA 5' IMPOUNDMENT DEPTH)
TIPTON PARK
NEW BRIDGE
CONTRACTOR'S LAYDOWN AREA
WATER CONTROL STRUCTURE
WESTMORELAND RD.
OLD TRINITY RIVER EAST OF WESTMORELAND RD.
SHADRACK WETLAND
FISH TRAP LAKE PARK
DISPOSAL SITE
LEGEND
EXISTING SUMP
WETLAND
REFORESTATION
IMPROVE EXISTING FORESTED AREA
200 0 200 400
SCALE IN FEET
N
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
DESIGNED BY:
DRAWN BY:
REVIEWED BY:
SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL/STRUCTURAL SECTION
OLD TRINITY RIVER
DALLAS, TEXAS
PROJECT FEATURES
PLATE 1
SOL. NO.
DATED:
CONTR. NO.
DRAWING NUMBER
SEQUENCE NO.
CADD FILE NAME: features.dgn





ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY:

DRAWN BY:

REVIEWED BY:

OLD TRINITY RIVER
DALLAS, TEXAS

PROJECT VICINITY MAP

PLATE 1a

SUBMITTED BY:

PAUL J. SMITH, P.E.
CHIEF, CIVIL/STRUCTURAL SECTION

SOL. NO. | DATED:
CONTR. NO.
DRAWING NUMBER | SHEET OF | SEQUENCE NO. | CONTR. NO.

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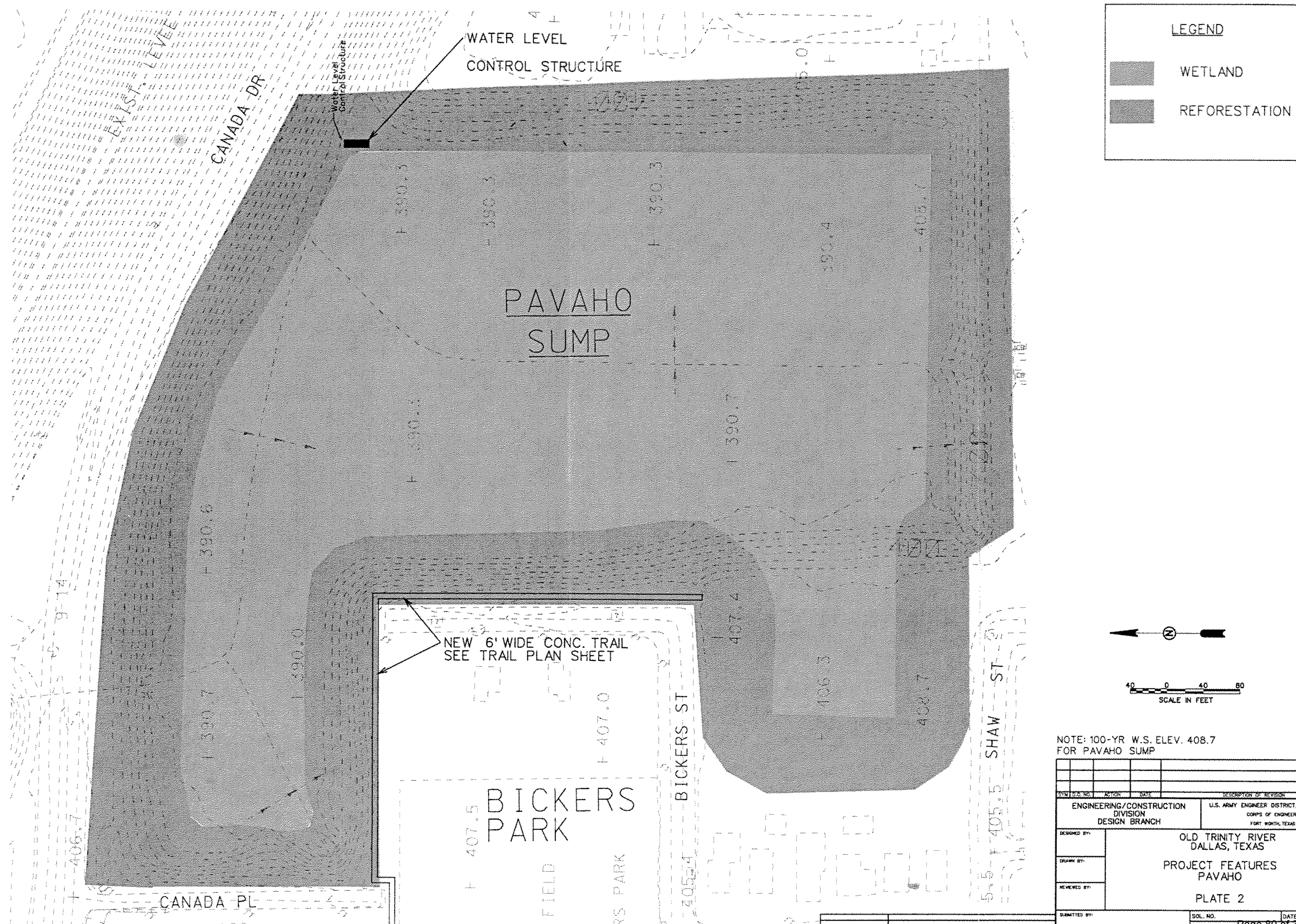

NOTE: 100-YR W.S. ELEV. 408.7
FOR PAVAHO SUMP

SYM	C.O. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY:
DRAWN BY:
REVIEWED BY:

OLD TRINITY RIVER
DALLAS, TEXAS

PROJECT FEATURES
PAVAHO

PLATE 2

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DATED:
CONTR. NO.
DRAWING NUMBER SHEET NO. OF
SEQUENCE NO.

CADD FILE NAME: FEATURES2.DGN

approximately 1.3 acres of wetland, an area where the depth of the impoundment is 3-feet or less. A deep pool area where the depth of the impounded water is greater than 3-feet will cover approximately 0.3 acres.

In addition to the wetlands described above, approximately 4.48 acres of reforestation and 5.39 acres of habitat improvement will occur along the old river channel. The reforestation will be comprised of planting 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre. The habitat improvement will consist of planting 5 one-inch caliper trees and 5 shrubs per acre.

Plate D-1 (Annex D) displays the Ledbetter wetland area.

Old Trinity River Between Ledbetter Gate and Westmoreland Road. This portion of the recommended plan consists of restoring a wetland community between Ledbetter Gate and Westmoreland Road. The design of the wetland area includes a downward opening weir gate that will be used to control the water surface elevation between the Ledbetter Gate and Westmoreland Road. The weir is designed to attach to the inside wall of a box that will surround the existing 60-inch reinforced concrete pipe (RCP) outfall under Westmoreland Road. A headwall will be build around the RCP. The gate is designed for a maximum opening range of 0 to 3-feet. Since the weir gate is 3-feet in height and moves through a range of three feet to its fully open position, the full operational range is 6-feet. A 1-foot slot on the inside of this structure will allow the gate to operate in this 6-foot range. In addition, approximately 11,000 cubic yards of material will be removed in this reach. The final maximum impoundment depth is 5-feet. Together, the structure and removal of the material restores approximately 8.36 acres of wetland area where the depth of the impoundment is 3-feet or less. A deep pool area where the depth of the impounded water is greater than 3-feet will cover approximately 2.3 acres.

In addition to the wetlands described above, approximately 22.4 acres of reforestation and 17.38 acres of habitat improvement will occur along the old river channel. The reforestation will be comprised of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre. The habitat improvement will consist of planting 5 one-inch caliper trees and 5 shrubs per acre.

Plates D-1 through D-4 (Annex D) display the Westmoreland Road Wetland cell area.

Shadrack Channel. This portion of the recommended plan consists of the abandonment of the existing concrete channel, the creation of a new earthen channel, and a wetland cell. The concrete in the existing Shadrack Channel will be broken-up in place, and the channel filled with select earth fill to the existing top of bank grades. A water control structure is included in the wetland cell to allow for up to a 3-foot fluctuation in the water level. The structure is designed to convey low flows from upstream runoff into the Old Trinity River channel portion of the sump between the Ledbetter Gate and Westmoreland Road and maintain a relatively constant water level in the Shadrack Channel wetland area. When the capacity of the water level control structure is exceeded due to higher rainfall events, the runoff is conveyed into the Old Trinity River channel from the Shadrack Channel wetland area over a berm between the wetland area and Old River channel area. The berm is designed as an earthen broad-crested weir armored with a geotextile fabric and has a constant level crest elevation. The berm serves to spread the flow evenly along the crest to reduce the flow to a non-erosive velocity between the wetland area and the Old Trinity River channel area. The structure and removal of the material restores approximately 3.03 acres of wetland with an impoundment depth of 3-feet or less.

In addition to the wetlands described above, approximately 1.09 acres of reforestation will occur along the old river channel. The reforestation will be comprised of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre.

Plates D-3 and D-4 (Annex D) display the Shadrack Channel Wetland Cell.

Pavaho Sump. This portion of the Recommended Plan includes the installation of a stop log water control structure as shown on Plate D-11, and is located at the head of the sump area outlet channel as shown on Plate D-4. The structure is designed to maintain the normal water level in the wetland at elevation 388.0 and will provide the capability for water level management in the wetland and to completely drain the wetland area for maintenance. The invert of the outlet channel down to the Pavaho pump will be re-graded to provide positive drainage of the wetland cell. This portion of the plan includes an expansion of the wetland area that is currently private property located on the southwest corner of the Pavaho Sump. The expansion area is shown on Plate D-4 and will be excavated down to a depth of approximately 2 feet below the normal design water level of elevation 388.0. The sump volume gained by the removal of material in this area will be used to include riparian island habitat in the wetland. Together, the structure and removal of the material restores approximately 8.64 acres of wetland with an average water depth of 3-feet or less.

In addition to the wetlands described above, approximately 6.58 acres of reforestation will occur along the old river channel. The reforestation will be comprised of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre. Plates D-7 through D-10 display various cross-sections.

Fish Trap Lake Park and Old Trinity River East of Westmoreland Road. Habitat improvement (5.65 acres) and reforestation (13.11 acres) will occur along the river channel from Westmoreland Road eastward to Sump and Pumping Plant D located north of Canada Drive. An additional 5.82 acres of reforestation will occur along an unnamed tributary running south from Bickers Street and bordering the east and west sides of Fish Trap Lake Park. The reforestation will be comprised of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre.

Table 5 is a summary of the restoration measures. The tree and shrub species recommended for planting were specifically selected because they are native to the region and are known to grow with minimal maintenance compared to normal cultivated plant species found in most landscape designs. Potential species to be utilized for reforestation in all the areas identified for this type of restoration are presented in Table 6.

In addition, depending on the planting season and site conditions, it might be necessary to apply a cover crop, such as cereal rye, to provide cover until the natives have time to become established.

In addition, restoration costs include watering for 53.48 acres of trees and shrubs planted as part of the recommended plan. Watering will help ensure a relatively high degree of survivability for the initial plantings. Without watering, survivability of trees and shrubs is often 30% or less, particularly during drought conditions. Generally, the supplemental watering continues for 3 to 5 years from the time of planting.

Table 5. Summary of Restoration Measures

	ACRES		
LOCATION	**Wetlands**	**Reforestation**	**Habitat Improvement**
Old Trinity West of Ledbetter Gate	1.60	4.48	5.39
Old Trinity River Between Ledbetter Gate and Westmoreland Road	10.66	22.40	17.38
Shadrack Channel	3.03	1.09	0.00
Pavaho Sump	8.64	6.58	0.00
Fish Trap Lake Park and Old Trinity River East of Westmoreland Road	0.00	18.93	5.65
Total	***23.93***	***53.48***	***28.42***

During the design of the recommended plan, there were substantial deposits of trash and debris observed in Pavaho Sump. While some of this trash may be coming from the surrounding residential areas, the bulk is likely coming from storm drains that discharge into the wetland site. In addition to being unsightly, it also adversely affects the water quality and wildlife habitat functions. Having to continually remove the trash and debris also contributes significantly to annual maintenance costs. A preliminary assessment of utilizing trash and silt collection devices, installed at the ends of storm drain pipe, was completed. It was determined these devices are relatively simple and inexpensive to install, and would likely reduce maintenance costs and enhance the wetland habitat functions. The implementation of these devices will be further explored during project implementation.

Recreation Features. The formulation of the recreational features is based on the educational and social potential afforded by the restoration project, and was conducted within the following framework.

- Recreation facilities are totally ancillary, i.e. the project was not formulated solely for recreation.
- Recreation facilities take advantage of the project's recreation potential.
- Recreation facilities are not vendible.
- Recreation facilities would not exist without the project.
- Recreation facilities are within the 10% Federal cost participation limit.

The recommended plan includes two recreation features. The first is a footbridge spanning the Old Trinity River in Tipton Park, located approximately 2,000-feet upstream of Westmoreland

Road. This facility will replace an existing footbridge within Tipton Park that provides residents on the north side of the Old Trinity River access to a playground and recreation area on the south side without having to cross Norwich Road, a vehicular bridge with no sidewalks, which would become impassable as a result of the higher water surface elevations required for the restoration of the wetland habitat. The footbridge will be a simple concrete deck placed on piers, approximately 215-feet in length and 12-feet wide with associated rails and other required safety features. The footbridge will also provide a vantage point from which to observe the restore habitat. The facility will be compliant with the American Disabilities Act, and will be incorporated into the planned Bernal Trail system, a joint venture between the Texas Department of Transportation and the city of Dallas. Plate D-5 displays a plan and profile of the footbridge.

Table 6. Species List for Native Trees and Shrubs to be used for Reforestation and Habitat Improvement.

Common Name	Scientific Name
TREES	
Gum bumelia	*Bumelia lanuginosa*
Pecan	*Carya illinoinsis*
Texas redbud	*Cercis canadensis texensis*
Roughleaf dogwood	*Cornus drummondii*
Persimmon	*Diospyros virginiana*
Yaupon holly	*Ilex vomitoria*
Black walnut	*Juglans nigra*
Osage orange	*Maclura pomifera*
Red mulberry	*Morus rubra*
Sycamore	*Platanus occidentalis*
Red oak	*Quercus buckleyi*
Burr oak	*Quercus macrocarpa*
Shumard oak	*Quercus shumardii*
American elder	*Sambucus canadensis*
American elm	*Ulmus americana*
Cedar elm	*Ulmus crassifolia*
Rusty blackhaw	*Virburnum rufidulum*
SHRUBS	
American beautyberry	*Callicarpa Americana*
Hawthorn	*Crataegus spp.*
Deciduous holly	*Ilex deciduas*
Chickasaw plum	*Prunus angustifolia*
Mexican plum	*Prunus mexicana*
Smooth sumac	*Rhus glabra*
Coralberry	*Symphoricarpus orbiculatius*
Winged elm	*Ulmus alata*

The second recommended recreation feature is a recreation trail connecting Bickers Park to the Pavaho sump wetland area. Bickers Park contains a playground and athletic fields. A trail is an excellent opportunity to provided appropriate access to the restoration project. The trail consists of a 6-foot wide concrete trail, extending approximately 975-feet from Ladd Street (on the east border of Bickers Park) west to Bickers Street, on the west side of Bickers Park and east of the wetland area, terminating at the southeast corner of the existing Pavaho Sump. Plate D-6 in Annex D displays the recreation trail plan.

Economic justification is based on an evaluation of competing facilities, existing and expected future use with and without the recommended plan, and unfulfilled demand. According to the Texas Parks and Wildlife Department, Texas Outdoor Recreation Plan, which identifies population, usage, and demand trends within the region, including the study area, the demand for recreation facilities, such as trails, is steadily increasing. Applying the appropriate participation rates to the population of potential users, the access will be used to capacity from the time it becomes available to the public through the period of analysis.

Current standards indicate facilities of this type can accommodate approximately 57,700 visitors per year per mile of access. For the 975-foot pedestrian trail, the total capacity usage would be (57,700/5,280) times 975, or about 10,700 visitor days per year. For the combination pedestrian bridge and observation deck, the total capacity usage would be (57,700/5,280) times 215 is about 2,350 visitor days per year. Point values are assigned based on selective criteria applicable to the recreation features. The criteria include the number and types of recreation activities, the proximity of and access to the recreation activities, and the quality and aesthetics of the facility. The estimated points assigned to the trail and the combination pedestrian bridge and observation deck total 45 for each facility. The current unit day value for 45 points in fiscal year 2003 is $6.00. Applying this value to 10,700 and 2,300 visitor-days per year results in an annual benefit of approximately $64,200 and $13,800 per year. The total cost (March 2003 price level) of the trail and the footbridge (including engineering, design, supervision, and administration) is $218,600 and $51,600, respectively. Annual costs based on a 5.875 percent interest rate and a 50-year project life is estimated to be $13,700 and $3,200, respectively, including estimated annual maintenance. Table 7 displays the summary of the recreation economic analysis.

Table 7. Economic Justification of Recreational Feature Costs

Item	Total Cost	Annual Cost	Annual Benefit	Benefit-Cost Ratio
Trail	$ 51,600	$ 3,200	$ 63,900	20.0
Pedestrian Bridge / Observation Deck	$ 218,600	$ 13,700	$ 14,100	1.0

IMPACTS OF THE RECOMMENDED PLAN

***Impacts to Existing Project and Land Use.** The creation of wetlands within the existing Dallas Floodway sump system requires the retention of water for long periods of time, so each alternative was analyzed for potential adverse affects on the performance of the sump system. Adequate performance of the sump system depends on the availability of the flood storage volume within the Old Trinity River channels and other sump areas to provide for the storage of floodwater during a flood event. Each feature of the recommended plan was designed to result in no net loss of flood storage within the affected sump drainage areas as well as adequate conveyance of floodwater to the pump stations.

Any reduction of the flood storage volume due to the recommended wetlands will be compensated by additional excavation of material within the effected sump. The wetlands in Ledbetter and Westmoreland Channels result in a reduction of sump volume; however, there is an increase in sump volume due to the construction of the Shadrack Channel wetland. It is expected that this increase in sump volume is sufficient to offset the sump volume reduction due to the Ledbetter and Westmoreland Channel wetlands. In order to maintain adequate volume in the sump system, the wetlands will need to be constructed in a sequence that ensures the existing sump volume is not reduced.

The recommended Ledbetter wetland cell is located within the Trinity-Portland sump, separated from the Westmoreland wetland cell by the Ledbetter Gate. The Westmoreland wetland is located within the Frances Street sump, and the Ledbetter Gate is used to transfer water between the Trinity-Portland sump and the Frances Street sump in the event of a major flood in order to minimize the flood damage risk. Therefore, in the event of a major flood, the Ledbetter Gate can be used to combine the flood storage capability of these two sumps. The combined impoundment loss of flood storage of the Westmoreland wetland and the Ledbetter wetland is compensated by the additional flood storage provided by the Shadrack Channel wetland cell. However, the Shadrack Channel improvements and wetland cell is located entirely within the Frances Street sump. This loss of flood storage within the Trinity-Portland sump may effect the operation of the Ledbetter Gate, and the city of Dallas River levee operations personnel need to be aware of the potential effects of this change. The excavation within the Pavaho Sump wetlands site will compensate for the loss of flood storage due to the impoundment of water at that site.

The impoundment of water against the Ledbetter Gate is noted as being long term. However, it is expected that with the water control capability for the Westmoreland and Ledbetter wetland cells, these cells may be drained periodically for maintenance and wildlife management. If coordinated with the city of Dallas levee operations personnel, this could provide the necessary timeframe for their required inspections and maintenance of the gate. There is the potential for adverse impacts to the proposed habitat restoration features in this area to occur if a problem with the Ledbetter Gate structure would arise that would necessitate draining the wetland cells during a period which would negatively impact either the wetland functions or the use of the wetlands by waterfowl during spring and fall migration periods.

The recommended plan will not have any adverse impacts to land use in the area. It is hoped that the project as proposed will serve as a model to local landowners and citizens for incorporating improvements on their own lands and encouraging them to take pride in their neighborhood. The sump areas evaluated in the BDDI study and the locations of the proposed project features within the sump areas are shown on Plate D-12.

***Aquatic Habitat and Species.** Any adverse impacts to the aquatic habitat from the construction of project features would be short term and the system would recover completely once terrestrial vegetation is well established in all the project areas. In fact, it is expected that habitat gains will accrue. Overall, the recommended plan will help to improve the aquatic habitat in the old river channel and deep-water pools by stabilizing the water regime and creating an additional 2.6 acres of deep-water habitat. Development of additional forested and vegetated areas on the banks that would then overhang the water in the ponds, river, and wetlands would provide shade to help maintain water temperatures within ranges optimal for the growth and development of aquatic organisms.

***Wetlands.** The recommended plan would have no long-term adverse impacts on the wetlands in the area; instead, it is anticipated that implementation of the proposed project would have significant positive long-term impacts and that habitat gains would accrue. Overall, the recommended plan would improve the wetland complex by stabilizing the water regime and creating an additional 21.36 acres of wetland habitat. More trees and vegetation in the riparian zone would improve the ability of the corridor to provide buffering against environmental pollutants in stormwater runoff and increase the input of nutrients into the wetland complex and the Trinity River. Water dependent avians and herptafauna will benefit from the increased size and improved quality of the wetland complex

***Terrestrial Habitat and Species.** There will be no adverse impacts to vegetational resources in the proposed project area from implementation of the recommended plan in the long-term, only temporary impacts during the construction phase. In fact, the gains in habitat quality and quantity will be significant once the planted vegetation becomes established and begins to mature. Overall, the recommended plan would convert 53.48 acres of open land to riparian forest and improve the forested habitat on 28.42 acres.

There will be no adverse impacts to the wildlife resources in the proposed project area as the result of implementation of this plan. Resident wildlife who live in this area currently have learned to adapt to, or at least be tolerant of, human presence. It is anticipated that resident wildlife will temporarily migrate to surrounding areas during the construction phase of the project and move right back into the area once construction has been completed. Further, the proposed project features will improve the habitat for wildlife in the future as the new water structures help to stabilize the water regime within the wetland areas and as the planted materials establish and mature.

***Threaten and Endangered Species.** The recommended plan will not adversely affect state or federally listed threatened or endangered species.

***Air and Water Quality.** No significant adverse impacts to air quality would occur from implementation of the proposed project. The recommended plan may temporarily have an adverse impact on water quality within the project area. The excavation of a small portion of the old river channel and existing sump may cause an increase in the amount of turbidity in the waterway and an increase in total suspended and dissolved solids for a short time following construction. This will be a temporary impact. A specific storm water pollution prevention plan will be developed during the plans and specifications phase of the project prior to construction, to include the use of best management practices such as silt fencing and staked straw bale dikes.

***Archeological and Cultural Resources.** Only one cultural resource locus has been identified within the recommended project area. The site, 41DL389, is a buried site located adjacent to the Shadrack Wetland. It will not be impacted by the recommended wetland configuration. Monitoring of this site will be necessary during construction of the wetland. Concurrence from the SHPO of this monitoring plan was received in March of 2000. In addition, the Pavaho sump wetland area has undergone several reconfigurations during the formulation of the recommended plan. While this area has been visually inspected for surface archaeological sites, it has not been deep tested. The area is considered a high probability for containing buried sites, and has therefore been recommended for monitoring during excavation. Concurrence from the SHPO on the proposed monitoring at Pavaho Sump was received by letter in March 2002 and is included in Annex A. No historic structures will be impacted by the recommended plan.

***Hazardous, Toxic, and Radioactive Wastes.** There are no known hazardous, toxic, or radioactive waste sites within the recommended plan area.

***Disposal Site**. The disposal site is located immediately west of Norwich Road and North of Singleton Boulevard. This 62-acres site has been previously disturbed with the placement of fill material. The site is primarily open land with some pioneer species (i.e., mesquite) beginning to sprout. The disposal site will receive approximately 115,600 cubic yards of excavated material, and result in one-foot of fill spread across the site. The site is located above the 100-year floodplain with no wetlands or other sensitive resources present. The placement of fill on this site is not expected to result in any significant adverse impacts.

***Recreational, Scenic, and Aesthetic Resources.** The recommended plan will have no adverse impacts on the recreational, scenic, and aesthetic resources in the area, in fact, it is anticipated that implementation of the proposed project features will have significant positive long-term impacts. Scenic and aesthetic resources in the area might be adversely impacted on a temporarily basis during the construction phase of the project, but the benefits to the area will be immediately seen with the clean up and grading of disturbed lands and establishment of the native plant materials. Some of this vegetation will be containerized trees and shrubs that become quickly established and attractive to view. The addition of these trees and shrub species will improve the aesthetics of these areas given the fact that it will take several years for the remaining seedlings to mature enough to provide aesthetic values to the area.

The addition of public access to the area will increase the recreational and educational opportunities for local citizens. In addition, there is great potential for this access to provide future linkage to trail systems to the north and south and become part of the regional Trinity Trails Plan, thereby, increasing the value of the proposed access features to, not only the local community, but to the region.

Importance of Project Outputs. In Texas, it is estimated that more than 60 percent of the historical bottomland hardwoods and bottomland-forested wetlands have been lost due to reservoir construction and operation, agricultural conversion, timber production, and urban and industrial development (Texas Center for Policy Studies 1995). Numerous studies have documented the increasing scarcity of bottomland hardwood forests in Texas and the nation (Frayer et al. 1983; Fish and Wildlife Service 1985; Frye 1987).

of grasses, and 802 species of herbaceous plants occur in Texas' bottomlands. They are known to support 116 species of fish, 31 species of amphibians, 54 species of reptiles, 273 bird species and 45 species of mammals. At least 74 species of threatened and endangered animals depend directly on bottomland hardwood systems and over 50 percent of neotropical songbirds not listed as endangered or threatened are associated with these systems. Besides contributing to the biodiversity of Texas, and providing critical wildlife and bird habitat, bottomland hardwood systems with associated wetlands 1) serve as catchment and water retention areas in times of flooding; 2) help control erosion; 3) contribute to the nutrient cycle, and 4) play a vital role in maintaining water quality by serving as a depository for sediments, wastes and pollutants from runoff. Despite these important functions, bottomland hardwoods ecosystems are one to the most endangered ecosystems in the United States.

In addition to being consistent with State and Federal government initiatives to conserve and increase declining wetland acreage and the North American Waterfowl Management Plan with its goal of preserving and increasing North America's waterfowl population, the recommended plan would increase the habitat value of the study area 698% over the without project ("no action") alternative and would restore or create approximately 23.93 acres of emergent wetlands, improve the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, and restore 53.48 acres of open space to bottomland hardwoods. Subsequently, fragmentation of the existing habitat would be reduced and a contiguous corridor for migration of avian and wildlife species restored. The recommended plan directly addresses the loss and scarcity of the resources described above as well as complements various state and federal plans for restoring resources.

PROJECT IMPLEMENTATION

Total Project Costs of Recommended Plan. The total project cost is comprised of all expenditures for the Detailed Project Report, the plans and specifications phase, lands easements, relocations, rights-of-way, and disposal areas, construction, construction management, and monitoring. Table 8 displays a summary of the estimated total project cost. The detailed total project cost estimate broken down in the Corps of Engineers code of accounts format using the MCACES software is located in Annex E.

Table 8. Estimated Total Project Cost (rounded)
March 2003 price level

Item	Ecosystem Cost	Recreation Cost	Total Project Cost
Detailed Project Report	$ 275,700	$ 0	$ 275,700
Plans and Specifications Phase	$ 332,100	$ 30,000	$ 362,100
Lands, Easements, Rights-of-Way, Relocations, Disposal Areas	$ 741,600	$ 0	$ 741,600
Construction:			
Contract	$ 1,214,000	$ 214,600	$ 1,428,600
Supervision & Administration, and Engineering During Construction	$ 144,500	$ 25,600	$ 170,100
Subtotal Construction	$ 1,358,500	$ 240,200	$ 1,598,700
Monitoring	$ 18,700	$ 0	$ 18,700
Total Project Cost	$ 2,726,600	$ 270,200	$ 2,996,800

Plans and Specifications Phase. During the plans and specifications phase, detailed design of the various water control structures, levees, and access will be completed. Also, detailed layouts will be shown for the restoration areas, including the areas to be reforested. This detailed design will culminate in drawings (plans) and detailed specifications for each component of the project. Also during the plans and specifications phase, the project will be approved, and Federal funds committed, for construction. This will be followed by the execution of the Project Cooperation Agreement, real estate acquisition, and then a construction contract will be advertised and bids will be opened. The cost of the plans and specifications is a part of the overall total project cost, and will be shared jointly by the Federal and non-Federal sponsor. Table 9 displays the cost estimates for the plans and specification phase.

Table 9. Plans and Specifications Phase Costs (rounded)
March 2003 price level

Item	Ecosystem Cost	Recreation Cost	Total Project Cost
Plans and Specifications	$ 245,700	$ 27,000	$ 272,700
Cost Engineering	$ 15,100	$ 3,000	$ 18,100
Environmental / Cultural Compliance	$ 28,800	$ 0	$ 28,800
Real Estate Acquisition Coordination	$ 24,300	$ 0	$ 24,300
Contract Advertisement and Award	$ 9,100	$ 0	$ 9,100
Management	$ 9,100	$ 0	$ 9,100
Total Plans and Specifications Cost	$ 332,100	$ 30,000	$ 362,100

Real Estate. The city of Dallas is responsible for providing all lands, easements, rights-of-way, relocations, and disposal areas (LERRD's) required for project construction, operation, and maintenance. Following the execution of the Project Cooperation Agreement, the city of Dallas will be provided a right-of-way map delineating the real estate to be acquired in fee or easement.

Land requirements for the recommended plan include 66.35 acres of lands dedicated to the Dallas Floodway Levee project, 45.04 acres of land to be acquired in fee simple, and 65 acres of temporary work area easement (a disposal and staging area located just south of the Old Trinity River and West of Norwich Street). There are 53 land acquisitions required. The total cost real estate cost of $741,600 is comprised of real estate payments ($419,300) and administration ($322,300). A description of the complete real estate requirements and a summary of costs are located in the real estate plan located in Annex F.

Project Cooperation Agreement. The Project Cooperation Agreement (PCA) is a contract between the Federal Government and the non-Federal partner describing the rights and responsibilities of each party during project implementation, including cost sharing. Annex G is a copy of a draft model PCA agreement. The PCA will be executed during the plans and specifications phase of project implementation after receiving a commitment of Federal funds for construction from Headquarters, United States Army Corps of Engineers.

Contract Advertisement and Award. Once the Project Cooperation Agreement is executed, and the city of Dallas has acquired all lands for project construction, operation, and maintenance and has provided the Fort Worth District with a right of entry document, a construction contract will be solicited and advertised. Prior to awarding the contract, the city of Dallas must provide any applicable cash contribution. The contract will be awarded to the lowest responsive bidder and construction will be initiated within 30-45 days from the bid opening.

Project Construction. After award of a construction contract, the Government will oversee the actual construction of the various components of the project. These components include the water control structures, access, and habitat improvement and restoration measures. Also, the construction contract will provide for oversight of the planting of the various flora noted above. Inherent with this contract, a warranty period for the actual construction items and the plantings will be specified before final acceptance of the project.

The construction phase of the project will take approximately 12 months to complete. The schedule for completion of the plantings will be following the second growing season past completion of the construction phase, a period of approximately 24 months in total. This may vary, if necessary, to allow for optimization of planting seasons for individual species.

The planting of the tree and shrub species will be spread out over two growing seasons to ensure a higher rate of overall survivability in case the initial planting season conditions are less than ideal

Monitoring and Adaptive Management. In an effort to ensure the success of the recommended plan, the restoration measures implemented will be periodically surveyed to provide feedback on the response of the ecosystem and its resources to the management measures taken. By connecting the ecosystem response to the restoration as well as the management measures, potential beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project. This is especially true of the plantings that will have to be frequently monitored from their initial planting until reasonable stabilization is achieved. To accomplish this goal, periodic monitoring of the restoration measures will be conducted over a two-year period beginning after the completion of the construction of project features and the initial reforestation plantings.

Operation, Maintenance, Rehabilitation and Repair. The city of Dallas is responsible for all project operations, maintenance, repairs, replacements, and rehabilitations. Project operation will include the manipulation of the water control structures in a manner consistent with the establishment and sustainability of emergent wetlands. Generally, the depth of the water will be greater between September and April to provide aquatic habitat for waterfowl. Between May and August water will be allowed to slowly drain to stimulate growth of vegetation. In addition, the city of Dallas will provide water, as needed, for a period of at least 3 years following the completion of initial plantings.

The intent of the restoration project is to establish an area of natural habitat. To accomplish this goal some project maintenance will be required; however, care should be taken to not "over maintain" the project and thus lose the natural aspect of the community. Pruning of trees and shrubs and mowing should not be performed except where the health and well-being of humans is at stake. It is anticipated that while maintenance early in the life of the project will be essential, as the vegetation communities become established less maintenance will be required with no maintenance being the ultimate goal. Specific maintenance requirements are as follows.

- Water control structures will need to be kept in good repair and functional. The areas adjacent to the water control structure must remain free of debris and other material that would adversely effect their operation.
- The removal of trash and debris throughout the project area, particularly the wetlands.
- Ensure the recreation trail is clear of debris, and free from cracks, buckles, and other abnormalities that may impede pedestrian traffic.

Project repair and rehabilitation will include the replacement of trees and shrubs damaged by natural or man-made activities, the repair and prevention of any potential localized erosion, and repairing and/or replacing water control structures that have become damaged or inoperable. In addition, the trail will be kept clear of debris, and repaired as necessary. A detailed operation and maintenance manual will be provided to the city of Dallas after project construction is complete. Total annual operation and maintenance costs, including labor, are estimated to be $27,000.

Cost Apportionment. As described in the PCA, the total project cost will be shared between the Federal Government (75%) and the city of Dallas (25%). Dallas' share is comprised of the following components. Table 10 displays the estimated cost apportionment at a March 2003 price level.

- A credit for the fair market value of all lands, easements, rights-or-way, relocations, and disposal areas (LERRD's) provided for project construction, operation, and maintenance.

- A credit for the value of any work-in-kind (WIK) provided toward project implementation. The WIK credit is limited to 80% of the city of Dallas' total share of the

the cost.

- In the event the sum of the values for LERRD's and WIK is less than the 25% contribution, the city of Dallas will contribute the balance in cash.

- In the event the value of the LERRD is greater than 25%, the city of Dallas may receive a cash reimbursement to reduce the total contribution to 25%.

- Combinations of WIK and LERRD that exceeds the 25% contribution will not result in a reimbursement.

The city of Dallas will receive a reimbursement, currently estimated at $59,950 for exceeding the 25-percent maximum non-Federal contribution on the ecosystem restoration portion of the recommended plan. The reimbursement is the result of the estimated credit the city of Dallas will receive for real estate acquisition. While the actual land payment ($419,300) is relatively small compared to the total project cost, given the large number of individual property owners, administrative costs are relatively high ($322,300). Note the LERRD cost also includes $142,000 in contingencies.

TABLE 10. Cost Apportionment

	Ecosystem Restoration	Recreation	Total
Total Project Cost	$ 2,726,600	$ 270,200	$ 2,996,800
Federal Share	$ 2,044,950	$ 135,100	$ 2,180,050
City of Dallas Share:			
LERRD's:			
Land Payments	$ 419,300	$ 0	$ 419,300
Administration	$ 322,300	$ 0	$ 322,300
Total LERRD's	$ 741,600	$ 0	$ 741,600
Work-in-Kind	$ 0	$ 0	$ 0
Cash Contribution/(Reimbursement)	$ (59,950)	$ 135,100	$ 75,150
Total City of Dallas	$ 681,650	$ 135,100	$ 816,750

Although the city of Dallas is entitled to the reimbursement as prescribed by law, it is the policy of the Corps of Engineers to place a lower priority for construction funding on those projects which result in a reimbursement for excess LERRD credit. After a review of the total land required for the recommended plan, it was determined that a reduction in the land requirements and the subsequent reduction in environmental output were not acceptable. Further, the potential to utilize "conservation easements" was investigated. Conservation easements are appropriate in certain rural ecosystem restoration projects where the landowners have a better ability to control disturbances and support or actually conduct some of the operation and maintenance activities. Small lots sizes and multiple property owners increases the difficulty of dealing with the number of potential visitors to the area, and the potential for conflicts between project operation needs and those of the owners, are all considered to be significant constraints to use of the conservation easements. Further, the reduced efficiencies resulting from these constraints coupled with the minimal economic savings between a conservation easement and fee simple acquisition, would result in a net reduction in habitat outputs with essentially no economic savings. Consequently, conservation easements were not considered a viable measure.

The city of Dallas understands the policy regarding excess LERRD costs, reimbursement of excess LERRD costs, the Corps policy regarding the low priority for construction funding given to projects with excess LERRD costs and reimbursements. The City does not favor foregoing a portion of their LERRD reimbursement, and have requested the entire reimbursement amount, as currently estimated. They understand and accept the inherent risk of not receiving construction approval and funding in the most timely manner.

Construction costs are indexed to a "fully-funded" amount, which occurs at the mid-point of construction, and is intended to measure cost increases due to inflation from the completion of the feasibility study. This fully funded amount is estimated at the mid-point of construction. The fully funded cost estimate is $3,128,400 ($2,839,000 for restoration and $289,400 for recreation). The Federal and non-Federal apportionment for the restoration features is $2,129,250 and $709,750, respectively, and includes a $31,850 reimbursement to the city. The Federal and non-Federal apportionment for the recreation features is $144,700 each.

Work-in-Kind. Work-in-kind is the provision of labor, materials, or equipment by the city of Dallas, or its contractors during project implementation, specifically after the execution of the Project Cooperation Agreement. The city of Dallas will comply with applicable Federal and state laws and regulations, including the requirement to secure competitive bids for all work to be performed by contract. Contributions of cash, funds, materials, or services from other than the non-Federal partner may be accepted; however, such contributions will not be credited to the non-Federal partner's share, but rather will be applied to the entire total project cost and therefore reduce both the Federal and non-Federal share. At this time, the city of Dallas has not identified any labor, materials, or equipment to be provided during project implementation as work-in-kind.

Project Implementation Schedule. Table 11 displays the project implementation schedule.

TABLE 11. Project Implementation Schedule

Components	Dates
Initiate Plans and Specifications	February 2004
Commitment of Federal Funds for Construction	March 2004
Execute Project Cooperation Agreement	May 2004
Complete Real Estate Acquisition	May 2005
Advertise Construction Contract	June 2005
Initiate Construction	August 2005
Complete Construction	March 2006
Complete Planting	March 2007
Complete Monitoring	March 2008

COORDINATION OF RECOMMENDED PLAN.

Views of the City of Dallas. The city of Dallas has been identified as the non-Federal sponsor. The city has reviewed the draft Detailed Project Report and Integrated Environmental Assessment and concurs with its findings. Further, they have reviewed the draft Project Cooperation Agreement, understand and accept its provisions, including cost sharing and operation and maintenance responsibilities. The city supports the recommended plan and intends to participate in its implementation. A letter of intent stating the city's position is located in Annex A.

Results of Agency Coordination. As previously noted in this report, representatives from the U.S. Fish and Wildlife Service, the city of Dallas, and U.S. Army Corps of Engineers all participated in the development and evaluation if the potential restoration measures. In addition, information on water and air quality was obtained from the Texas Commission on Environmental Quality (TCEQ). The draft Detailed Project Report and Integrated Environmental Assessment has been reviewed by the Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Environmental Protection Agency (Region 6), the Texas Historic Commission, and the TCEQ, in accordance with coordination requirements as set forth by the National Environmental Protection Act (NEPA). Any comments received during the mandatory 30 day Public Notice period will be included in the final report, along with any letters received from the coordinating agencies. Annex H contains the U.S. Fish and Wildlife Service coordination documentation.

Regulatory Requirements. The proposed project has been reviewed in accordance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. In addition, Executive Order 11990, Protection of Wetlands, and Executive Order 11988, Floodplain Management, were considered during the development of the proposed project. The recommended plan would impact waters of the United States and is subject to provisions of Section 404 of the Clean Water Act. The project's restoration activities would meet the conditions of Nationwide Permit 27, Wetland and Riparian Restoration and Creation Activities. The State of Texas has issued a water quality certificate for Nationwide Permit 27 and, therefore, no further coordination is required under Section 404. There are no feasible alternatives to conducting the proposed project within the floodplain since the project as proposed requires siting within the floodplain to meet its intended purpose. However, the proposed activities would not induce development in, alter boundaries of, or significantly impact the 100-year floodplain in any way. The proposed project is in compliance with Executive Order 11988, Floodplain Management. The proposed project would neither adversely impact nor result in any net loss of wetland areas so the project is in compliance with Executive Order 11990. An Environmental Assessment (EA) was completed and A Finding of No Significant Impact (FONSI) was executed on November 25, 2003.

FINDINGS AND CONCLUSIONS

This Detailed Project Report (DPR) documents the results of a study conducted under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201). The purpose of the study was to identify the environmental degradation caused by the construction and operation of the Dallas Floodway project and subsequent development activities, evaluate measures to restore degraded wildlife habitat, and recommend a cost effective project for implementation that would result in functional stability, integrity, and sustainability of important ecological resources.

The recommended plan would increase the habitat value of the study area 698.9% over the without project ("no action") alternative and would restore or create approximately 23.93 acres of emergent wetlands, improve the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, and reforest 53.48 acres of open space to bottomland hardwoods. Subsequently the remaining acres of habitat within the study area become more valuable by reducing the fragmented nature of the existing habitat and restoring a contiguous corridor for migration of avian and wildlife species through the area.

The estimated total project cost of the recommended plan is $2,996,800. The total project cost of the ecosystem restoration features ($2,726,600) will be apportioned between the Federal Government (75-percent) and the city of Dallas (25-percent), or $2,044,950 and $681,650, respectively. The total project cost of the recreation features ($270,200) will be apportioned between the Federal Government (50-percent) and the city of Dallas (50-percent), or $135,100.

The city of Dallas is identified as the non-Federal sponsor, and has stated their support for the recommended plan, including cost sharing, and agreed to assume responsibilities for all operation, maintenance, replacement, and repair costs. A review of the information provided by the city of Dallas regarding its financial capability to meet the cost sharing requirements has been completed. The city has the statue authority and the financial capability to provide the required non-Federal items of local cooperation.

An Environmental Assessment (EA) was integrated into the DPR to assess the potential impacts of the recommended plan. A public notice will be released in May 2003 disclosing the availability of the EA. A Finding of No Significant Impact was executed on November 25, 2003.

Extensive coordination and input was obtained from the U.S. Fish and Wildlife Service during the development of the recommended plan and the agency is supportive of the project. The recommended plan is consistent with state and Federal government initiatives to conserve and increase declining wetland acreage. It is also consistent with the North American Waterfowl Management Plan with its goal of preserving and increasing North America's waterfowl population.

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RECOMMENDATIONS

I propose the recommended plan described in this Detailed Project Report be authorized for implementation under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended, as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. The first cost of this project at a March 2003 price level is estimated to be approximately $2,996,800.

Prior to commencement of construction, local interests must agree to meet the requirements for non-Federal responsibilities as outlined in this report and future legal documents. The city of Dallas has demonstrated that they have the authority and the financial capability to provide all non-Federal requirements for the implementation, operation, and maintenance of the project. The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works' construction program not the perspective of higher review levels within the Executive Branch.

John R. Minahan
Colonel, Corps of Engineers
District Engineer

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Finding of No Significant Impact

OLD TRINITY RIVER ECOSYSTEM RESTORATION
DALLAS, TEXAS

At the request of the City of Dallas, and under the authority of Engineers Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201), the Fort Worth District Corps of Engineers conducted an ecosystem restoration study to identify the environmental degradation caused by the construction and operation of the Dallas Floodway project and subsequent development activities, evaluate measures to improve the functional stability and integrity of important ecological resources, identify opportunities that would improve the quality of these important ecological resources, and recommend a cost effective ecosystem restoration project, if applicable. The study results are presented in an integrated Detailed Project Report and Environmental Assessment (EA).

The proposed project would restore or create approximately 23.29 acres of emergent wetlands, improve the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, reforest 53.48 acres of open space to bottomland hardwoods. The remaining acres of existing habitat within the study area would become more valuable by reducing the fragmented nature of the habitat and restoring a contiguous corridor for migration of avian and wildlife species through the area. The recommended plan would significantly increase the habitat value of the study area over the future without project alternative.

Several measures were evaluated for their potential to restore ecosystem function and stability. Alternatives included various plans to help stabilize the water regime in the study area to protect and improve the habitat value of existing wetlands, acquire disturbed lands adjacent to Old Trinity River and restore bottomland hardwoods, improve riparian and bottomland hardwood habitat for the benefit of multiple species of birds and wildlife; create and improve emergent wetlands to benefit waterfowl, shore and wading birds, and allow reestablishment of historic vegetation communities. In addition, a "no action" plan was evaluated.

The recommended plan would impact waters of the United States and is subject to provisions of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. The restoration activities recommended would meet the conditions of Nationwide Permit 27, Wetland and Riparian Restoration and Creation Activities. The State of Texas has issued a water quality certificate for Nationwide Permit 27 and therefore no further coordination is required under Section 404. The proposed project is located within the flood plain of the Trinity River. The project, as proposed, requires siting within the flood plain to meet its intended purpose and further, the project would not induce or increase flood damages within the area, therefore, the proposed project is in compliance with Executive Order 11988, Floodplain Management. The proposed project would neither adversely impact nor result in any loss of wetland areas so the project is in compliance with Executive Order 11990.

Three letters with comments about the proposed fish and wildlife restoration project were received during the comment period. One letter was from the U.S. Fish and Wildlife Service and two letters were from private citizens. All three letters contained no adverse comments and expressed general support of the project. Based upon reviewing the findings of the DPR and the EA, I conclude that the construction of the proposed project will result in a finding of no significant impact (FONSI).

DATE 25 Nov 03

John R. Minahan
for Colonel, Corps of Engineers
District Engineer

ANNEX A
CORRESPONDENCES

CITY OF DALLAS

November 18, 2003

Ms. Marcia Hackett
Project Manager
U.S. Army Corps of Engineers, Fort Worth District
ATTN: CESWF-PM-C
P.O. Box 17300
Fort Worth, Texas 76102-0300

RE: Project Cooperation Agreement and Letter of Intent

Dear Ms. Hackett:

I have reviewed the "Detailed Project Report and Integrated Environmental Assessment for Old Trinity River Channel Ecosystem Restoration, Dallas, Texas" and the draft Project Cooperation Agreement. I concur with the report's findings. The City of Dallas as the project sponsor would be responsible for an estimated $681,400 in project cost sharing with the U.S. Army Corps of Engineers' estimated project contribution of $2,995,800. The Corps' overall contribution to the project would include $270,200 for recreation. The City's overall contribution would include a cash contribution of $135,100 to share 50 percent of the cost for recreation.

I have reviewed and concur with the draft Project Cooperation Agreement as it identifies the roles and responsibilities of the Corps and the local sponsor (City of Dallas) for the implementation of this project. The City of Dallas remains committed to the implementation of this project.

If you should have any questions, please contact me at 214-671-9504.

Sincerely,

Greg Ajemian

Greg Ajemian
Executive Coordinator
Trinity River Corridor Project
City of Dallas

TRINITY RIVER CORRIDOR PROJECT / PUBLIC WORKS AND TRANSPORTATION 1500 MARILLA, 6BS DALLAS, TEXAS 75201 TELEPHONE 214/671-9500 FAX 214/670-3226

~~PM-C~~ ~~PM~~ mm/r

Eli Kangas

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CITY OF DALLAS

December 24, 1998

Colonel James S. Weller
District Engineer
U.S. Army Corps of Engineers
P.O. Box 17300
Ft. Worth, Texas 76102-0300

Dear Colonel Weller:

The City of Dallas has reviewed the draft Preliminary Restoration Plan for the Old Trinity River Channel Wildlife Habitat Restoration Project in West Dallas. The City of Dallas agrees with the evaluation and selection of the recommended plan. The draft Project Cooperation Agreement (PCA) has also been reviewed. We understand and accept the provisions of the PCA including project cost-sharing by the City of Dallas, once the project has been approved following completion of the Feasibility Study, to provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) required for project construction, operation and maintenance. The City further acknowledges the preliminary estimated cost of $1,066,700, and that our responsibility under the PCA is estimated at $131,700 in cash and $135,000 credit, and that the estimated annual operation and maintenance costs is $25,000. We also understand that the Feasibility Study will be prepared by the U.S. Army Corps of Engineers at no cost to the City.

The City of Dallas is in full support of further study, and it is our intent to participate in the implementation of the project as the non-Federal partner. We look forward to working with the U.S. Army Corps of Engineers on this project.

Sincerely yours,

Teodoro J. Benavides

Teodoro J. Benavides
City Manager

TJB/PHV/MS:mms

cc. Eli Kangas, Project Manager, USACE
Mary Suhm, First Assistant City Manager
Ryan S. Evans, Assistant City Manager
David C. Dybala, P.E., Director, Public Works & Transportation
Marina Sukup, Trinity River Corridor Project

PER-EC

DEPARTMENT OF THE ARMY

FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

RECEIVED

FEB 22 2002

TEXAS HISTORICAL COMMISSION

REPLY TO
ATTENTION OF

February 19, 2002

Planning, Environmental, and Regulatory Division

SUBJECT: Proposed Wetland Construction at Pavaho Sump, Old West Fork of the Trinity River, Dallas County, Texas

Mr. Lawrence Oakes
State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276, Capitol Station
Austin, Texas 78711

Dear Mr. Oakes:

The U.S. Army Corps of Engineers, Fort Worth District, utilizing Geo-Marine, Inc., conducted a cultural resources assessment of the above referenced project in 1999. A report of investigations, *Cultural Resources Survey of the Proposed Environmental Restoration Areas Along the Old West Fork of the Trinity River, Dallas County, Texas* (Burson and Cliff 1999) was coordinated with your office on November 1, 1999. Our determination of No Historic Properties Affected (36 CFR § 800.3(d0(1) was concurred with by your office on December 3, 1999. Since this determination, a modification to a project component has occurred.

It has been proposed to enlarge the area referred to as Wetland C by an additional 1.6 acres. Please see the enclosed figure and photographs for reference to the proposed original wetland configuration and the new proposed wetland configuration. Of this additional acreage, 0.71 acres will be excavated to an approximate depth of 15 feet to match the depth of the adjacent existing sump. The remaining 0.89 acres will be subjected to surface impacts from reforestation, which will be limited to the planting of seedlings.

Corps of Engineers archeologist, Ms. Michelle Dippel, conducted a visual reconnaissance of the new acreage. This small parcel of land is adjacent to the existing sump area, which comprises the original proposed Wetland C. The sump was excavated to a depth of 15 feet below the floodplain surface in the 1940's. This area was determined to be low probability for containing intact cultural resources due to the disturbed nature of the soils. The new additional acreage has not been disturbed by previous sump excavation. The 1.6 acre tract is a partially tree covered lot with evidence of trash dumping and surface soil disturbance.

No historic structures or surface sites were observed on the property. Based on geoarchaeological investigations conducted by Geo-Marine, Inc. in the vicinity (Burson and Cliff 1999, Cliff et al 1999), the soils in the area are very likely undisturbed Trinity Clay. The likelihood of finding intact deeply buried cultural resources is considered to be high in these soils.

Because of the small size of the additional acreage to be excavated, we do not propose to do pre-construction deep testing, but we will require monitoring by a qualified archaeologist during excavation of the proposed wetland. If cultural resources are identified during the monitored excavation, all work will cease until a determination of eligibility for the National Register of Historic Places can be made.

Please send us your concurrence and comments within 30 days to facilitate the project schedule. Should you have questions or require additional information regarding this project, please contact Ms. Michelle Dippel, Project Archeologist at (817) 886-1719.

Sincerely,

William Fickel, Jr.
Chief, Planning, Environmental,
and Regulatory Division

Enclosure

CONCUR

by William A. Martin
for F. Law[illegible]
State Hist[illegible] Preservation Officer
Date 3/20/03

EV-E

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

RECEIVED
FEB 16 2000
TEXAS HISTORICAL COMMISSION

REPLY TO ATTENTION OF

February 14, 2000

Environmental Division

SUBJECT: Proposal to avoid archeological site near Old West Fork of the Trinity River, Dallas County, Texas.

James Bruseth, Ph.D.
Deputy State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276, Capitol Station
Austin, TX 78711-2276

Dear Dr. Bruseth:

A recent survey effort for archeological sites within several environmental restoration areas located along a cut-off section of the West Fork of the Trinity River identified an archeological site (41DL389) in one of the restoration areas (Restoration Area B). A report of investigations, *Cultural Resources Survey of the Proposed Environmental Restoration Areas Along the Old West Fork of the Trinity River, Dallas County, Texas* (Burson and Cliff 1999) prepared by Geo-Marine, Inc., of Plano, Texas, under a contract to the U.S. Army Corps of Engineers, Fort Worth District, was coordinated with your office on November 1, 1999 with our contingent determination of No Historic Properties Affected (36 CFR § 800.3(d)(1)) if reforestation or tree planting was the only project impact. Your office responded on December 3, 1999 concurring with our determination.

Archeological site 41DL389 was tentatively identified as being buried approximately one to one and one half meters below the present ground surface with no visible features or identifiable components. One large utilized flake and some mammal bone fragments were recovered. The physical site boundaries are approximated based on mechanical trenches north and south of the site and an estimate of the potential site boundaries to the east. The geoarcheological conclusion was that the area through the center and eastern portion of the project area was substantially disturbed and that the site itself was either less than thirty five meters in diameter or that the site is discontinuous and sparse. The west portion was likely removed during the placement of the existing concrete channel and the area to the east of the site was probably impacted by the original meander of Shadrack Creek.

The project scope has been developed to now propose the removal and filling of the concrete channel (Shadrack Channel) just west of the archeological site, and the excavation of the old Shadrack Creek meander originally located to the east of the site. The new channel configuration will correspond to the original location of the creek (Enclosure 1). The wetland construction will now be limited to smaller areas in the northern portion of the project location along the re-opened Shadrack Creek and closer to the Old West Fork of the Trinity River. We believe we can avoid any impacts to the identified archeological site by placing the new channel as far east on the property as possible and by providing cultural resources personnel to monitor the construction to ensure the site is not inadvertently impacted.

In consideration of the foregoing, we have made a determination of *No Adverse Effect* (36 C.F.R. § 800.5(d)(1). We appreciate your comments on this determination. If we do not hear from you within thirty (30) days of receipt of this letter we will assume concurrence and proceed accordingly. If you have any questions, please contact Mr. Stephen P. Austin of this office at 817-978-6385.

Sincerely,

Paul M Hathorn

Enclosure

for William Fickel, Jr.
Chief, Environmental Division

C[illegible]CUR

by William A. [illegible]
for F. Lawe[illegible]
State Histo[illegible] Officer
Date 3/13/00

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

REPLY TO ATTENTION OF

November 1, 1999

Environmental Division

SUBJECT: Old West Fork Channel of the Trinity River, Proposed Environmental Restoration Areas, Dallas, Texas

RECEIVED
NOV 04 1999
TEXAS HISTORICAL COMMISSION

James Bruseth, Ph.D.
Deputy State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276, Capitol Station
Austin, TX 78711-2276

Dear Dr. Bruseth:

We are providing your office two copies of the report, *Cultural Resources Survey of the Proposed Environmental Restoration Areas Along the Old West Fork of the Trinity River, Dallas County, Texas* (Burson and Cliff 1999) for your review and comment (Enclosures). The referenced report was prepared for the U.S. Army Corps of Engineers, Fort Worth District, by Geo-Marine, Inc. (GMI), of Plano, Texas, and is being provided to your office as part of our management responsibilities under the *National Historic Preservation Act of 1966 as Amended Through 1992* (NHPA)(P.L. 89-665 *et seq.*). The survey effort by GMI was conducted to determine the potential for archeological sites or other historic properties within several environmental restoration areas (A, B, and C), near an existing drop inlet, and along a proposed pedestrian trail, located along a cut-off section of the West Fork of the Trinity River. This portion of the West Fork was cut-off from the main channel during the 1930s construction of the present Dallas Floodway for the Trinity River. The investigations identified the possibility of a buried archeological site at environmental restoration area A, and identified one confirmed buried archeological site (41DL389) at environmental restoration area B). No other archeological sites or other historic properties were identified within the remaining proposed project areas.

The current archeological investigation is exploratory and the planning for the project undertaking is still on-going. Existing plans are that excavation to create a wetland in both the area A and area B restoration areas is a potential, and tree-plantings will be utilized in both areas for reforestation of the areas. We believe that the potential to impact the one recorded and the one possible archeological site in both areas does not exist if the plan to utilize saplings and one gallon tree plantings area for reforestation remains the extent of the undertaking. However, we believe the undefined archeological site in area A and the recorded archeological site in area B, have the potential to be impacted by the proposed wetland construction.

Because the planning for this project is on-going and either the reforestation and/or wetland construction are still a consideration, we would like your comment on the following contingent determination. We have made the determination of No Historic Properties Affected (36 CFR § 800.3(d)(1)) within the proposed project areas contingent on the use of the planned reforestation effort alone. If the proposed wetland excavation effort is the future selected alternative then we will again consult with your office to prepare alternatives to avoid or reduce impacts to these sites or to develop an appropriate testing methodology for the one confirmed archeological site in area B and a strategy to determine the extent and integrity of the undefined archeological site in area A.

We appreciate your comments on this determination. If we do not hear from you within thirty (30) days of receipt of this letter we will assume concurrence and proceed accordingly. If you have any questions, please contact Mr. Stephen P. Austin at 817-978-6385.

Sincerely,

William Fickel, Jr.
Chief, Environmental Division

Enclosures(2)

CONCUR

by William A. Martin
for F. Lawerence Oaks
State Historic Preservation Officer
Date 12/3/99

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Stadium Centre Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

February 4, 1999

Colonel James S. Weller
District Engineer
(Attn: CESWF-EV-EE)
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Weller:

The U. S. Fish and Wildlife Service has recently discussed a potential habitat restoration plan in the vicinity of the Dallas Floodway Flood Control Project, Dallas, Texas, with representatives of your Environmental Resources planning staff. This plan, the Old Trinity River Channel Wildlife Restoration project, would involve restoring ecosystem values on approximately 100 acres of shallow water, emergent wetlands, and riparian forest associated with the Old Trinity River channel in west Dallas. Specific features of the restoration project would include reestablishment and improvement of riparian forested habitat, installation of a water control structure for aquatic habitat manipulation, and restoration of wetland hydrology within existing sump areas of the Dallas Floodway. Other habitat restoration measures could possibly be identified during detailed project evaluation and planning.

We believe a restoration project at the Old Trinity River channel would be very beneficial to fish and wildlife resources, especially wetland dependent species such as waterfowl, migratory shorebirds, and non-game passerine species. Restoration of these wetlands should contribute substantially to the goals and objectives of the North American Waterfowl Management Plan through the reestablishment of higher quality breeding and resting habitats. Improved riparian forested habitats would also provide vital reproductive and migratory habitat for neotropical migrant birds, thus contributing substantially to the international Partners in Flight program. Therefore, we strongly support the implementation of this beneficial project and offer our assistance in its evaluation, design, and construction.

We appreciate the opportunity to provide input on this worthwhile project. For future coordination and assistance, please feel free to contact me at the above address or telephone (817) 277-1100.

Sincerely,

T J Cloud, Jr.

Thomas J. Cloud, Jr.
Acting Field Supervisor

cc: Executive Director, TPWD, Austin, TX

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Stadium Centre Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

June 2, 1999

Colonel James S. Weller
District Engineer
(Attn: CESWF-EV-EE)
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Weller:

Our office is currently coordinating with your Environmental Resources Division on the evaluation and planning of potential restoration features for the Old Trinity River Channel in the City of Dallas, Texas. During several meetings and telephone conversations with our office, a number of restoration features and concepts have been discussed with your staff. We have also conducted preliminary field evaluations of baseline habitat conditions within the overall project area in cooperation with your staff. The purpose of this letter is to provide this existing baseline data and identify restoration concepts which our agency believes would be appropriate for the Old Trinity River project site. We hope these concepts and/or features will receive further consideration during your evaluations.

Baseline Habitat Conditions

Table 1 provides a summary of the baseline habitat conditions of the project area based on field sampling conducted on May 5, 1999. Field data was collected and analyzed using the Service's *Habitat Evaluation Procedures* (HEP). In HEP, baseline habitat conditions are expressed as a numeric function ranging from 0 to 1.0, where 0 represents no suitable habitat for a representative evaluation species and 1.0 represents optimum conditions for the species. Approximately six sites were evaluated for riparian/bottomland hardwood habitat, four sites for emergent, herbaceous wetlands, and four sites for grass/forblands. The nine wildlife species utilized for the habitat evaluations are indicative of the urban mammalian and avian species found within the upper Trinity River basin.

Riparian/Bottomland Hardwoods

Our field evaluations indicate that riparian and associated bottomland hardwood habitats within the project area have a moderate value to the wildlife evaluation species (i.e., 0.56). Generally, these habitats are dominated by a very dense overstory canopy of cedar elm, hackberry, and green ash

(Figure 1). In some locations, cottonwood, American elm, and black willow are abundant. Desirable, hard mast producing trees such as pecan, walnut, bur oak, red oak, and post oak were occasionally present, but they were not plentiful at any of the sample plots. Other overstory and mid-story vegetation species observed included red mulberry, Bois d'arc, honey locust, western soapberry, chinaberry, and mesquite. Chinese privet was the most common understory species, and in some of the sample plots consisted of thick impenetrable thickets which out compete more desirable native shrub species. The major limiting factors observed for the riparian and bottomland hardwood habitats appear to be the dense overstory and understory canopy cover of the cedar elm and privet which inhibits production and growth of more desirable species. In some locations, the lack of large mature trees also results in fewer, large cavities and snags which provide important nesting and refuge sites for fox squirrels, raccoons, and cavity nesting birds. At one site adjacent to Canada Drive, heavy grazing of confined livestock has totally decimated the riparian habitat, leaving virtually no ground cover or understory. At this site bare ground contributes heavy loads of silt and animal wastes directly to the Old Trinity River oxbow system (Figure 2).

Table 1. Baseline Habitat Suitability Indices (HSI's) for representative wildlife species within the Old Trinity River Channel project area, west Dallas, Texas.

Evaluation Species	Riparian/BLH	Emergent Wetland	Grass-Forbland
Fox squirrel	0.33		
Carolina chickadee	0.59		
Barred owl	0.63		
Raccoon	0.70	0.58	
Green heron		0.76	
Wood duck		0.75	
Eastern cottontail			0.98
Eastern meadowlark			0.44
Red-tailed hawk			0.25
Avg. HSI	**0.56**	**0.70**	**0.56**

Emergent Herbaceous Wetlands

Emergent wetlands within the project area are associated primarily with the margins of the old Elm Fork channel, tributary drainages, and the sumps associated with the Dallas Floodway levee system (Figure 3). These wetland sites contained a relatively high diversity of hydrophytic vegetation with

Figure 1. Riparian/Bottomland Hardwood cover-type associated with the Old Trinity River channel and adjacent tributary systems.

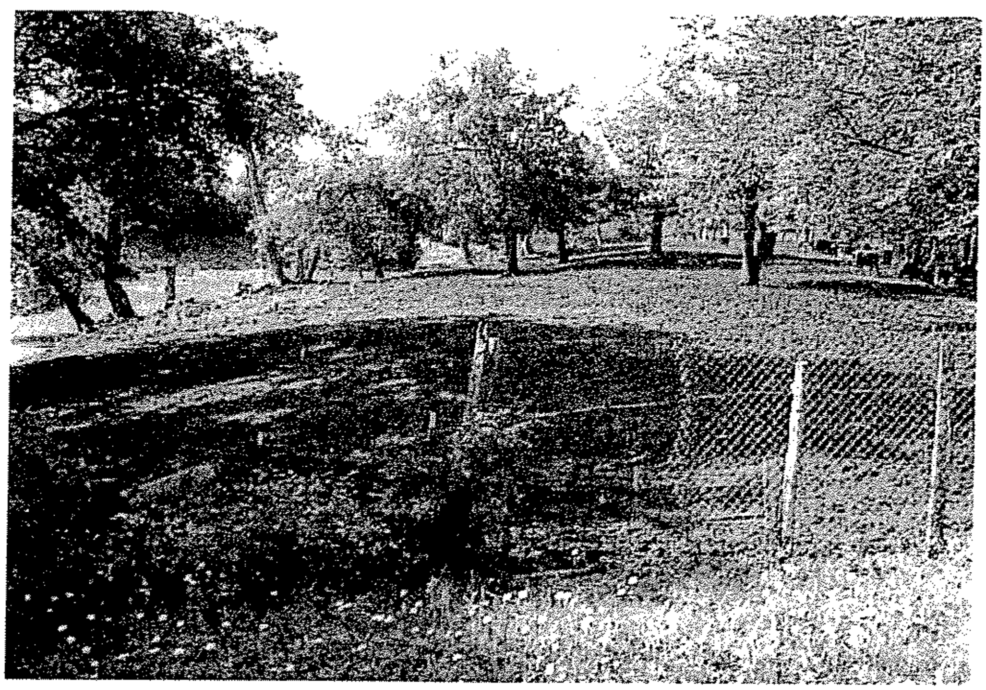


Figure 2. Riparian/Bottomland Hardwood site heavily impacted by confined grazing-feeding operation near Canada Drive crossing of the Old Trinity River channel.

dominant species including several varieties of sedges, cattail, rush, phragmites, water primrose, smartweed, and curly dock. Numerous species of waterfowl, wading birds, and wetland-dependent passerines were observed utilizing the wetlands, especially the larger sites associated with the sumps.

The wetlands provide good habitat conditions for the wildlife evaluation species, yielding an HSI of 0.70. Limiting factors observed for wetlands within the project area include the lack of water on a seasonal basis, absence of cavities and nest sites for wood ducks, and insufficient perch and roost sites for wetland foraging species (e.g., herons).

Grass-Forblands

This habitat type within the project area is dominated by introduced herbaceous species, such as bermudagrass and ryegrass, which are maintained year-round by mowing. Other dominant species within this cover-type include dallisgrass, crabgrass, Canada wildrye, wild oats, foxtail, Texas wintergrass, giant and western ragweed, aster, curly dock, coneflowers, clovers, and evening primrose. In some locales, a few cottonwood, black willow, buttonbush, green ash, cedar elm, honey locust, and mesquite seedlings were regenerating on sites that are not as well maintained (Figure 4).

Overall, grass-forblands within the project area provided moderate valued habitat (average HSI of 0.56), but this was primarily due to its high food and cover value to the Eastern cottontail (Table 1). Most of the herbaceous areas evaluated were either too dense and tall or lacked sufficient perch sites to provide optimum habitat conditions for the meadowlark and red-tailed hawk, respectively. There was an obvious lack of tall bunchgrasses, such as switchgrass, Indiangrass, and the bluestems, which are the most desirable native, herbaceous species for the project site.

Habitat Restoration Recommendations

We believe the following recommendations could be implemented within the project area to restore natural habitats impacted by the construction and operation of the Dallas Floodway project and help ameliorate many of the secondary impacts from urban development within the project site.

Riparian/Bottomland Hardwoods

As previously noted, the lack of mature, hard-mast producing trees is probably the most limiting factor observed within the project area. Sites dominated by a dense overstory canopy of cedar elm, hackberry, and green ash could be selectively thinned to release more desirable hardwood species, such as red oak, bur oak, and pecan. Some of these areas could also be improved through the thinning of the heavy understory which is presently dominated by non-native privet species. Where desirable hardwoods and woody shrubs are not present, the planting of containerized seedlings should be considered. Large snags and dead trees should be left standing in place to provide cavities and refuge sites for wildlife.

Figure 3. Emergent Herbaceous Wetland associated with sump of the Dallas Floodway project.

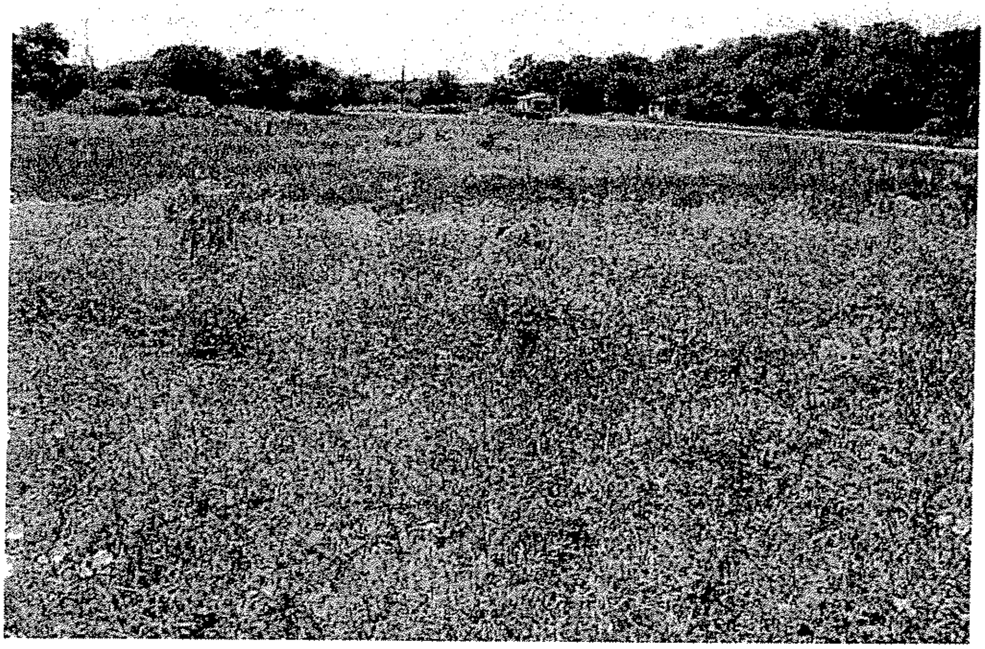


Figure 4. Grass-Forbland cover-type located adjacent to Shadrack channel.

We also recommend that consideration be given to the removal of livestock grazing at the Canada Drive location. This site, since it is so heavily impacted, would require the establishment of a herbaceous ground cover to stabilize erosion and reduce sediment run-off into the Old Trinity River channel. The area should also be planted with a variety of mast-producing trees and shrubs in order to reestablish the riparian buffer which has been completely eliminated at this site.

Emergent Herbaceous Wetlands

Emergent wetlands, especially those associated with the floodway sumps, also provide relatively good habitat for wildlife species. However, these areas could be improved through specific management activities. We recommend that consideration be given to increasing water availability on a seasonal basis. This could be accomplished by excavating and grading small areas around the perimeter of the sumps so that they will contain 12-18 inches of water when inundated. The center of the sumps should not be altered, except some of the excavated material may be utilized to create small, scattered islands throughout the sump area. Islands and the perimeters of the sumps should be vegetated with perennial bunch grasses, such as switchgrass, for wildlife food and cover. Wood duck nest boxes and perch/roost sites could also be provided on the islands and perimeter of the sumps to provide habitat for wetland-dependent species.

Since emergent wetlands provide some of the best available habitat within the project area and are a critical habitat component for a variety of wildlife species, we recommend that consideration continue to be given to the creation of additional wetlands within the project area. Areas identified in the Corps' Initial Appraisal document, including the confluence of the Shadrack and Old Trinity River channels and an internal drainage area west of Norwich Street, would provide suitable sites for the creation of wetland habitat. These areas are predominantly grasslands which have an overall lower wildlife resource value and could be converted to wetlands.

Grass-Forblands

Herbaceous habitats within the project area provide moderate habitat values, but these sites generally have less wildlife value than forested and wetland areas. Most of the herbaceous vegetation in the project area is dominated by "improved grass species" (e.g., bermudagrass and ryegrass) which is maintained by mowing. Therefore, these areas usually are less diverse and provide minimal habitat values on a seasonal basis. Some herbaceous areas, previously discussed, would be suitable for the construction of emergent wetlands.

Existing herbaceous areas could be improved for wildlife through a reduction or modification of the maintenance schedule. For example, reducing mowing frequency and timing and the controlled burning of select sites could encourage seed production and propagation of more desirable, native herbaceous grasses and forbs such as switchgrass, Indiangrass, bluestems, Illinois bundleflower, etc. Management activities should generally stress development and propagation of native bunchgrasses and leguminous forbs if wildlife use is to be considered a major function of the herbaceous areas within the project site.

In summary, wildlife habitats within the project area provide moderate to relatively good habitat values for urban wildlife species. However, most of the habitats have been dramatically impacted by construction of the Dallas Floodway project and urbanization, resulting in habitat fragmentation, loss of species diversity, and reduced habitat maturity. Several management features could be implemented within the area to restore and improve habitat conditions, especially for emergent, herbaceous wetlands and riparian/bottomland hardwood communities. These habitat types are extremely important to a variety of migratory and non-migratory species that utilize floodplain forests and wetlands for their habitat requisites.

We appreciate the opportunity to work with your agency on the evaluation and development of features to restore wildlife habitat values within the Old Trinity River project area. We look forward to continued coordination with your Environmental Resources staff on this project.

Sincerely,

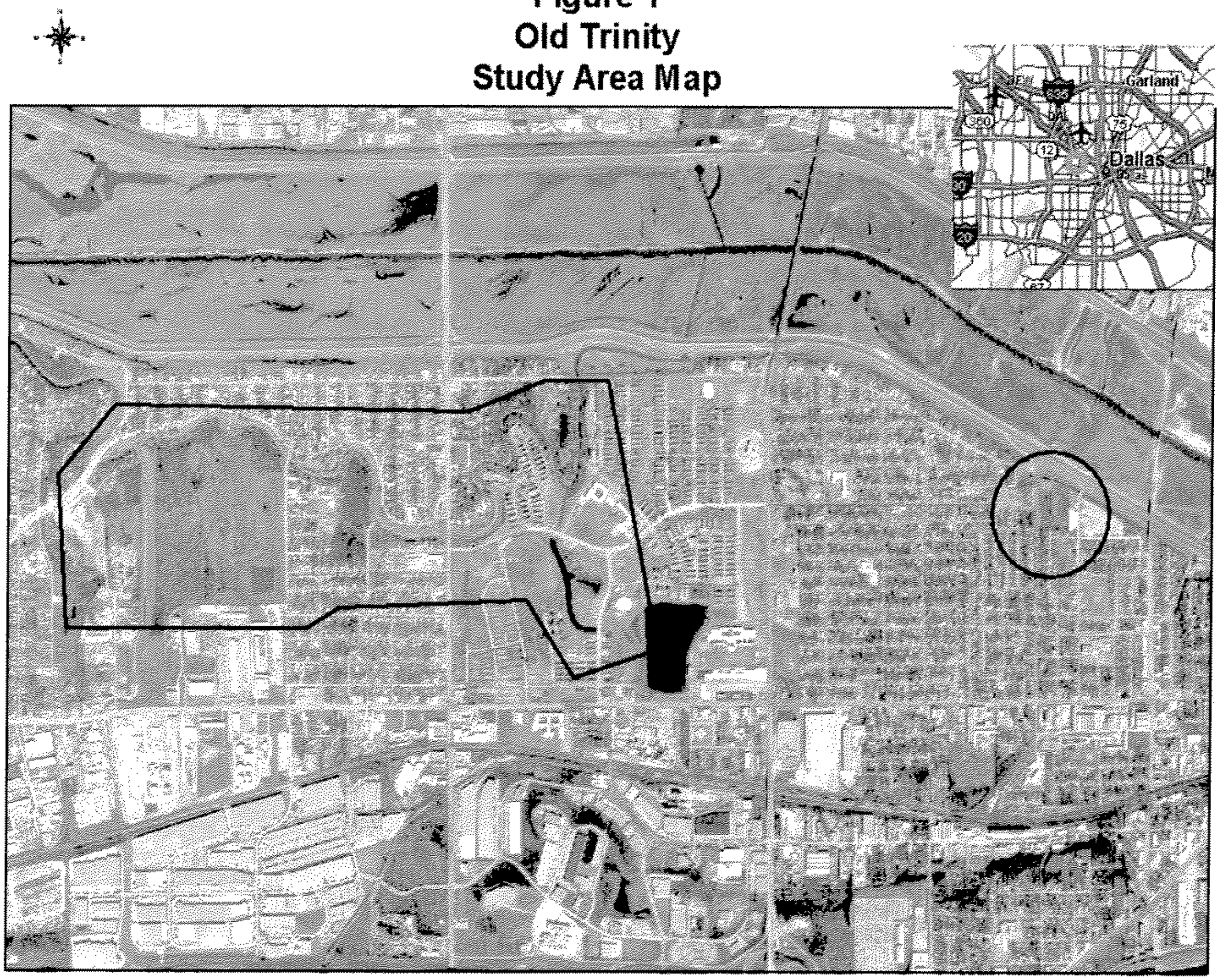
Thomas J. Cloud, Jr.

Thomas J. Cloud, Jr.
Senior Staff Biologist/ Federal Activities Coordinator

cc: Dr. Ray Telfair, TPWD, Tyler, Texas

ANNEX B
PHOTOGRAPHS

Figure 1
Old Trinity
Study Area Map



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Photograph 1: View of Old Trinity River Channel

Photograph 2: View of Old Trinity River Channel

Photograph 3: View of Pavaho Sump

Photograph 4: View of Shadrack Channel

ANNEX C
INCREMENTAL ANALYSIS

SCENARIO STATISTICS

03/11/2002 9:44 AM

SCENARIO: 2/22/02, 11 AM Old Trinity with combinability
FILE: C:\IWRPLAN\Data\Old Trinity February 22_2002.mdb
COST VARIABLE: Cost Total Annual Charges **SENSITIVITY:** Expected
OUTPUT VARIABLE: Habitat Average Annual Habitat Units **SENSITIVITY:** Expected
CREATED: 3/11/2002 9:42:00 A **EDITED:** **ANALYZED:**

POSSIBLE COMBINATIONS: 567,000 **COST EFFECTIVE:** 58
ACTUAL COMBINATIONS: 29,400 **BEST BUY:** 10

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Dependency	Non-Combinability
Y S	S T
Z S	T S
Z T	Y

Y W
L Z
Z L

SOLUTION LEGEND

Solution / Scale Code		Solution Description	Scale Description
R	0	Reforestation	No Action
R	1	Reforestation	Acquistion Land
R	2	Reforestation	40, 1"Trees, 10 Shrubs, 100 Seedlings/
R	3	Reforestation	10, 1" Trees, 5 Shrubs, 150 seedlings/a
R	4	Reforestation	5, 1" Trees, 5 Shrubs, 200 Seedlings/ac
R	5	Reforestation	300 Seedlings, 150 Shrub Seedlings/acr
E	0	Habitat Enhancement	No Action
E	1	Habitat Enhancement	Acquistion Land
E	2	Habitat Enhancement	10, 1" Trees, 7 Shrubs/acre
E	3	Habitat Enhancement	5, 1"Trees, 5 Shrubs/acre
E	4	Habitat Enhancement	2, 1" Trees, 2 Shrubs/acre
S	0	Shadrack Option 1	No Action
S	1	Shadrack Option 1	Option 1 No Island
S	2	Shadrack Option 1	Option 1 with Island
T	0	Shadrack Option 2	No Action
T	1	Shadrack Option 2	Option 2 No Island
T	2	Shadrack Option 2	Option 2 with Island
P	0	Pavaho	No Action
P	1	Pavaho	Option 1, Just Gate
P	2	Pavaho	Option 2, Gate with Mote
P	3	Pavaho	Option 3a, Small Expansion
P	4	Pavaho	Option 3b, Small Expansion-Tiered
P	5	Pavaho	Option 4a, Large Expansion
P	6	Pavaho	Option 4b, Large Expansion-Tiered
W	0	Westmoreland	No Action
W	1	Westmoreland	4-foot with Excavation

W	2	Westmoreland	5-foot with Excavation
L	0	Ledbetter	No Action
L	1	Ledbetter	4-foot with excavation
L	2	Ledbetter	5-foot with excavation
L	3	Ledbetter	6-foot with excavation
Y	0	Westmoreland Combinability	No Action
Y	1	Westmoreland Combinability	4-foot no excavation
Y	2	Westmoreland Combinability	5-foot no excavation
Y	3	Westmoreland Combinability	5-foot some excavation
Y	4	Westmoreland Combinability	6-foot with excavation
Z	0	Ledbetter Combinability	No Action
Z	1	Ledbetter Combinability	4-foot no excavation
Z	2	Ledbetter Combinability	5-foot no excavation
Z	3	Ledbetter Combinability	5-foot some excavation
Z	4	Ledbetter Combinability	6-foot no excavation

INPUT DATA

CODE		Cost	Habitat
E	0	0	7.08
E	1	23.945	14
E	2	28.807	23.58
E	3	28.1	23.58
E	4	27.494	19
L	0	0	0.04
L	1	12.048	0.91
L	2	12.059	0.87
L	3	12.058	0.73
P	0	0	0.98
P	1	30.758	2.33
P	2	31.688	2.55
P	3	46.892	7.1
P	4	50.082	7.25
P	5	69.258	8.66
P	6	71.811	8.84
R	0	0	0
R	1	5.77	0
R	2	35.028	26.14
R	3	24.769	23.78

INPUT DATA

CODE	Cost	Habitat
R 4	24.199	23.67
R 5	22.679	22.59
S 0	0	0
S 1	35.44	2.76
S 2	35.44	2.86
T 0	0	0
T 1	21.24	0.87
T 2	21.24	0.91
W 0	0	0.32
W 1	33.44	5.4
W 2	33.597	5.57
Y 0	0	0.32
Y 1	9.418	2.17
Y 2	9.418	4.15
Y 3	14.413	6.48
Y 4	33.494	4.32
Z 0	0	0.04
Z 1	7.071	0.26
Z 2	7.071	0.48
Z 3	8.575	1.06

INPUT DATA

CODE	Cost	Habitat
Z 4	7.071	1.05

Incremental Cost Of Best Buy Plan Combinations (Ordered By Output)

Scenario: 2/22/02, 11 AM

Counter	Plan Code	Habitat (AAHU)	Cost ($1000)	Avg. Cost $1000 / AAHU	Inc. Cost ($1000)	Inc. Output (AAHU)	Incremental Cost Per Output
1	R0 E0 S0 T0 P0 W0 L0 Y0 Z0	8.78	0.00	0.0000	0.0000	8.7800	0
2	R5 E0 S0 T0 P0 W0 L0 Y0 Z0	31.37	22.68	0.7230	22.6790	22.5900	1.00394
3	R4 E0 S0 T0 P0 W0 L0 Y0 Z0	32.45	24.20	0.7457	1.5200	1.0800	1.407407
4	R4 E3 S0 T0 P0 W0 L0 Y0 Z0	48.95	52.30	1.0684	28.1000	16.5000	1.70303
5	R2 E3 S0 T0 P0 W0 L0 Y0 Z0	51.42	63.13	1.2277	10.8290	2.4700	4.384211
6	R2 E3 S2 T0 P0 W0 L0 Y3 Z0	60.44	112.98	1.8693	49.8530	9.0200	5.52694
7	R2 E3 S2 T0 P0 W0 L0 Y3 Z4	61.45	120.05	1.9537	7.0710	1.0100	7.00099
8	R2 E3 S2 T0 P3 W0 L0 Y3 Z4	67.57	166.94	2.4707	46.8920	6.1200	7.662092
9	R2 E3 S2 T0 P6 W0 L0 Y3 Z4	69.31	191.86	2.7682	24.9190	1.7400	14.32126
10	R2 E3 S2 T0 P6 W0 L0 Y3 Z3	69.32	193.37	2.7895	1.5040	0.0100	150.4

* Plan Of Interest

Average Cost Of Best Buy Plan Combinations (Ordered By Output)

Scenario: 2/22/02, 11 AM 03/11/2002 9:54 AM

Counter	Plan Code	Habitat (AAHU)	Cost ($1000)	Average Cost $1000 / AAHU
1	R0 E0 S0 T0 P0 W0 L0 Y0 Z0	8.78	0.00	0.0000
2	R5 E0 S0 T0 P0 W0 L0 Y0 Z0	31.37	22.68	0.7230
3	R4 E0 S0 T0 P0 W0 L0 Y0 Z0	32.45	24.20	0.7457
4	R4 E3 S0 T0 P0 W0 L0 Y0 Z0	48.95	52.30	1.0684
5	R2 E3 S0 T0 P0 W0 L0 Y0 Z0	51.42	63.13	1.2277
6	R2 E3 S2 T0 P0 W0 L0 Y3 Z0	60.44	112.98	1.8693
7	R2 E3 S2 T0 P0 W0 L0 Y3 Z4	61.45	120.05	1.9537
8	R2 E3 S2 T0 P3 W0 L0 Y3 Z4	67.57	166.94	2.4707
9	R2 E3 S2 T0 P6 W0 L0 Y3 Z4	69.31	191.86	2.7682
10	R2 E3 S2 T0 P6 W0 L0 Y3 Z3	69.32	193.37	2.7895

SUMMARY OF COST EFFECTIVE PLANS

Alternative 2 – Reforestation (seedlings). Restoring 53.48 acreas of riparian hardwoods using 300 tree seedlings and 150 shrub seedlings per acre. The 53.48 restored acres include 4.48 acres along the Old Trinity west of Ledbetter Gate, 22.4 acres along the Old Trinity River Between Ledbetter Gate and Westmoreland Road, 1.09 acres along Shadrack Channel, 6.58 acres along Pavaho Sump, and 18.93 acres along Fish Trap Lake and the Old Trinity River east of Westmoreland Road.

Alternative 3 – Reforestation (seedlings and containers). Restoring 53.48 acres of riparian hardwoods with five one-inch caliper trees, five shrubs, and 200 tree seedlings per acre.

Alternative 4 – Reforestation. Alternative 3 plus riparian habitat improvement to 28.42 acres using five one-inch caliper trees and 5 shrubs per acre. The 28.42 acres of restored area includes 5.39 acres along the Old Trinity west of Ledbetter Gate, 17.38 acres along the Old Trinity River Between Ledbetter Gate and Westmoreland Road, and 5.65 acres along Fish Trap Lake and the Old Trinity River east of Westmoreland Road.

Alternative 5 – Reforestation. Restoring 53.48 acres of riparian hardwoods with 40 one-inch caliper trees, ten shrubs, and 100 seedlings per acre, and riparian habitat improvement to 28.42 acres using five one-inch caliper trees and 5 shrubs per acre.

Alternative 6 – Reforestation and Shadrack Channel/Westmoreland Wetland. Alternative 5 plus the abandonment of the existing Shadrack concrete channel and the creation of a new combined earthen channel and wetland cell, and partial excavation and final impoundment to a depth of 5 foot for Westmoreland Channel sump and installation of a water control structure to allow for a 3-foot fluctuation in the water surface elevation.

Alternative 7 – Reforestation and Wetlands (Ledbetter). Alternative 6 plus the impoundment of the Ledbetter Channel sump to a depth of 6-foot with no excavation. A water control structure is included to allow for a 3-foot fluctuation in the water surface elevation.

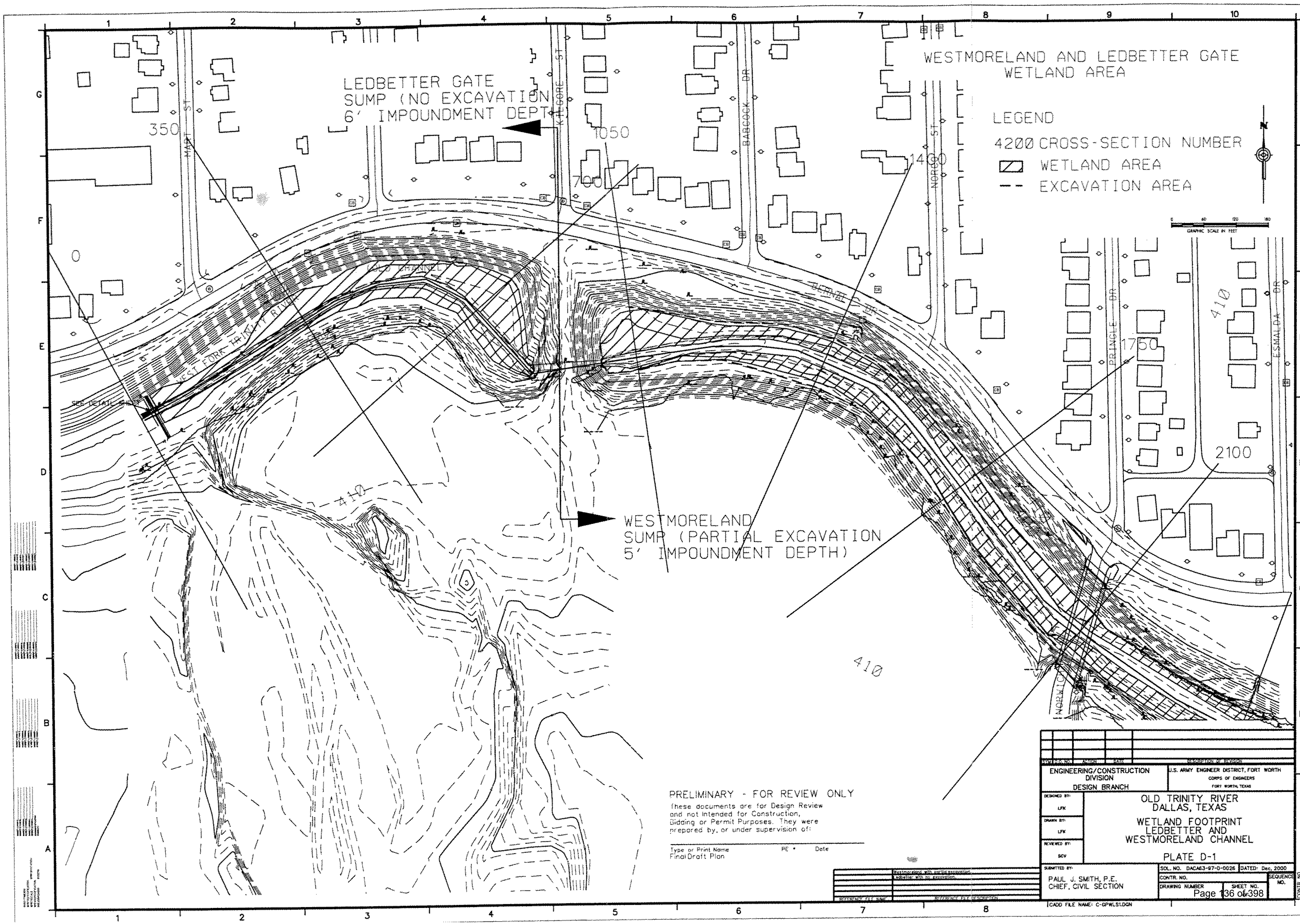
Alternative 8 – Reforestation and Wetlands (Pavaho Sump). Alternative 7 plus a water control structure within Pavaho Sump to allow for a fluctuation in the water surface elevation, and the expansion of the southesatern portion Pavahoe sump for additional wetland area. The sump volume removed may be used to include island habitat in the wetland.

Alternative 9 – Reforestation and Wetlands. Alternative 8 plus acquiring real estate on the western fringe of the Pavaho sump and the excavation of both the small expansion from Plan 8 and the larger expansion would be partial for a tiered effect. The excavation material removed may be used to include island habitat in the wetland.

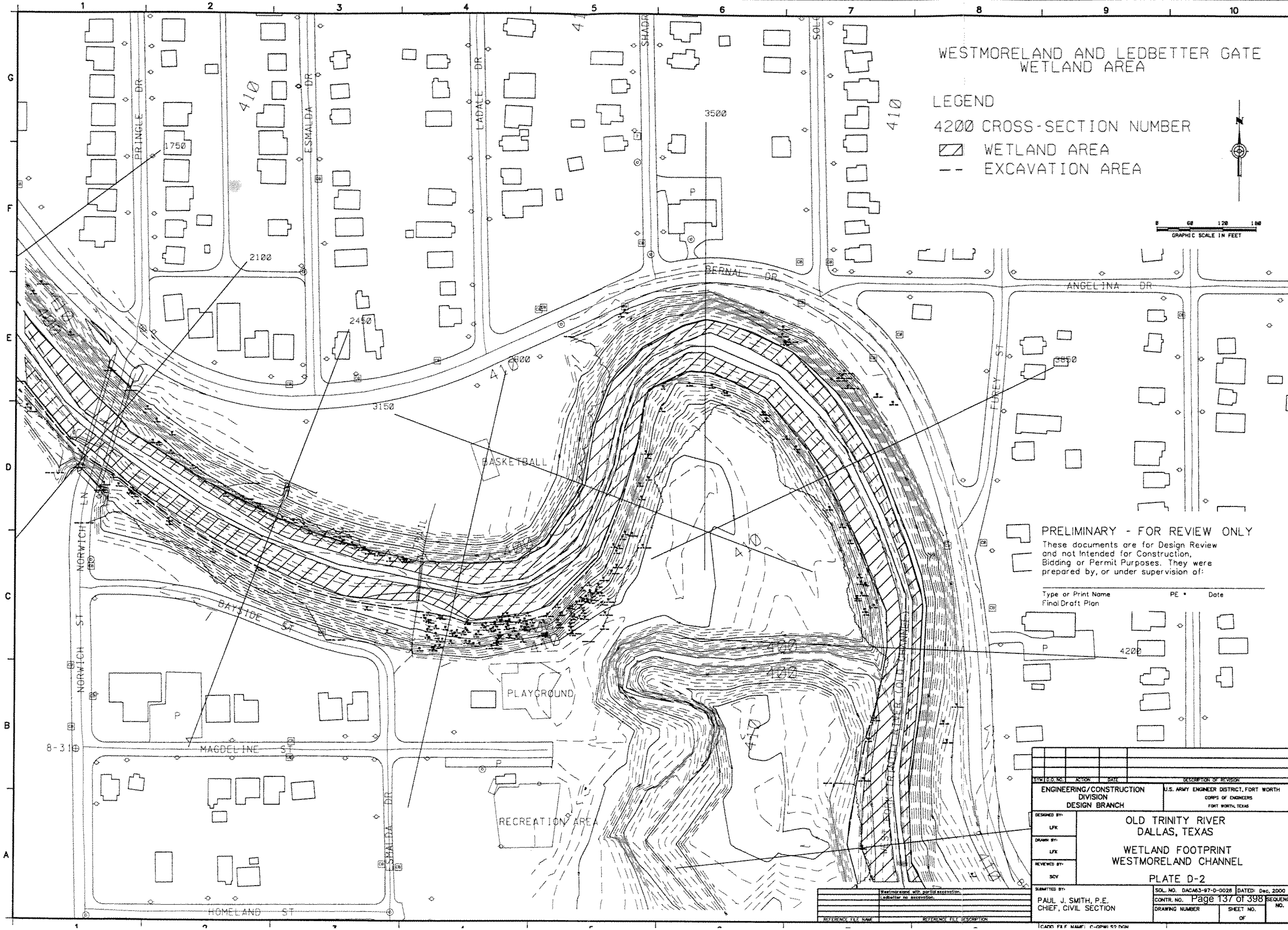
Alternative 10 – Reforestation and Wetlands. Alternative 9 except the impoundment of the Ledbetter sump would be to a depth of 5-foot with some excavation.

The table below identifies the average AAHUs, incremental AAHUs, annualized costs, incremental annualized costs, and incremental cost per output for each of the ten plans. The figure is a graphic representation showing the AAHUs and annualizes costs for the best buy alternatives.

ANNEX D
DESIGN PLATES



WESTMORELAND AND LEDBETTER GATE WETLAND AREA
LEGEND
4200 CROSS-SECTION NUMBER
WETLAND AREA
EXCAVATION AREA
LEDBETTER GATE SUMP (NO EXCAVATION 6' IMPOUNDMENT DEPTH)
WESTMORELAND SUMP (PARTIAL EXCAVATION 5' IMPOUNDMENT DEPTH)
0
350
700
1050
1400
1750
2100
410
MART ST
KILGORE ST
BABCOCK DR
NORGO ST
PRINGLE DR
ESMALDA DR
NORWICH
WEST FORK TRINITY RIVER
OLD CHANNEL
SEE DETAIL SHEET
PRELIMINARY - FOR REVIEW ONLY
These documents are for Design Review and not intended for Construction, Bidding or Permit Purposes. They were prepared by, or under supervision of:
Type or Print Name
Final Draft Plan
PE #
Date
ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
OLD TRINITY RIVER
DALLAS, TEXAS
WETLAND FOOTPRINT
LEDBETTER AND
WESTMORELAND CHANNEL
PLATE D-1
DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCV
SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec, 2000
CADD FILE NAME: C-OPWLSLDGN



WESTMORELAND AND LEDBETTER GATE WETLAND AREA
LEGEND
4200 CROSS-SECTION NUMBER
WETLAND AREA
EXCAVATION AREA
GRAPHIC SCALE IN FEET
PRINGLE DR
ESMALDA DR
LADALE DR
BERNAL DR
ANGELINA DR
FUREY ST
NORWICH LN
NORWICH ST
BAYSIDE ST
MAGDELINE ST
HOMELAND ST
BASKETBALL
PLAYGROUND
RECREATION AREA
1750
2100
2450
2800
3150
3500
3850
4200
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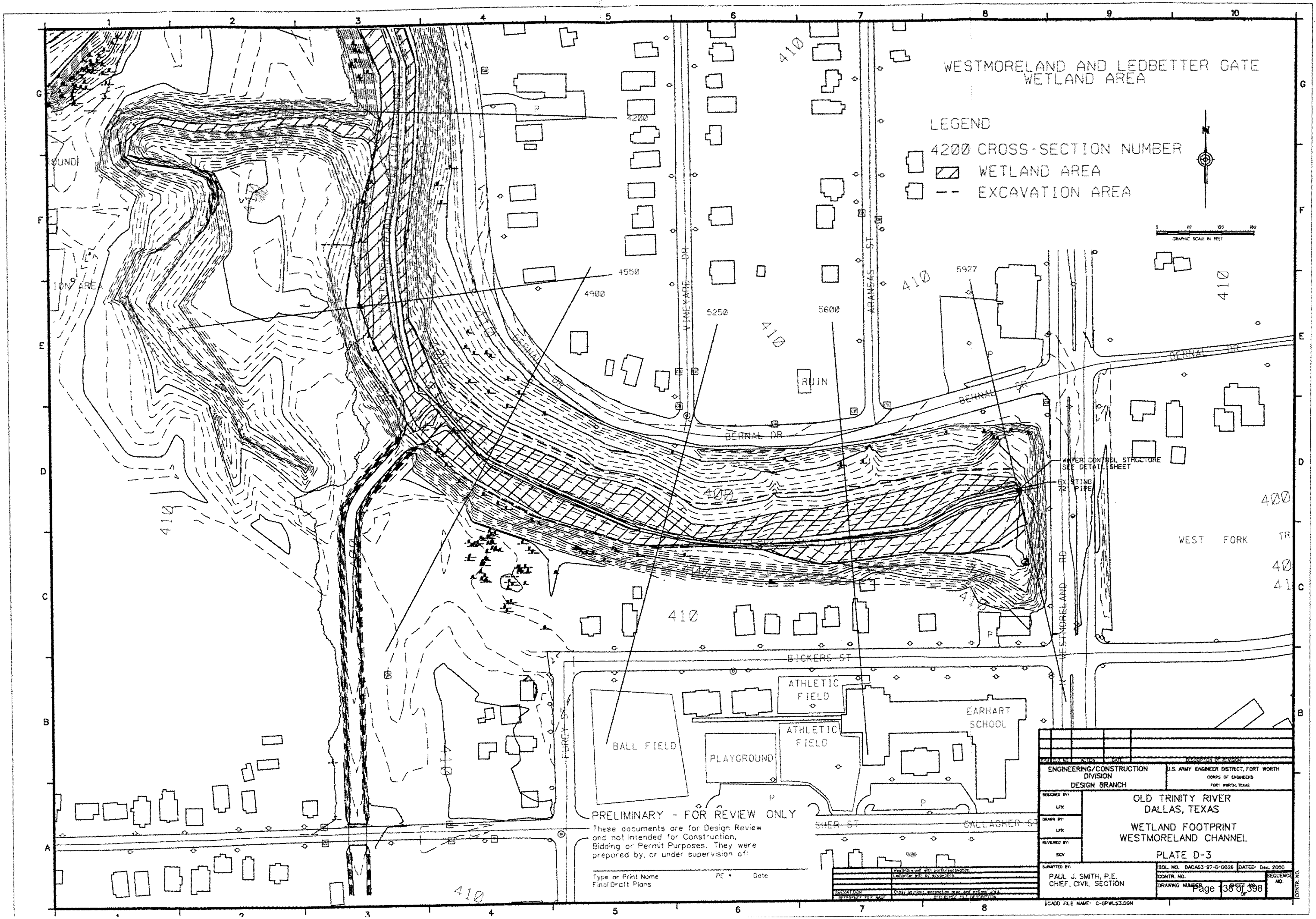
Type or Print Name PE • Date
Final Draft Plan
Westmoreland with partial excavation.
Ledbetter no excavation.
REFERENCE FILE NAME
REFERENCE FILE DESCRIPTION
SYM D.O. NO. ACTION DATE DESCRIPTION OF REVISION
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCY
OLD TRINITY RIVER
DALLAS, TEXAS
WETLAND FOOTPRINT
WESTMORELAND CHANNEL
PLATE D-2
SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec, 2000
CONTR. NO.
DRAWING NUMBER
SHEET NO. OF
SEQUENCE NO.
CADD FILE NAME: C-OPWLS2.DGN


WESTMORELAND AND LEDBETTER GATE
WETLAND AREA
LEGEND
4200 CROSS-SECTION NUMBER
WETLAND AREA
EXCAVATION AREA
GRAPHIC SCALE IN FEET
4200
4550
4900
5250
5600
5927
VINEYARD DR
ARANSAS ST
BERNAL DR
WESTMORELAND RD
BICKERS ST
FUREY ST
GALLAGHER ST
RUIN
WATER CONTROL STRUCTURE SEE DETAIL SHEET
EXISTING 72" PIPE
WEST FORK
ATHLETIC FIELD
EARHART SCHOOL
BALL FIELD
PLAYGROUND
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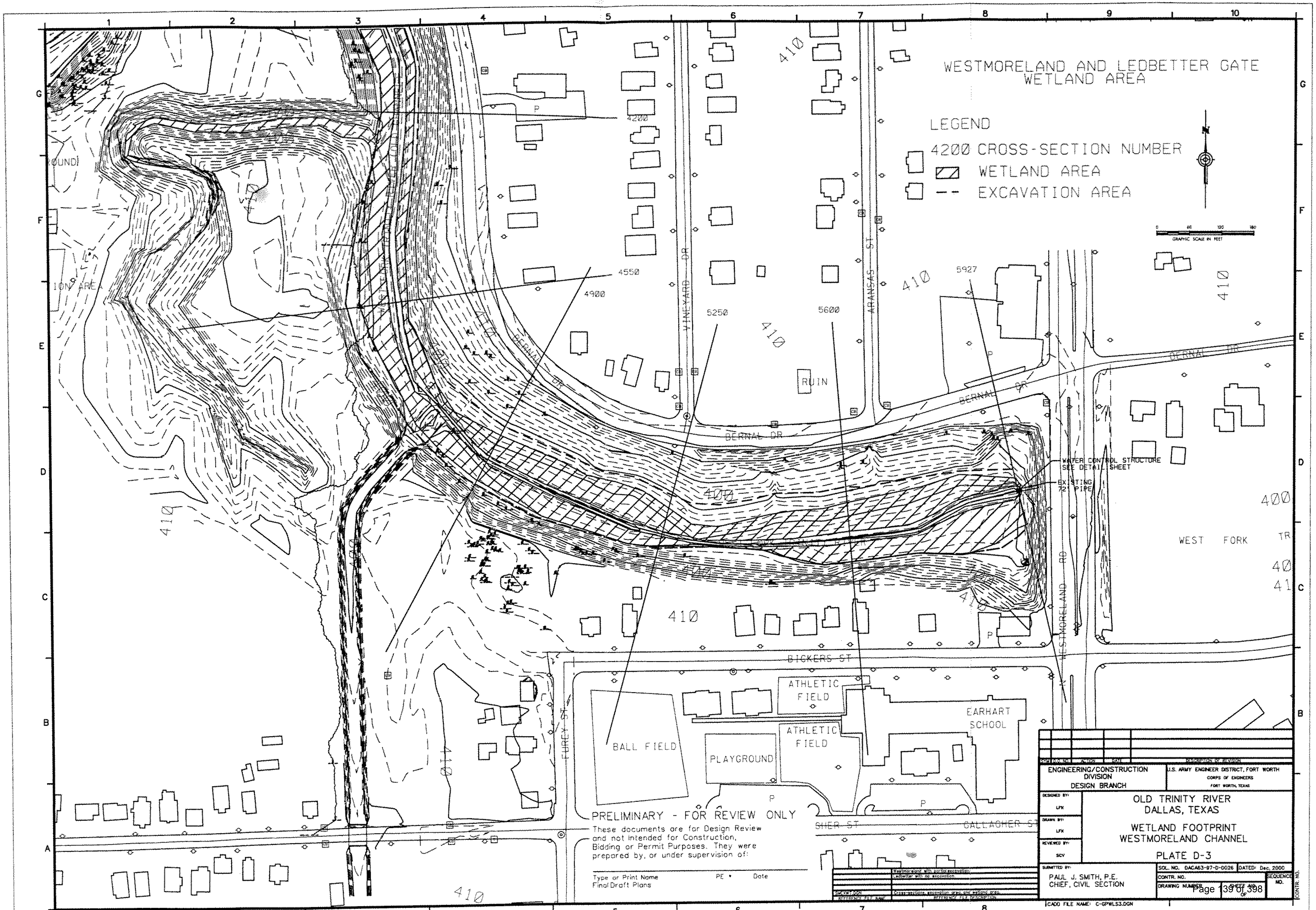
DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCV
OLD TRINITY RIVER
DALLAS, TEXAS
WETLAND FOOTPRINT
WESTMORELAND CHANNEL
PLATE D-3
SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec. 2000
CONTR. NO.
DRAWING NUMBER
SHEET NO.
SEQUENCE NO.
CADD FILE NAME: C-GPWLS3.DGN


WESTMORELAND AND LEDBETTER GATE
WETLAND AREA
LEGEND
4200 CROSS-SECTION NUMBER
WETLAND AREA
EXCAVATION AREA
GRAPHIC SCALE IN FEET
4200
4550
4900
5250
5600
5927
VINEYARD DR
ARANSAS ST
BERNAL DR
RUIN
WATER CONTROL STRUCTURE
SEE DETAIL SHEET
EXISTING
72" PIPE
WEST FORK
WESTMORELAND RD
BICKERS ST
ATHLETIC FIELD
EARHART SCHOOL
BALL FIELD
PLAYGROUND
FUREY ST
GALLAGHER ST
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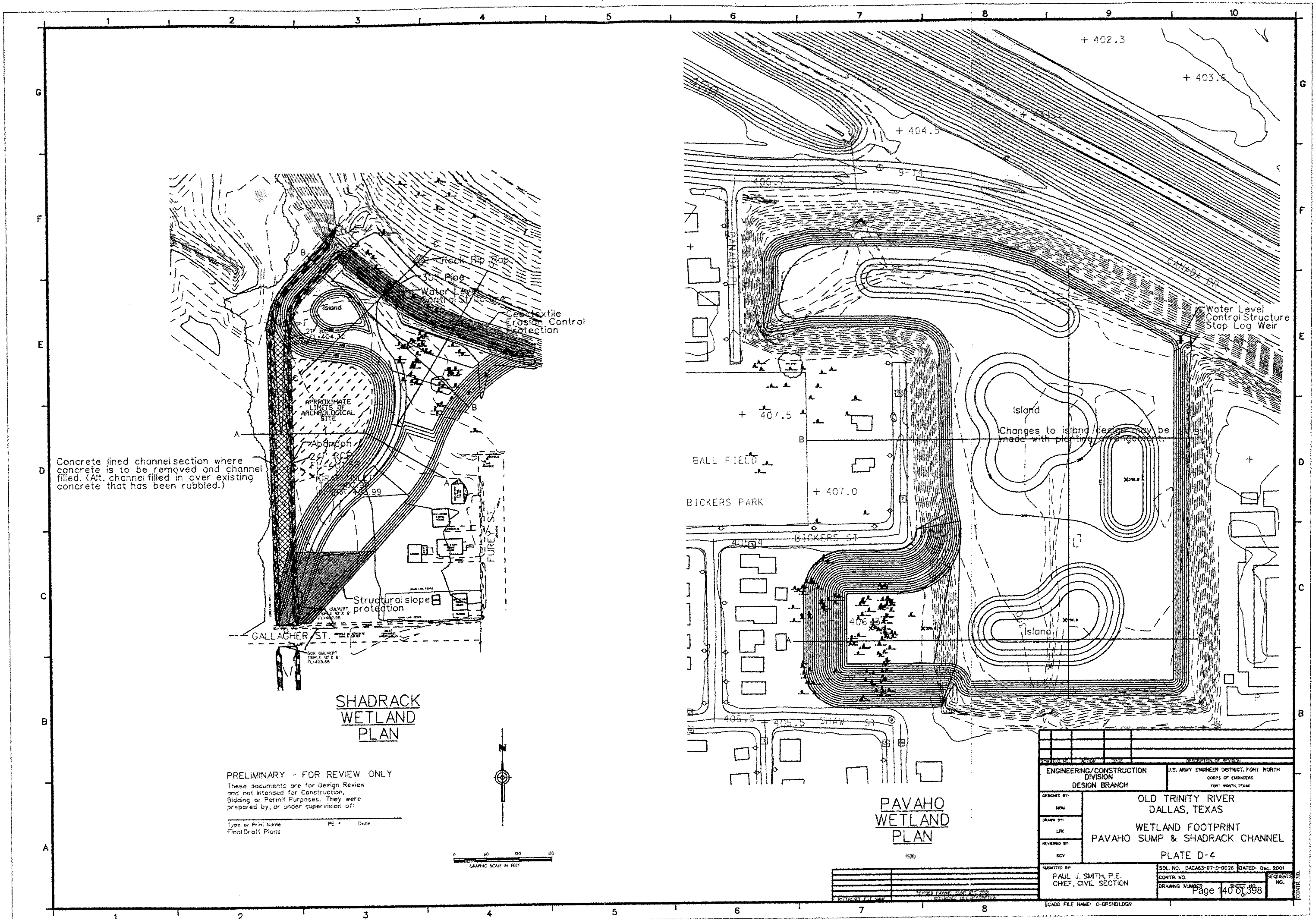
CORPS OF ENGINEERS
FORT WORTH, TEXAS
OLD TRINITY RIVER
DALLAS, TEXAS
WETLAND FOOTPRINT
WESTMORELAND CHANNEL
PLATE D-3
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec. 2000
CADD FILE NAME: C-GPWLS3.DGN


SHADRACK WETLAND PLAN
Rock Rip Rap
30" Pipe
Water Level Control Structure
Geo-textile Erosion Control Protection
Island
APPROXIMATE LIMITS OF ARCHEOLOGICAL SITE
Abandon 24" RCP
Concrete lined channel section where concrete is to be removed and channel filled. (Alt. channel filled in over existing concrete that has been rubbled.)
FUREY ST.
Structural slope protection
GALLAGHER ST.
PRELIMINARY - FOR REVIEW ONLY
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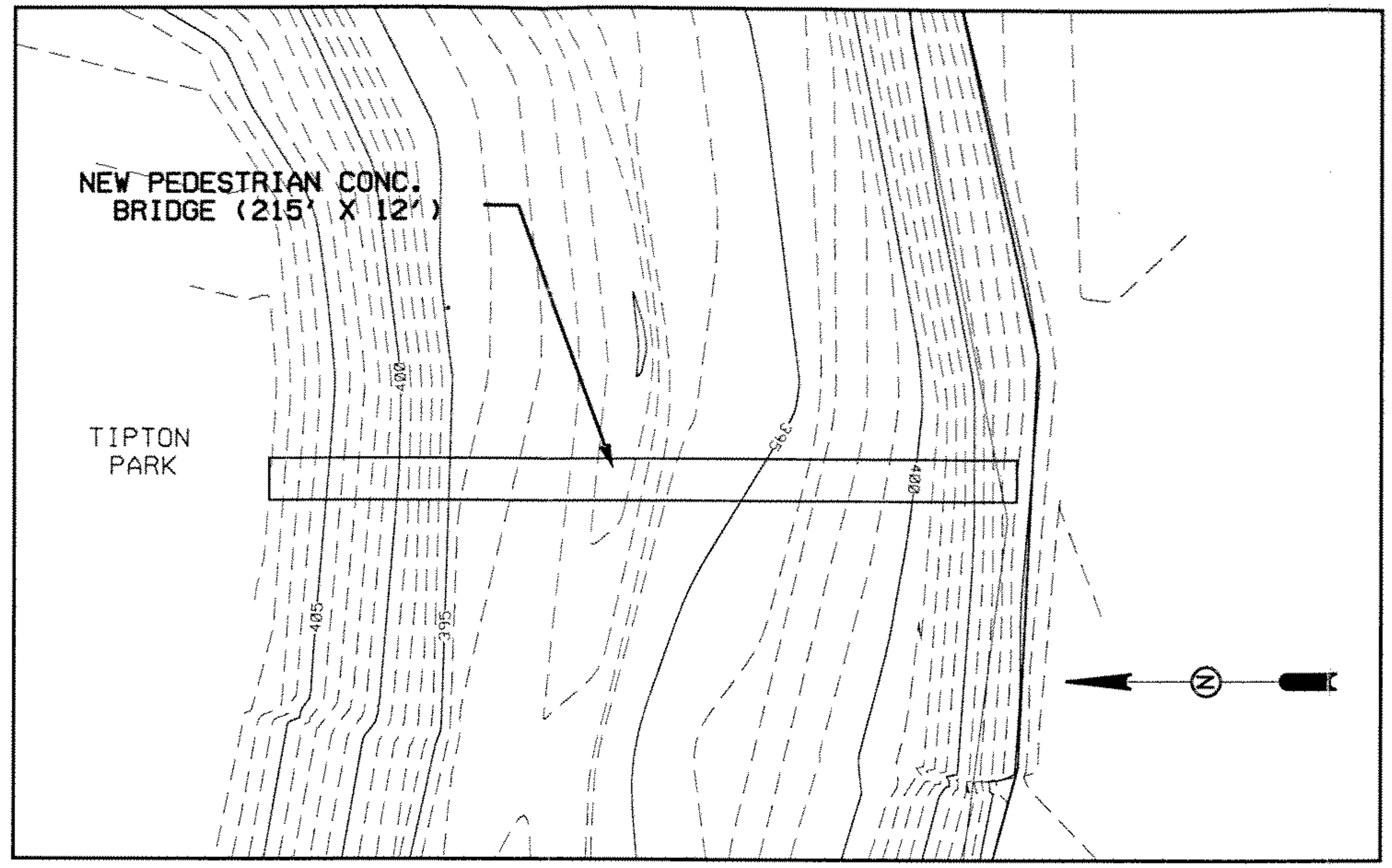
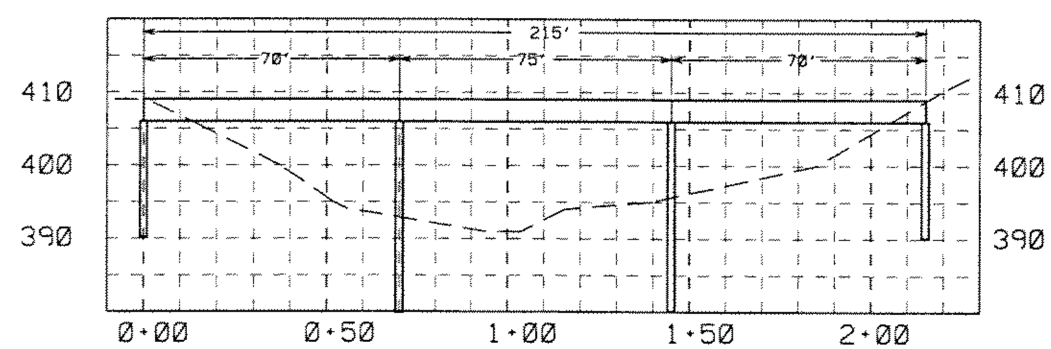
Type or Print Name
PE #
Date
Final Draft Plans
GRAPHIC SCALE IN FEET
PAVAHO WETLAND PLAN
+ 402.3
+ 403.6
+ 404.5
406.7
CANADA DR.
Water Level Control Structure Stop Log Weir
Island
Changes to island design may be made with planting arrangement.
+ 407.5
BALL FIELD
BICKERS PARK
+ 407.0
BICKERS ST
Island
405.5
+ 405.5
SHAW ST
ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
OLD TRINITY RIVER
DALLAS, TEXAS
WETLAND FOOTPRINT
PAVAHO SUMP & SHADRACK CHANNEL
PLATE D-4
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec. 2001
CADD FILE NAME: C-GPSHD1.DGN
REVISED PAVAHO SUMP DEC 2001



PLAN

20 0 20 40
SCALE IN FEET



PROFILE

SYM	D.C. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY:
DRAWN BY:
REVIEWED BY:

OLD TRINITY RIVER
DALLAS, TEXAS

PEDESTRIAN BRIDGE
AT TIPTON PARK

PLATE D-5

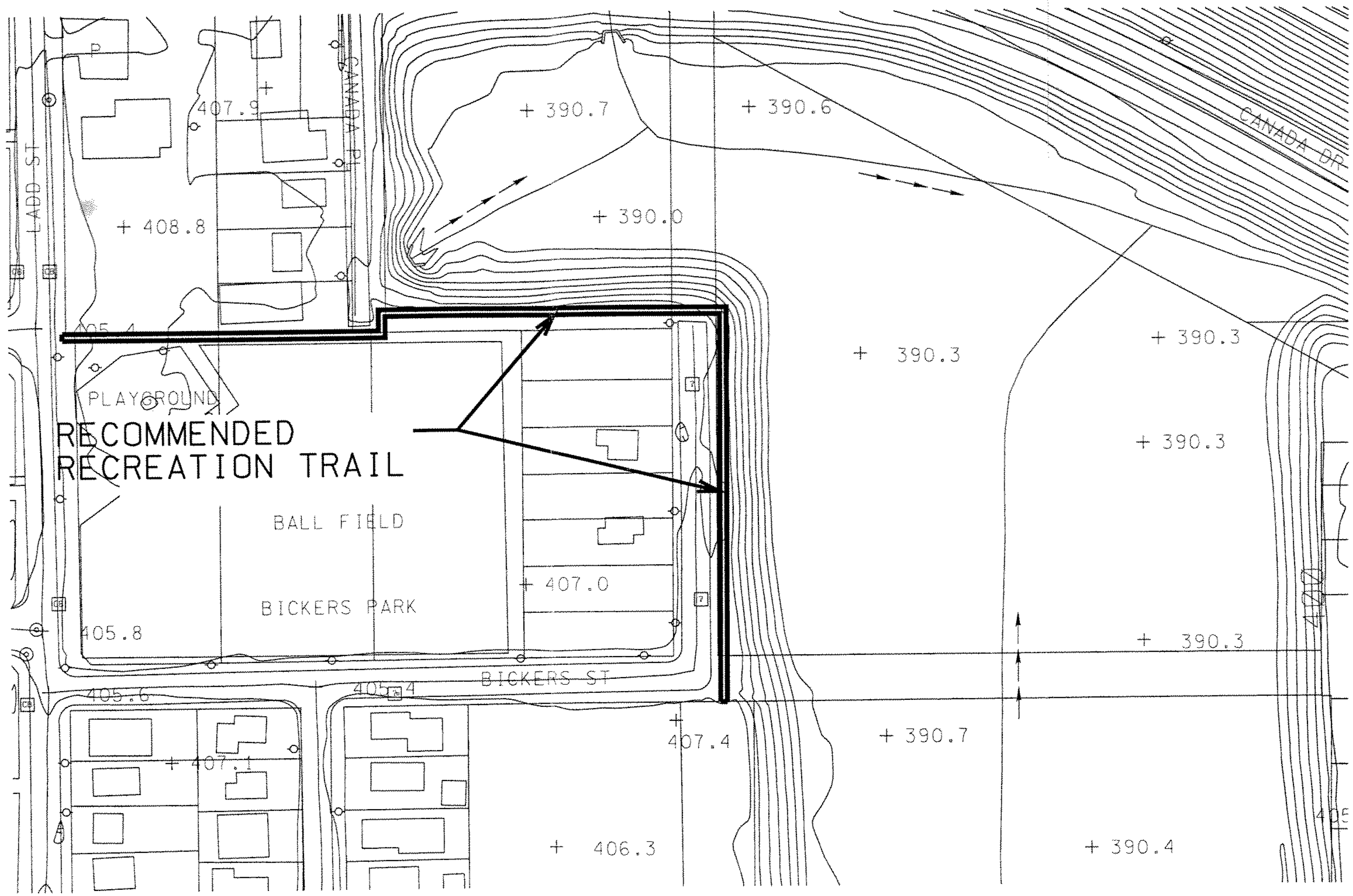
SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO.
DATED:
CONTR. NO.

DRAWING NUMBER
SHEET NO. OF
SEQUENCE NO.
CONTR. NO.

REFERENCE FILE NAME | REFERENCE FILE DESCRIPTION

CADD FILE NAME: BRIDGE.DGN



SCALE IN FEET

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY:
DRAWN BY:
REVIEWED BY:

OLD TRINITY RIVER
DALLAS, TEXAS

TRAIL PLAN AT PAVAHO SUMP

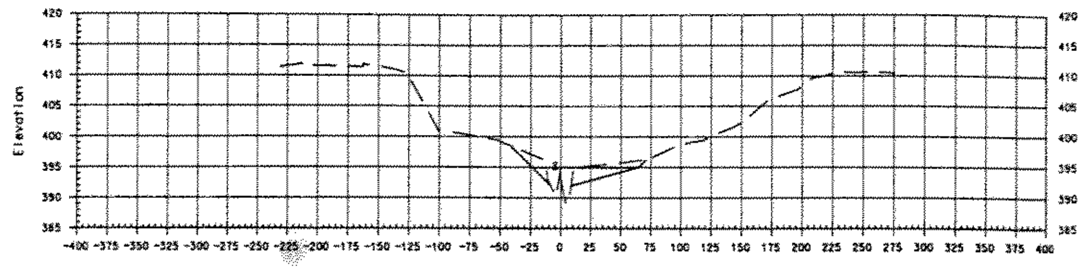
PLATE D-6

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. | DATED:
CONTR. NO.
DRAWING NUMBER | SHEET NO.
SEQUENCE NO.

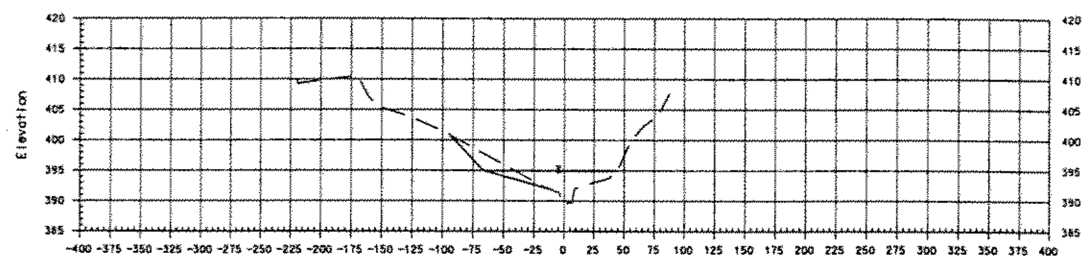
CADD FILE NAME: TRAIL.DGN

WESTMORELAND CHANNEL CROSS-SECTIONS



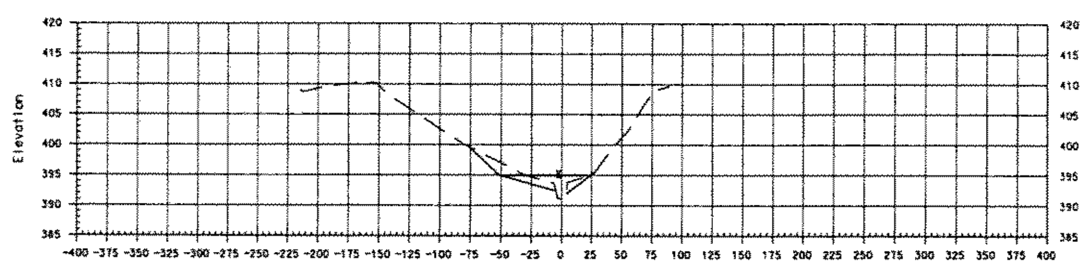
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

5927



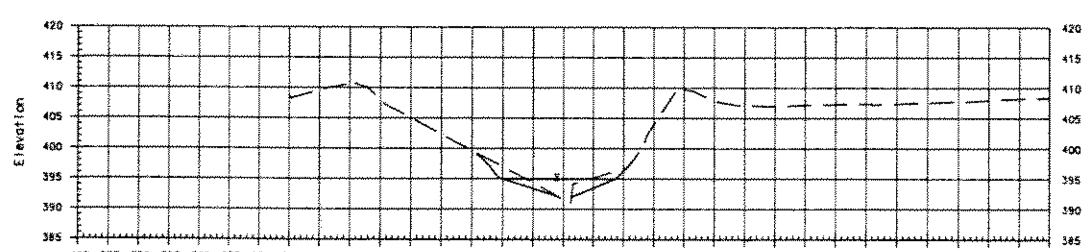
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

5600



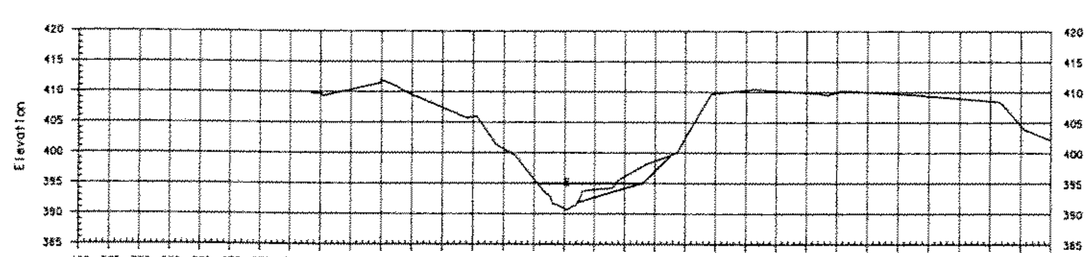
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

5250



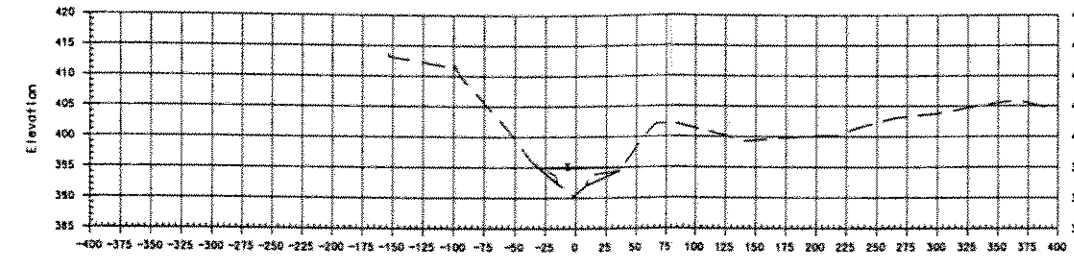
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

4900



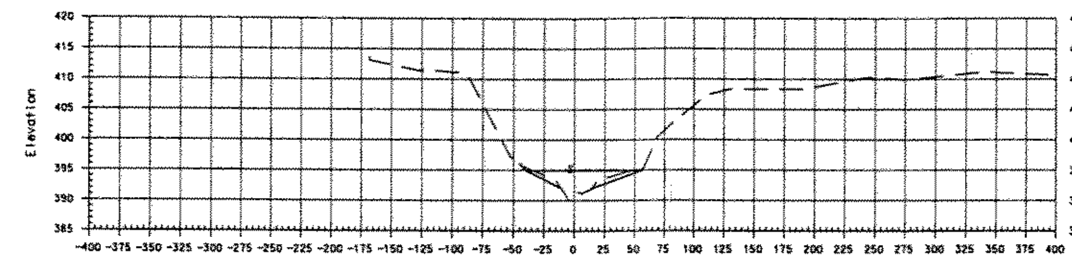
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

4550



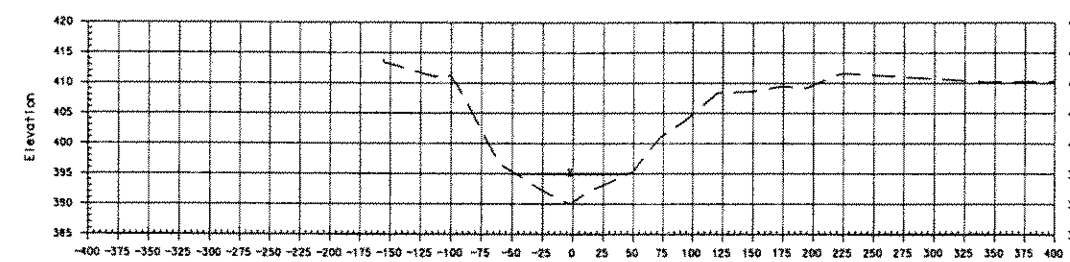
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

4200



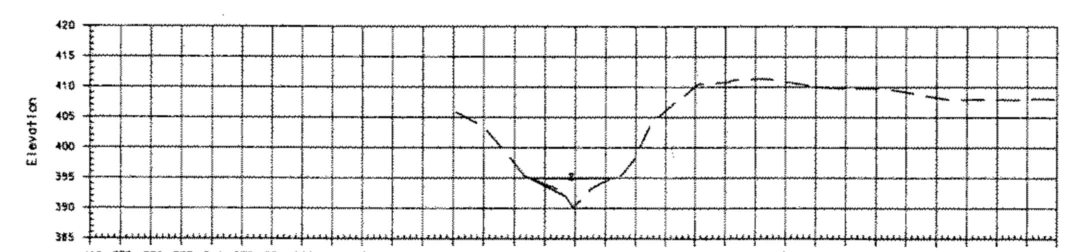
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

3850



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

3500



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

3150

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Final Draft Plans

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SYM	D.O. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCY

OLD TRINITY RIVER
DALLAS, TEXAS

WETLAND FOOTPRINT
CROSS-SECTIONS
WESTMORELAND CHANNEL

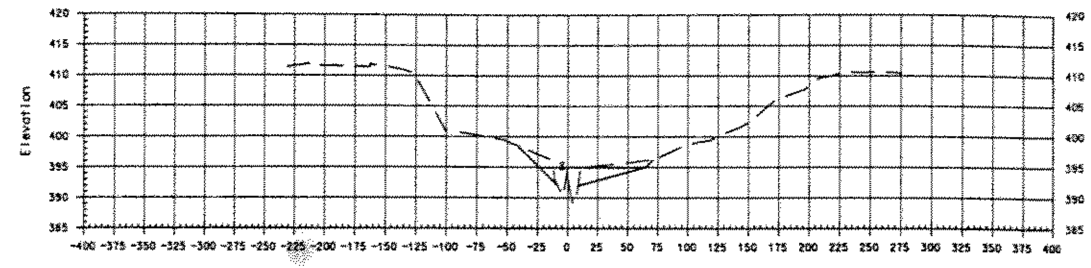
PLATE D-7

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DACA63-97-D-0026 DATED: Dec. 2000
CONTR. NO. Page 143 of 398
SEQUENCE NO.
DRAWING NUMBER SHEET NO. OF
CONTR. NO.

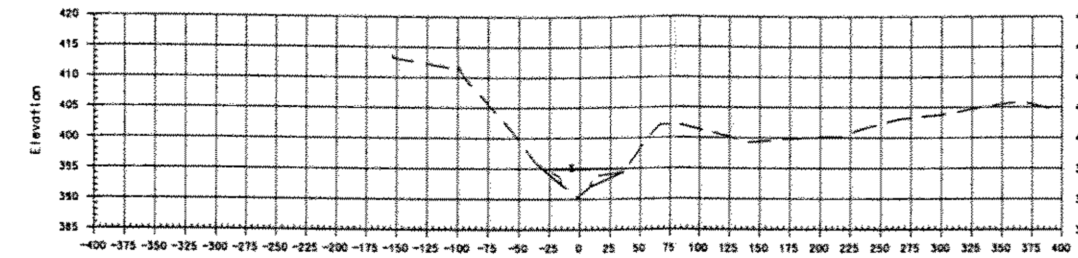
CADD FILE NAME: C-GPXSS1.DGN

WESTMORELAND CHANNEL CROSS-SECTIONS



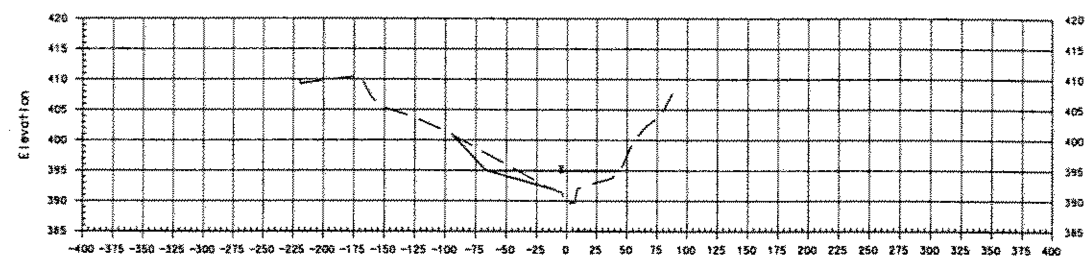
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

5927



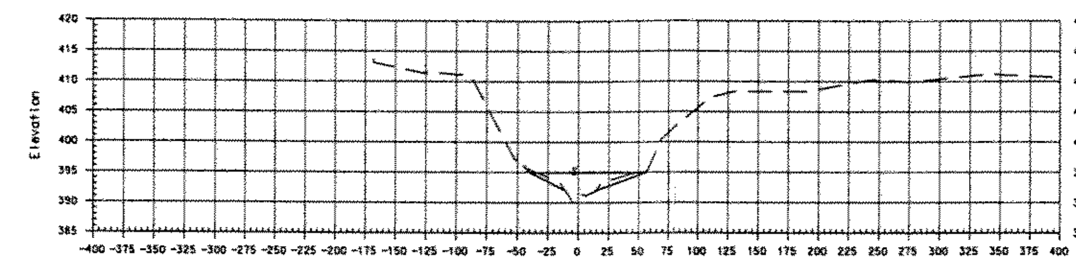
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

4200



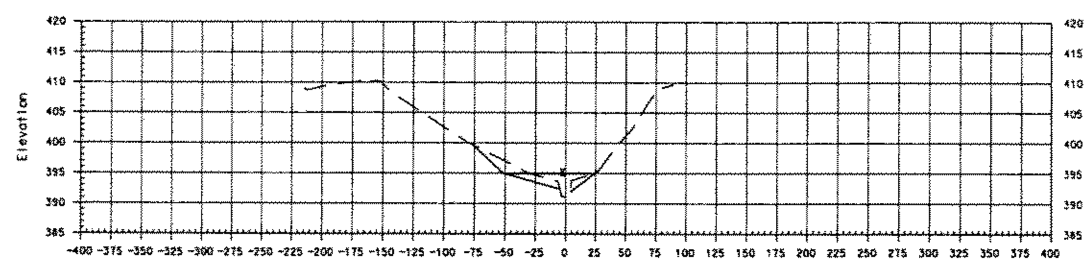
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

5600



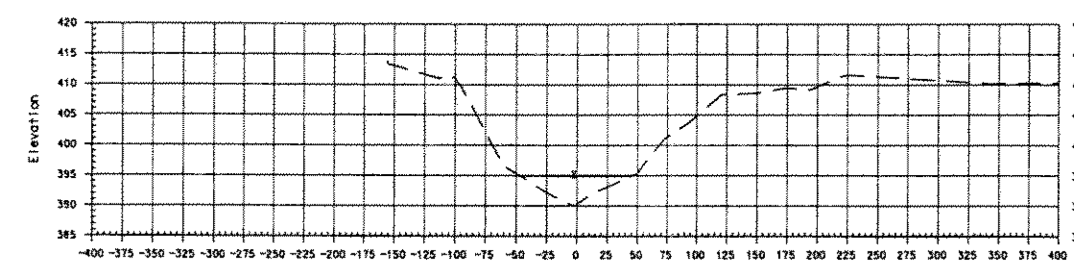
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

3850



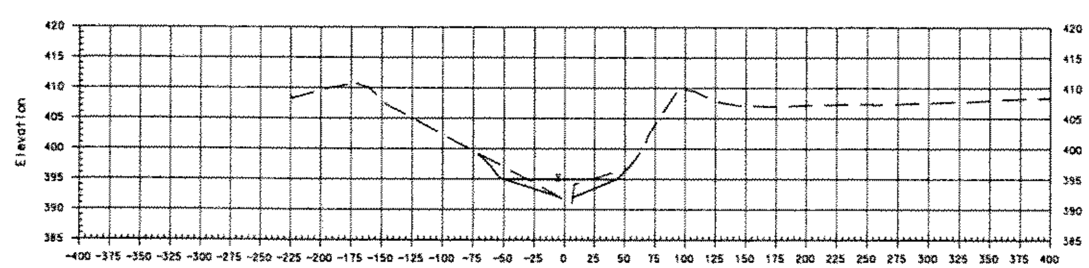
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

5250



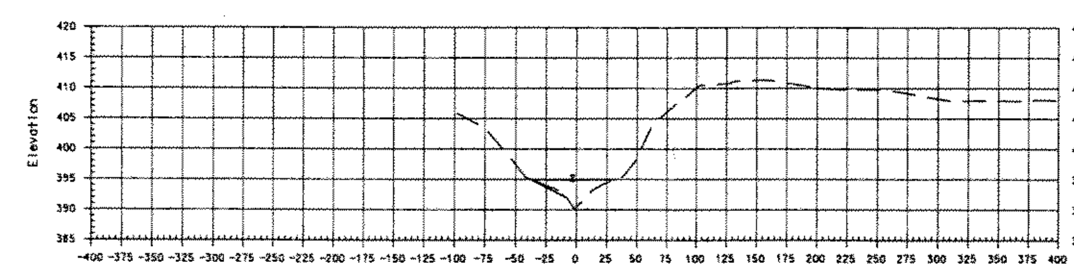
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

3500



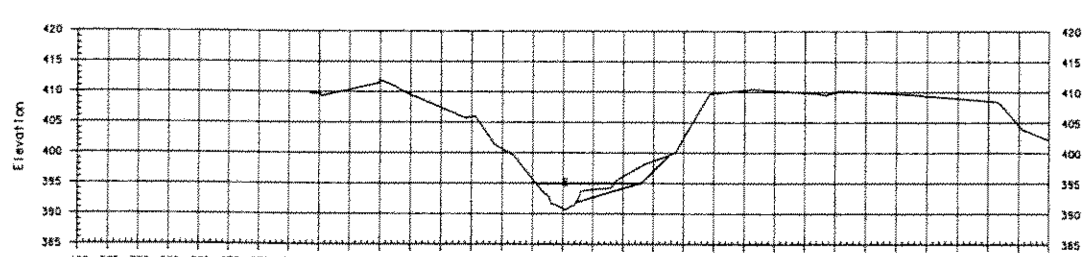
— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

4900



— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

3150



— — Existing Grade
——— Proposed Grade
—▽— Proposed Water Surface Elevation

4550

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Final Draft Plans

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SYM | D.O. NO. | ACTION | DATE | DESCRIPTION OF REVISION

ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCY

OLD TRINITY RIVER
DALLAS, TEXAS

WETLAND FOOTPRINT
CROSS-SECTIONS
WESTMORELAND CHANNEL

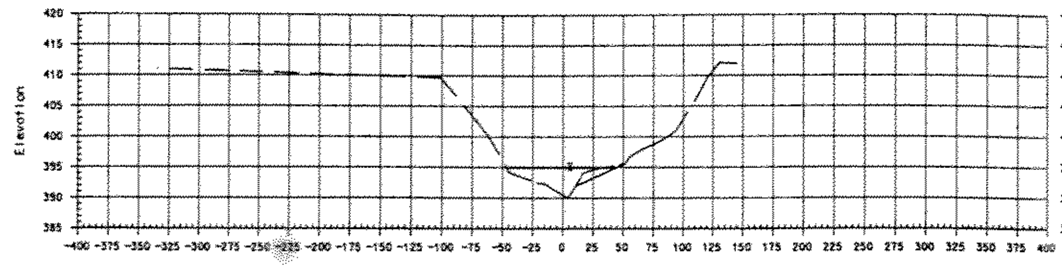
PLATE D-7

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DACA63-97-D-0026 DATED: Dec. 2000
CONTR. NO. Page 144 of 398 SEQUENCE NO.
DRAWING NUMBER SHEET NO. OF

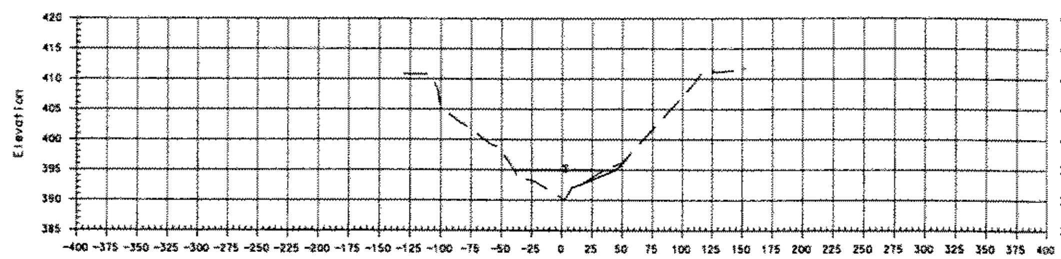
CADD FILE NAME: C-GPXSS1.DGN

WESTMORELAND CHANNEL CROSS-SECTIONS



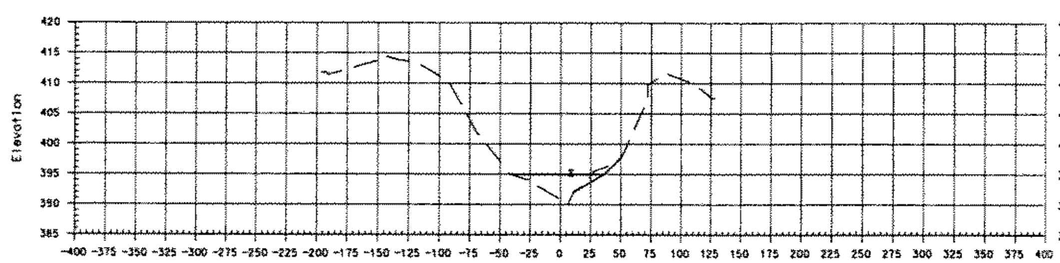
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

2800



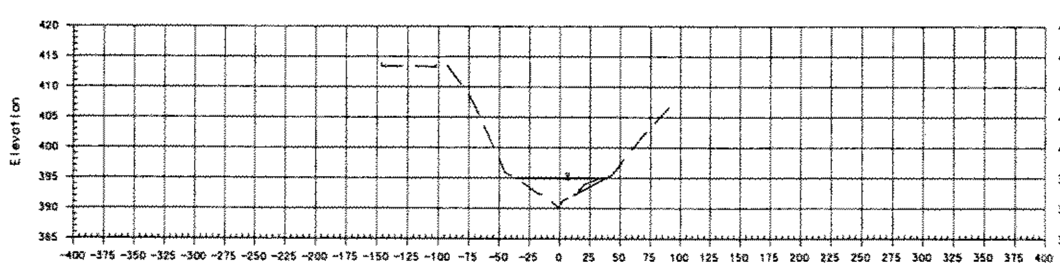
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

2450



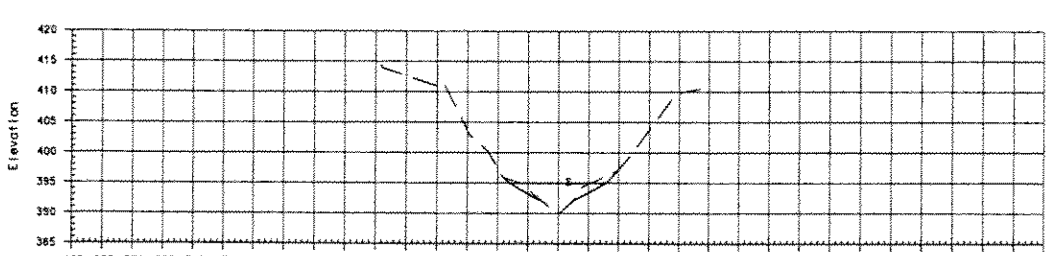
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

2100



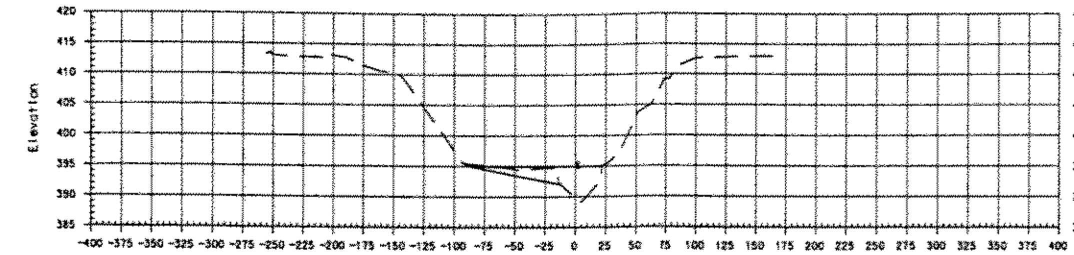
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

1750



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

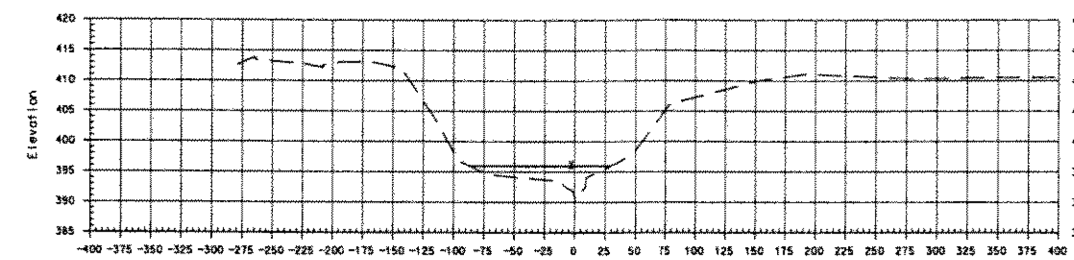
1400



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

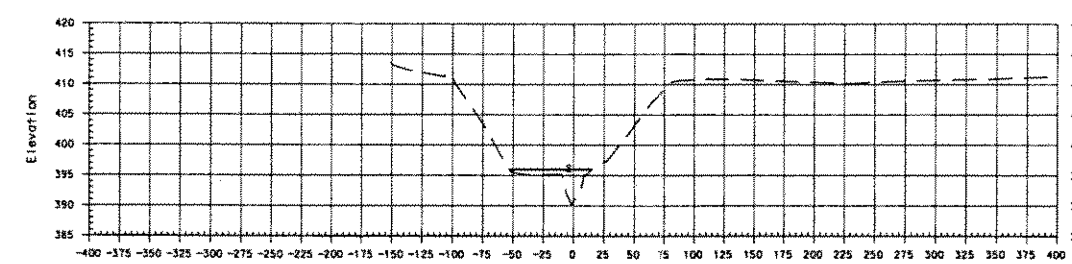
1050

LEDBETTER CHANNEL CROSS-SECTIONS



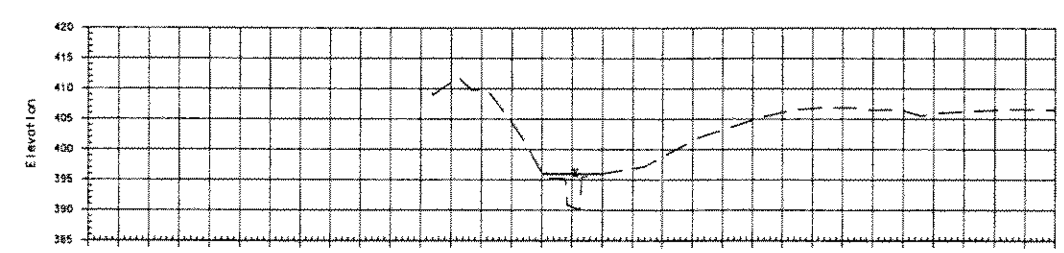
— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

700



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

350



— — Existing Grade
—— Proposed Grade
—▽— Proposed Water Surface Elevation

0

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	Westmoreland has excavation provided by the Corp. Ledbetter has no excavation.
REFERENCE FILE NAME	REFERENCE FILE DESCRIPTION

SYM	D.O. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: LFK
DRAWN BY: LFK
REVIEWED BY: SCV

OLD TRINITY RIVER
DALLAS, TEXAS

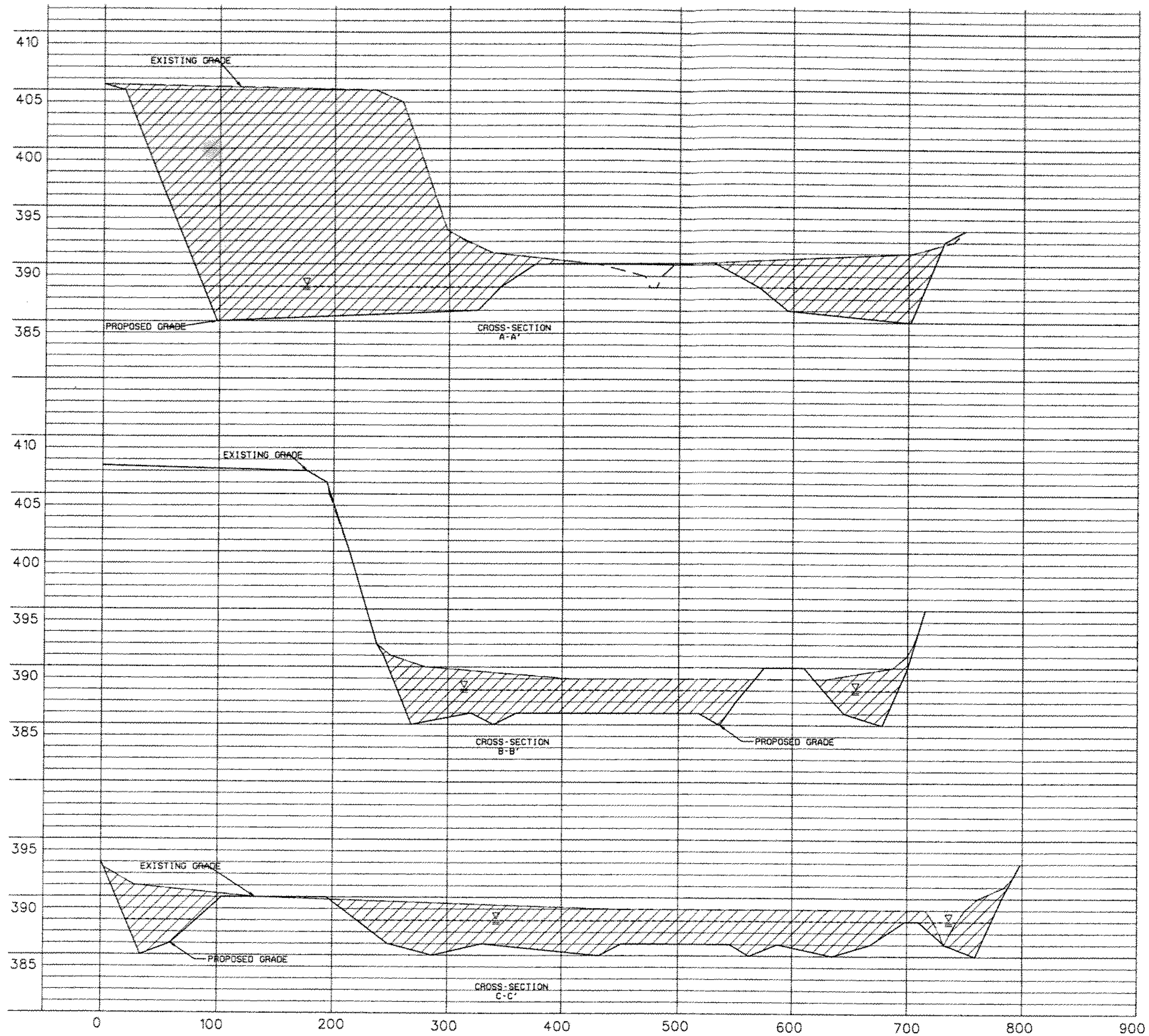
WETLAND FOOTPRINT
CROSS-SECTIONS
WESTMORELAND & LEDBETTER CHANNEL

PLATE D-8

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DACA63-97-D-0026 DATED: Dec, 2000
CONTR. NO. Page 145 of 398
SEQUENCE NO.
DRAWING NUMBER
SHEET NO. OF
CONTR. NO.

CADD FILE NAME: C-GPXSS2.DGN



PAVAHO SUMP CROSS-SECTIONS

LEGEND

- - - EXISTING GRADE
——— PROPOSED GRADE
MATERIAL TO BE EXCAVATED
WATER SURFACE ELEVATION

PRELIMINARY - FOR REVIEW ONLY

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12/12/01

Type or Print Name PE # Date

Final Draft Plans

PROFILE SCALES
1" = 40' HORZ.
1" = 4' VERT.

SYM	O.C. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING DIVISION
ENVIRONMENTAL DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: AGT
DRAWN BY: LFK
REVIEWED BY: SCV

OLD TRINITY RIVER
DALLAS, TEXAS

WETLAND FOOTPRINT
CROSS-SECTIONS
PAVAHO SUMP SITE

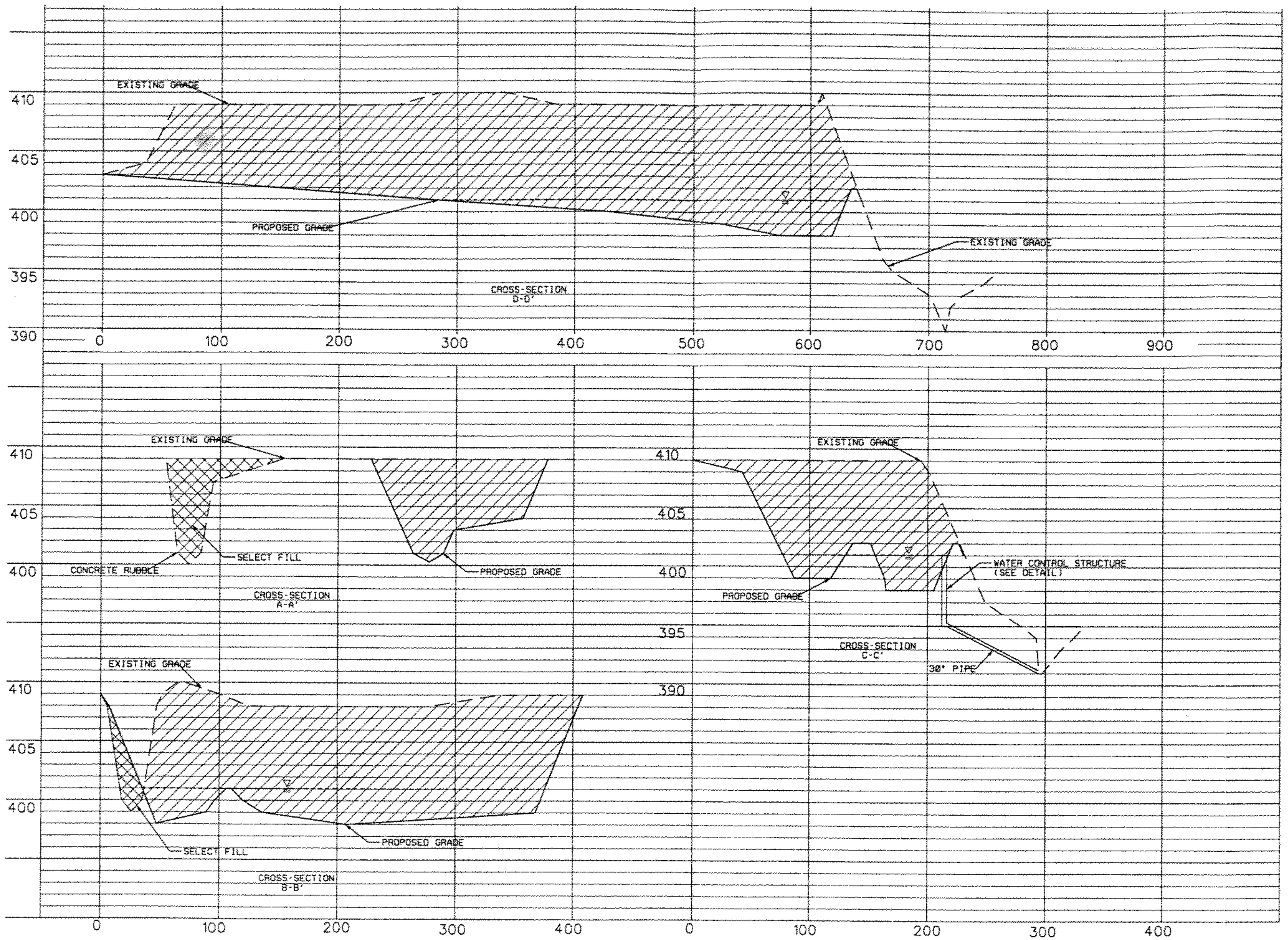
PLATE D-9

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DACA63-97-D-0026 DATED: Dec, 2001
CONTR. NO. SEQUENCE NO.
DRAWING NUMBER SHEET NO. OF

REFERENCE FILE NAME	REFERENCE FILE DESCRIPTION
REVISED DEC. 2001	OPTION MODIFIED TO HAVE NO TIERED WETLAND

CADD FILE NAME: C-GPPAVX.DGN



SHADRACK CHANNEL CROSS-SECTIONS

LEGEND

- – – – EXISTING GRADE
- ——— PROPOSED GRADE
- MATERIAL TO BE EXCAVATED
- SELECT FILL
- WATER SURFACE ELEVATION

PRELIMINARY - FOR REVIEW ONLY

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Type or Print Name PE # Date

Final Draft Plans

PROFILE SCALES:
1" = 40' HORZ.
1" = 4' VERT.

SYM	D.O. NO.	ACTION	DATE	DESCRIPTION OF REVISION

ENGINEERING DIVISION
ENVIRONMENTAL DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: AGT
DRAWN BY: LFK
REVIEWED BY: SCV

OLD TRINITY RIVER
DALLAS, TEXAS

WETLAND FOOTPRINT
CROSS-SECTIONS
SHADRACK CHANNEL SITE

PLATE D-10

SUBMITTED BY:
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION

SOL. NO. DACA63-97-D-0026 DATED: Dec, 2000
CONTR. NO. Page 147 of 398 SEQUENCE NO.
DRAWING NUMBER SHEET NO. OF

REFERENCE FILE NAME REFERENCE FILE DESCRIPTION

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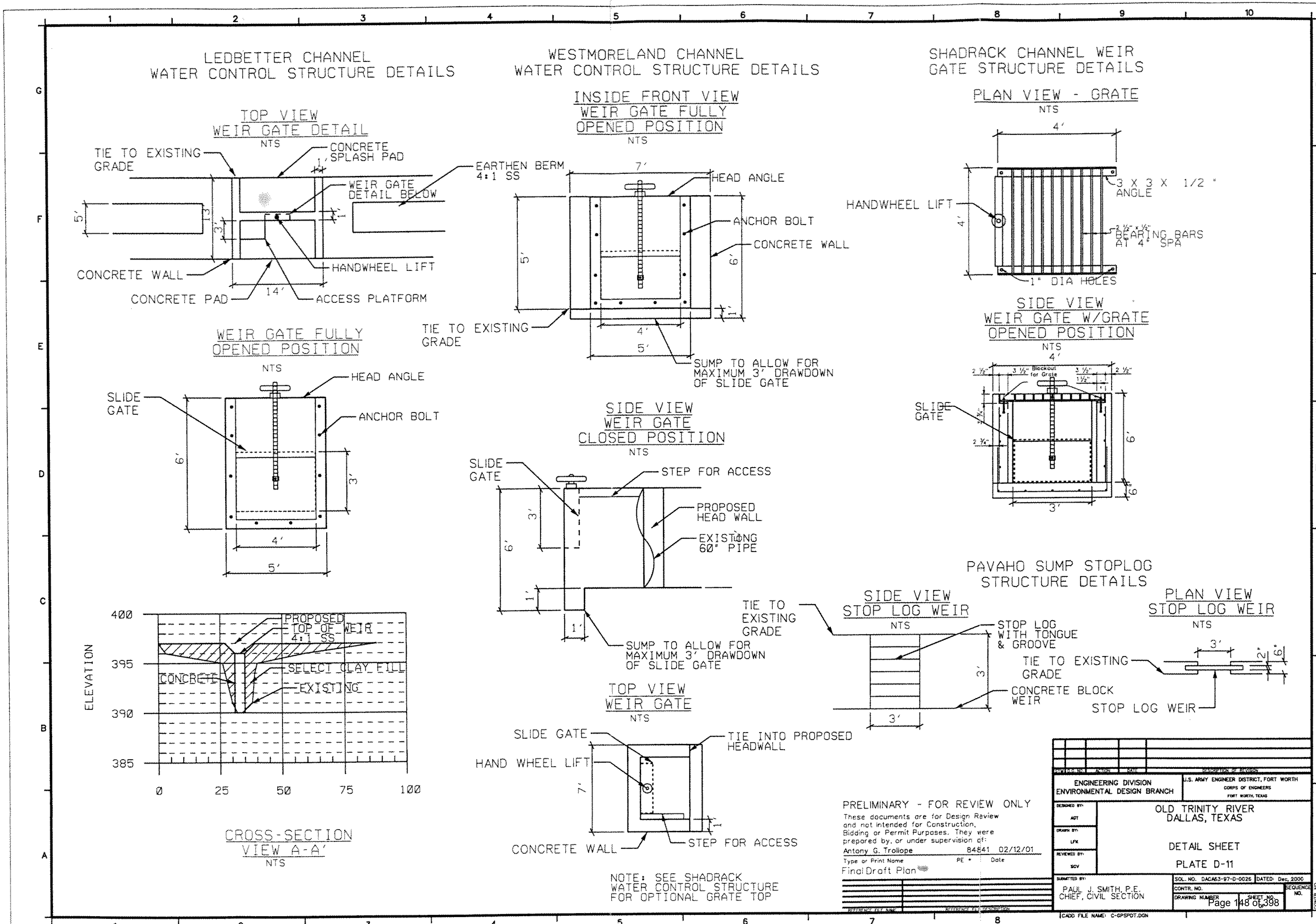
LEDBETTER CHANNEL
WATER CONTROL STRUCTURE DETAILS
TOP VIEW
WEIR GATE DETAIL
NTS
TIE TO EXISTING GRADE
CONCRETE SPLASH PAD
WEIR GATE DETAIL BELOW
CONCRETE WALL
CONCRETE PAD
HANDWHEEL LIFT
ACCESS PLATFORM
14'
WEIR GATE FULLY OPENED POSITION
NTS
SLIDE GATE
HEAD ANGLE
ANCHOR BOLT
4'
5'
CROSS-SECTION VIEW A-A'
NTS
ELEVATION
PROPOSED TOP OF WEIR
4:1 SS
SELECT CLAY FILL
CONCRETE
EXISTING
WESTMORELAND CHANNEL
WATER CONTROL STRUCTURE DETAILS
INSIDE FRONT VIEW
WEIR GATE FULLY OPENED POSITION
NTS
EARTHEN BERM 4:1 SS
HEAD ANGLE
ANCHOR BOLT
CONCRETE WALL
TIE TO EXISTING GRADE
SUMP TO ALLOW FOR MAXIMUM 3' DRAWDOWN OF SLIDE GATE
SIDE VIEW
WEIR GATE
CLOSED POSITION
NTS
SLIDE GATE
STEP FOR ACCESS
PROPOSED HEAD WALL
EXISTING 60" PIPE
SUMP TO ALLOW FOR MAXIMUM 3' DRAWDOWN OF SLIDE GATE
TOP VIEW
WEIR GATE
NTS
SLIDE GATE
HAND WHEEL LIFT
TIE INTO PROPOSED HEADWALL
CONCRETE WALL
STEP FOR ACCESS
NOTE: SEE SHADRACK WATER CONTROL STRUCTURE FOR OPTIONAL GRATE TOP
SHADRACK CHANNEL WEIR
GATE STRUCTURE DETAILS
PLAN VIEW - GRATE
NTS
HANDWHEEL LIFT
3 X 3 X 1/2 " ANGLE
BEARING BARS AT 4" SPA
1" DIA HOLES
SIDE VIEW
WEIR GATE W/GRATE
OPENED POSITION
NTS
SLIDE GATE
PAVAHO SUMP STOPLOG
STRUCTURE DETAILS
SIDE VIEW
STOP LOG WEIR
NTS
TIE TO EXISTING GRADE
STOP LOG WITH TONGUE & GROOVE
CONCRETE BLOCK WEIR
PLAN VIEW
STOP LOG WEIR
NTS
TIE TO EXISTING GRADE
STOP LOG WEIR
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Antony G. Trollope 84841 02/12/01
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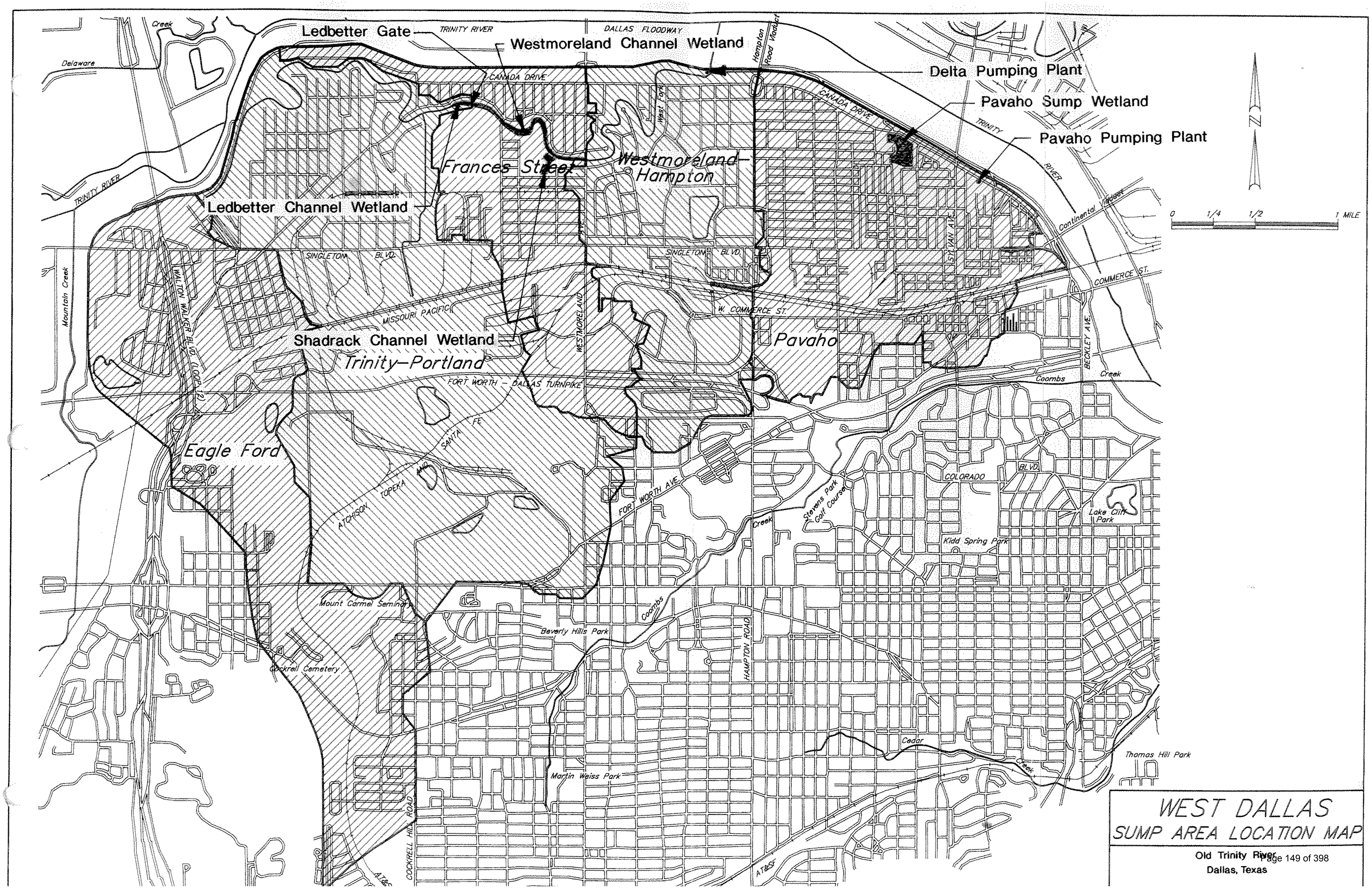
ENVIRONMENTAL DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
OLD TRINITY RIVER
DALLAS, TEXAS
DETAIL SHEET
PLATE D-11
PAUL J. SMITH, P.E.
CHIEF, CIVIL SECTION
SOL. NO. DACA63-97-D-0026
DATED: Dec. 2000
CADD FILE NAME: C-GPSPDT.DGN
Page 148 of 398



WEST DALLAS
SUMP AREA LOCATION MAP

Old Trinity River
Dallas, Texas

ANNEX E
DETAILED COST ESTIMATE

Old Trinity River DPR(Revised 2)
Detailed Project Report (DPR)
Old Trinity River Ecosystem
Restoration
Dallas, Texas

Designed By:
Estimated By:

Prepared By:

Preparation Date: 03/27/03
Effective Date of Pricing: 03/27/03

Sales Tax: 0.00%

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APPROVED BY:

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by Building Systems Design, Inc.
Release 1.2

Currency in DOLLARS

General Narrative

The estimate was prepared by the Cost Engineering Section using current guidelines and directives. Quantities and costs for the construction work were developed and furnished by the AE Firm of Carter and Burgess, Inc.

The costs for Lands and Damages, Planning, Engineering, and Design and Construction Management efforts were furnished by the responsible elements.

The estimate reflects pricing consistent with the available information and the level of confidence in the quantities. All of these factors were considered in developing and assigning contingency allowances. The level of accuracy for the data furnished by the various elements was considered to be usual and customary for this stage of design.

The project consists of the construction of water control structures, a concrete pedestrian bridge, a six foot wide concrete trail, seeding, mulching and reforestation of designated areas.

Account Code 01 - Lands and Damages

The various line item costs summarized under this account code were furnished by the Real Estate Division. Based on the information available, and the relative difficulty anticipated with the acquisitions and other items of work required, the contingency rate assigned to the various line items ranged from 10 % to 25 %

Account Code 14 - Recreation

This work consists of the construction of a 6' wide concrete trail. These costs considered unlikely to vary by a large percentage. A contingency allowance of 25% is allowed for this work.

Account Code 15 - Floodway Control - Diversion Structures

Design data for this account was furnished by the Design Branch of the Fort Worth District and the AE firm of Carter and Burgess, Inc. The work to be performed under this account is for the construction water control structures, seeding, mulching, and the reforestation of designated areas. A contingency allowance of 25% is allowed for this work.

Account Code 30 - Planning, Engineering, and Design

The anticipated costs for this account were furnished by the responsible elements. A contingency of 20% was assigned to this work which is a result of the stage of design and a confidence factor in the available information.

Account Code 31 - Supervision and Administration

The anticipated costs for this account were furnished by the responsible elements. A contingency of 20% has been applied to costs for this account code and is considered adequate form this stage of design.

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
01 Lands and Damages					
01_23 Constructn Contract(s) Documnts					
01_23.03 Real Estate Analysis Documents					
01_23.03.01 Real Estate Planning Documents		10,000	1,000	11,000	
TOTAL Real Estate Planning Documents		10,000	1,000	11,000	
01_23.03.02 Real Estate Acquisition Documnts					
01_23.03.02_ 01 Acquisition by Local Sponsor		40,000	4,000	44,000	
01_23.03.02_ 02 Review by Local Sponsor		2,000	200	2,200	
TOTAL Real Estate Acquisition Documnts		42,000	4,200	46,200	
01_23.03.03 Real Estate Condemnatn Documnts					
01_23.03.03_ 01 Condemnation by Sponsor		63,600	15,900	79,500	
01_23.03.03_ 02 Review by Sponsor		4,000	1,000	5,000	
TOTAL Real Estate Condemnatn Documnts		67,600	16,900	84,500	
01_23.03.05 Real Estate Appraisal Documents					
01_23.03.05_ 01 Appraisal by Sponsor		106,000	26,500	132,500	
01_23.03.05_ 02 Review by Sponsor		26,500	6,625	33,125	
TOTAL Real Estate Appraisal Documents		132,500	33,125	165,625	
01_23.03.15 Real Estate Payment Documents					
01_23.03.15_ 01 Payment by Sponsor		335,445	83,861	419,306	
01_23.03.15_ 02 Review by Sponsor		10,000	2,500	12,500	
TOTAL Real Estate Payment Documents		345,445	86,361	431,806	
01_23.03.17 RE LERRD Accounting					
01_23.03.17_ 01 Documents		2,000	500	2,500	
TOTAL RE LERRD Accounting		2,000	500	2,500	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Real Estate Analysis Documents			599,545	142,086	741,631	
TOTAL Constructn Contract(s) Documnts	1.00	EA	599,545	142,086	741,631	741631
TOTAL Lands and Damages	1.00	EA	599,545	142,086	741,631	741631
14 Recreation Facilities						
14_00 Recreation Facilities						
14_00.22 Parking Lots and Service Roads						
14_00.22.02 Site Work						
14_00.22.02_ 10 6' Wide Concrete Trail	650.00	SY	32,825	8,206	41,031	63.13
14_00.22.02_ 12 Relocate Bridge	2580.00	SF	138,889	34,722	173,611	67.29
TOTAL Site Work			171,714	42,929	214,643	
TOTAL Parking Lots and Service Roads			171,714	42,929	214,643	
TOTAL Recreation Facilities			171,714	42,929	214,643	
TOTAL Recreation Facilities	1.00		171,714	42,929	214,643	214643
15 Floodway Control-Diversion Struc						
15_00 Floodway Control-Diversion Struc						
15_00.10 Earthwork for Structures						
15_00.10.02 Site Work						
15_00.10.02_ 03 Excav., Westmoreland Sump Area	11000	CY	52,995	13,249	66,243	6.02
15_00.10.02_ 04 Excav., Shadrack Channel-Common	30650	CY	147,663	36,916	184,578	6.02
15_00.10.02_ 05 Excav., Shadrack Channel-Conc.	3556.00	CY	20,580	5,145	25,725	7.23
15_00.10.02_ 06 Excav. Pavaho Sump Area	74000	CY	356,510	89,127	445,637	6.02
TOTAL Site Work			577,747	144,437	722,183	
TOTAL Earthwork for Structures	1.00		577,747	144,437	722,183	722183
15_00.11 Concrete Culvert Pipe						
15_00.11.02 24" Cl.111 RCP @ Ledbetter Sump						
15_00.11.02_ 01 24" RCP @ Ledbetter Sump Area	8.00	EA	3,636	909	4,545	568.13

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL 24" Cl.111 RCP @ Ledbetter Sump			3,636	909	4,545	
15_00.11.03 24" Cl.111 RCP @ Shadrack Channl						
15_00.11.03_ 01 24" RCP @ Shadrack Channel	7.00	EA	3,182	795	3,977	568.13
TOTAL 24" Cl.111 RCP @ Shadrack Channl			3,182	795	3,977	
TOTAL Concrete Culvert Pipe			6,818	1,704	8,522	
15_00.12 Concrete Headwall						
15_00.12.02 60" Headwall @ Westmoreland Sump						
15_00.12.02_ 01 60" RCP Headwall @ Westmoreland	1.00	EA	6,464	1,616	8,080	8080.00
TOTAL 60" Headwall @ Westmoreland Sump	1.00	EA	6,464	1,616	8,080	8080.00
TOTAL Concrete Headwall	1.00	EA	6,464	1,616	8,080	8080.00
15_00.25 Erosion Control						
15_00.25.05 Erosion Ctrl Blanket @ Shadrack	1531.00	SY	17,396	4,349	21,745	14.20
15_00.25.08 6" Conc Slope Paving	1692.00	SY	47,508	11,877	59,385	35.10
15_00.25.09 #3 bars @12" OCEW	11678	LB	7,549	1,887	9,436	0.81
TOTAL Erosion Control			72,453	18,113	90,566	
15_00.53 Gated Water Control Structure						
15_00.53.03 Stop Log Water Control Structure						
15_00.53.03_ 01 Stop Log Water Control Structure			16,160	4,040	20,200	
TOTAL Stop Log Water Control Structure			16,160	4,040	20,200	
15_00.53.AA Ledbetter Channel Water Ctrl Str						
15_00.53.AA_ AA Concrete	17.00	CY	6,031	1,508	7,539	443.45
15_00.53.AA_ BA Reinforcing Steel	1907.00	LB	1,233	308	1,541	0.81
15_00.53.AA_ CA Sliding Weir Gate (72" x 48")			7,277	1,819	9,096	
15_00.53.AA_ DA Excavate & Backfill	245.00	CY	1,138	285	1,423	5.81
TOTAL Ledbetter Channel Water Ctrl Str			15,679	3,920	19,599	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
15_00.53.BA Westmoreland Chan Water Ctrl Str					
15_00.53.BA_ AA Concrete	5.00 CY	1,774	443	2,217	443.45
15_00.53.BA_ BA Reinforcing Steel	511.00 LB	330	83	413	0.81
15_00.53.BA_ CA Sliding Weir Gate (72" x 48")		7,277	1,819	9,096	
TOTAL Westmoreland Chan Water Ctrl Str		9,381	2,345	11,726	
15_00.53.CA Shadrach Channel Water Ctrl Str					
15_00.53.CA_ AA Concrete	1.70 CY	603	151	754	443.45
15_00.53.CA_ BA Reinforcing Steel	85.00 LB	55	14	69	0.81
15_00.53.CA_ CA Sliding Weir Gate (36" x 48")		4,545	1,136	5,681	
TOTAL Shadrach Channel Water Ctrl Str		5,203	1,301	6,504	
TOTAL Gated Water Control Structure	1.00	46,423	11,606	58,029	58029
15_00.99 Associated General Items					
15_00.99.02 Seeding and Mulching					
15_00.99.02_ 01 Seeding & Mulching,LedbetterSump	1.03 AC	3,339	835	4,174	4052.63
15_00.99.02_ 02 Seeding&Mulching,WestmorelandSmp	25000 SY	16,665	4,166	20,831	0.83
15_00.99.02_ 05 Seeding & Mulching,ShadrackChanl	6170.00 SY	4,113	1,028	5,141	0.83
15_00.99.02_ 06 Seeding & Mulching,Pavaho Sump	9000.00 SY	1,091	273	1,364	0.15
TOTAL Seeding and Mulching		25,208	6,302	31,510	
15_00.99.05 Reforestation					
15_00.99.05_ 01 Reforestation (1),Ledbetter Sump	4.48 AC	18,099	4,525	22,624	5050.00
15_00.99.05_ 02 Reforestation (2),Ledbetter Sump	5.39 AC	3,185	796	3,981	738.56
15_00.99.05_ 03 Reforestation (1), Westmoreland	22.40 AC	90,496	22,624	113,120	5050.00
15_00.99.05_ 04 Reforestation (2), Westmorerland	17.38 AC	10,269	2,567	12,836	738.56
15_00.99.05_ 05 Reforestation (1), Shadrack Chan	1.09 AC	4,404	1,101	5,505	5050.00
15_00.99.05_ 06 Reforestation (1), Pavaho Sump	7.00 AC	26,583	6,646	33,229	4747.00
15_00.99.05_ 07 Reforestation (1), Fish TrapLake	18.93 AC	76,477	19,119	95,597	5050.00
15_00.99.05_ 08 Reforestation (2), Fish TrapLake	5.65 AC	3,338	835	4,173	738.56
TOTAL Reforestation		232,851	58,213	291,064	
15_00.99.16 Relocate Guy Wire @ Shadrack Chn					
15_00.99.16_ 01 Relocate Guy Wire		1,076	269	1,345	
TOTAL Relocate Guy Wire @ Shadrack Chn		1,076	269	1,345	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
15_00.99.17 Modify Curb&Guard Fnc@ShadrackCh					
15_00.99.17_ 01 Modify Curb & Guard Fence		2,156	539	2,695	
TOTAL Modify Curb&Guard Fnc@ShadrackCh		2,156	539	2,695	
TOTAL Associated General Items	1.00	261,291	65,323	326,614	326614
TOTAL Floodway Control-Diversion Struc	1.00	971,195	242,799	1,213,994	1213994
TOTAL Floodway Control-Diversion Struc		971,195	242,799	1,213,994	
30 Planning, Engineering and Design					
30_23 Constructn Contracts(s) Documnts					
30_23.01 Plans and Specifications (P&S)					
30_23.01.02 Plans and Specifications		227,250	45,450	272,700	
TOTAL Plans and Specifications (P&S)		227,250	45,450	272,700	
30_23.04 Environmental Studies Documents					
30_23.04.12 All Other Environmentl Documents					
30_23.04.12_ 01 Environmental/Cultural Complianc		5,050	1,010	6,060	
30_23.04.12_ 02 Monitoring		18,926	3,785	22,712	
TOTAL All Other Environmentl Documents		23,976	4,795	28,772	
TOTAL Environmental Studies Documents	1.00 EA	23,976	4,795	28,772	28772
30_23.07 Cost Estimates					
30_23.07.03 Project Cost Estimate					
30_23.07.03_ 01 Cost Engineering		15,150	3,030	18,180	
TOTAL Project Cost Estimate		15,150	3,030	18,180	
TOTAL Cost Estimates		15,150	3,030	18,180	
30_23.09 Real Estate Acquisition Coord.					
30_23.09.01 Real Estate Acquisition Coord.		20,200	4,040	24,240	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
TOTAL Real Estate Acquisition Coord.		20,200	4,040	24,240	
30_23.10 Engn. & Design During Const.					
30_23.10.01 Engineering & Design During		56,691	11,338	68,030	
TOTAL Engn. & Design During Const.	1.00 EA	56,691	11,338	68,030	68030
30_23.14 Management Documents					
30_23.14.04 All Other Management Documents		7,575	1,515	9,090	
TOTAL Management Documents		7,575	1,515	9,090	
30_23.16 Contract Advertisement and Award					
30_23.16.01 Contract Advertisement and Award		7,575	1,515	9,090	
TOTAL Contract Advertisement and Award		7,575	1,515	9,090	
30_23.18 Detailed Project Report					
30_23.18. 1 Detailed Project Report		274,700	0	274,700	
TOTAL Detailed Project Report		274,700	0	274,700	
TOTAL Constructn Contracts(s) Documnts	1.00 EA	633,118	71,684	704,801	704801
TOTAL Planning, Engineering and Design	1.00	633,118	71,684	704,801	704801
31 Construction Management					
31_23 Construction Contracts					
31_23.11 Supervision and Administration					
31_23.11.01 Prjt Office Supervn and Adminstn		85,042	17,008	102,050	
TOTAL Supervision and Administration		85,042	17,008	102,050	
TOTAL Construction Contracts	1.00	85,042	17,008	102,050	102050
31_25 Monitoring					
31_25.12 Monitoring					

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT
31_25.12.14 Monitoring		18,700	0	18,700	
TOTAL Monitoring		18,700	0	18,700	
TOTAL Monitoring		18,700	0	18,700	
TOTAL Construction Management	1.00 EA	103,742	17,008	120,750	120750
TOTAL Old Trinity River DPR(Revised 2)		2,479,314	516,506	2,995,820	

	QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
01 Lands and Damages					
01_23 Constructn Contract(s) Documnts					
01_23.03 Real Estate Analysis Documents					
01_23.03.01 Real Estate Planning Documents		10,000	0	10,000	
TOTAL Real Estate Planning Documents		10,000	0	10,000	
01_23.03.02 Real Estate Acquisition Documnts					
01_23.03.02_ 01 Acquisition by Local Sponsor		40,000	0	40,000	
01_23.03.02_ 02 Review by Local Sponsor		2,000	0	2,000	
TOTAL Real Estate Acquisition Documnts		42,000	0	42,000	
01_23.03.03 Real Estate Condemnatn Documnts					
01_23.03.03_ 01 Condemnation by Sponsor		63,600	0	63,600	
01_23.03.03_ 02 Review by Sponsor		4,000	0	4,000	
TOTAL Real Estate Condemnatn Documnts		67,600	0	67,600	
01_23.03.05 Real Estate Appraisal Documents					
01_23.03.05_ 01 Appraisal by Sponsor		106,000	0	106,000	
01_23.03.05_ 02 Review by Sponsor		26,500	0	26,500	
TOTAL Real Estate Appraisal Documents		132,500	0	132,500	
01_23.03.15 Real Estate Payment Documents					
01_23.03.15_ 01 Payment by Sponsor		335,445	0	335,445	
01_23.03.15_ 02 Review by Sponsor		10,000	0	10,000	
TOTAL Real Estate Payment Documents		345,445	0	345,445	
01_23.03.17 RE LERRD Accounting					
01_23.03.17_ 01 Documents		2,000	0	2,000	
TOTAL RE LERRD Accounting		2,000	0	2,000	

	QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
TOTAL Real Estate Analysis Documents		599,545	0	599,545	
TOTAL Constructn Contract(s) Documnts	1.00 EA	599,545	0	599,545	599545
TOTAL Lands and Damages	1.00 EA	599,545	0	599,545	599545
14 Recreation Facilities					
14_00 Recreation Facilities					
14_00.22 Parking Lots and Service Roads					
14_00.22.02 Site Work					
14_00.22.02_ 10 6' Wide Concrete Trail	650.00 SY	32,500	325	32,825	50.50
14_00.22.02_ 12 Relocate Bridge	2580.00 SF	137,514	1,375	138,889	53.83
TOTAL Site Work		170,014	1,700	171,714	
TOTAL Parking Lots and Service Roads		170,014	1,700	171,714	
TOTAL Recreation Facilities		170,014	1,700	171,714	
TOTAL Recreation Facilities	1.00	170,014	1,700	171,714	171714
15 Floodway Control-Diversion Struc					
15_00 Floodway Control-Diversion Struc					
15_00.10 Earthwork for Structures					
15_00.10.02 Site Work					
15_00.10.02_ 03 Excav., Westmoreland Sump Area	11000 CY	52,470	525	52,995	4.82
15_00.10.02_ 04 Excav., Shadrack Channel-Common	30650 CY	146,201	1,462	147,663	4.82
15_00.10.02_ 05 Excav., Shadrack Channel-Conc.	3556.00 CY	20,376	204	20,580	5.79
15_00.10.02_ 06 Excav. Pavaho Sump Area	74000 CY	352,980	3,530	356,510	4.82
TOTAL Site Work		572,026	5,720	577,747	
TOTAL Earthwork for Structures	1.00	572,026	5,720	577,747	577747
15_00.11 Concrete Culvert Pipe					
15_00.11.02 24" Cl.111 RCP @ Ledbetter Sump					
15_00.11.02_ 01 24" RCP @ Ledbetter Sump Area	8.00 EA	3,600	36	3,636	454.50

	QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
TOTAL 24" Cl.111 RCP @ Ledbetter Sump		3,600	36	3,636	
15_00.11.03 24" Cl.111 RCP @ Shadrack Channl					
15_00.11.03_ 01 24" RCP @ Shadrack Channel	7.00 EA	3,150	32	3,182	454.50
TOTAL 24" Cl.111 RCP @ Shadrack Channl		3,150	32	3,182	
TOTAL Concrete Culvert Pipe		6,750	68	6,818	
15_00.12 Concrete Headwall					
15_00.12.02 60" Headwall @ Westmoreland Sump					
15_00.12.02_ 01 60" RCP Headwall @ Westmoreland	1.00 EA	6,400	64	6,464	6464.00
TOTAL 60" Headwall @ Westmoreland Sump	1.00 EA	6,400	64	6,464	6464.00
TOTAL Concrete Headwall	1.00 EA	6,400	64	6,464	6464.00
15_00.25 Erosion Control					
15_00.25.05 Erosion Ctrl Blanket @ Shadrack	1531.00 SY	17,224	172	17,396	11.36
15_00.25.08 6" Conc Slope Paving	1692.00 SY	47,038	470	47,508	28.08
15_00.25.09 #3 bars @12" OCEW	11678 LB	7,474	75	7,549	0.65
TOTAL Erosion Control		71,735	717	72,453	
15_00.53 Gated Water Control Structure					
15_00.53.03 Stop Log Water Control Structure					
15_00.53.03_ 01 Stop Log Water Control Structure		16,000	160	16,160	
TOTAL Stop Log Water Control Structure		16,000	160	16,160	
15_00.53.AA Ledbetter Channel Water Ctrl Str					
15_00.53.AA_ AA Concrete	17.00 CY	5,971	60	6,031	354.76
15_00.53.AA_ BA Reinforcing Steel	1907.00 LB	1,220	12	1,233	0.65
15_00.53.AA_ CA Sliding Weir Gate (72" x 48")		7,205	72	7,277	
15_00.53.AA_ DA Excavate & Backfill	245.00 CY	1,127	11	1,138	4.65
TOTAL Ledbetter Channel Water Ctrl Str		15,524	155	15,679	

		QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
15_00.53.BA	Westmoreland Chan Water Ctrl Str					
15_00.53.BA_ AA	Concrete	5.00 CY	1,756	18	1,774	354.76
15_00.53.BA_ BA	Reinforcing Steel	511.00 LB	327	3	330	0.65
15_00.53.BA_ CA	Sliding Weir Gate (72" x 48")		7,205	72	7,277	
	TOTAL Westmoreland Chan Water Ctrl Str		9,288	93	9,381	
15_00.53.CA	Shadrach Channel Water Ctrl Str					
15_00.53.CA_ AA	Concrete	1.70 CY	597	6	603	354.76
15_00.53.CA_ BA	Reinforcing Steel	85.00 LB	54	1	55	0.65
15_00.53.CA_ CA	Sliding Weir Gate (36" x 48")		4,500	45	4,545	
	TOTAL Shadrach Channel Water Ctrl Str		5,152	52	5,203	
	TOTAL Gated Water Control Structure	1.00	45,964	460	46,423	46423
15_00.99	Associated General Items					
15_00.99.02	Seeding and Mulching					
15_00.99.02_ 01	Seeding & Mulching,LedbetterSump	1.03 AC	3,306	33	3,339	3242.10
15_00.99.02_ 02	Seeding&Mulching,WestmorelandSmp	25000 SY	16,500	165	16,665	0.67
15_00.99.02_ 05	Seeding & Mulching,ShadrackChanl	6170.00 SY	4,072	41	4,113	0.67
15_00.99.02_ 06	Seeding & Mulching,Pavaho Sump	9000.00 SY	1,080	11	1,091	0.12
	TOTAL Seeding and Mulching		24,959	250	25,208	
15_00.99.05	Reforestation					
15_00.99.05_ 01	Reforestation (1),Ledbetter Sump	4.48 AC	17,920	179	18,099	4040.00
15_00.99.05_ 02	Reforestation (2),Ledbetter Sump	5.39 AC	3,153	32	3,185	590.85
15_00.99.05_ 03	Reforestation (1), Westmoreland	22.40 AC	89,600	896	90,496	4040.00
15_00.99.05_ 04	Reforestation (2), Westmorerland	17.38 AC	10,167	102	10,269	590.85
15_00.99.05_ 05	Reforestation (1), Shadrack Chan	1.09 AC	4,360	44	4,404	4040.00
15_00.99.05_ 06	Reforestation (1), Pavaho Sump	7.00 AC	26,320	263	26,583	3797.60
15_00.99.05_ 07	Reforestation (1), Fish TrapLake	18.93 AC	75,720	757	76,477	4040.00
15_00.99.05_ 08	Reforestation (2), Fish TrapLake	5.65 AC	3,305	33	3,338	590.85
	TOTAL Reforestation		230,546	2,305	232,851	
15_00.99.16	Relocate Guy Wire @ Shadrack Chn					
15_00.99.16_ 01	Relocate Guy Wire		1,065	11	1,076	
	TOTAL Relocate Guy Wire @ Shadrack Chn		1,065	11	1,076	

	QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
15_00.99.17 Modify Curb&Guard Fnc@ShadrackCh					
15_00.99.17_ 01 Modify Curb & Guard Fence		2,135	21	2,156	
TOTAL Modify Curb&Guard Fnc@ShadrackCh		2,135	21	2,156	
TOTAL Associated General Items	1.00	258,704	2,587	261,291	261291
TOTAL Floodway Control-Diversion Struc	1.00	961,579	9,616	971,195	971195
TOTAL Floodway Control-Diversion Struc		961,579	9,616	971,195	
30 Planning, Engineering and Design					
30_23 Constructn Contracts(s) Documnts					
30_23.01 Plans and Specifications (P&S)					
30_23.01.02 Plans and Specifications		225,000	2,250	227,250	
TOTAL Plans and Specifications (P&S)		225,000	2,250	227,250	
30_23.04 Environmental Studies Documents					
30_23.04.12 All Other Environmentl Documents					
30_23.04.12_ 01 Environmental/Cultural Complianc		5,000	50	5,050	
30_23.04.12_ 02 Monitoring		18,739	187	18,926	
TOTAL All Other Environmentl Documents		23,739	237	23,976	
TOTAL Environmental Studies Documents	1.00 EA	23,739	237	23,976	23976
30_23.07 Cost Estimates					
30_23.07.03 Project Cost Estimate					
30_23.07.03_ 01 Cost Engineering		15,000	150	15,150	
TOTAL Project Cost Estimate		15,000	150	15,150	
TOTAL Cost Estimates		15,000	150	15,150	
30_23.09 Real Estate Acquisition Coord.					
30_23.09.01 Real Estate Acquisition Coord.		20,000	200	20,200	

	QUANTY UOM	DIRECT	Escalatn	TOTAL COST	UNIT
TOTAL Real Estate Acquisition Coord.		20,000	200	20,200	
30_23.10 Engn. & Design During Const.					
30_23.10.01 Engineering & Design During		56,130	561	56,691	
TOTAL Engn. & Design During Const.	1.00 EA	56,130	561	56,691	56691
30_23.14 Management Documents					
30_23.14.04 All Other Management Documents		7,500	75	7,575	
TOTAL Management Documents		7,500	75	7,575	
30_23.16 Contract Advertisement and Award					
30_23.16.01 Contract Advertisement and Award		7,500	75	7,575	
TOTAL Contract Advertisement and Award		7,500	75	7,575	
30_23.18 Detailed Project Report					
30_23.18. 1 Detailed Project Report		274,700	0	274,700	
TOTAL Detailed Project Report		274,700	0	274,700	
TOTAL Constructn Contracts(s) Documnts	1.00 EA	629,569	3,549	633,118	633118
TOTAL Planning, Engineering and Design	1.00	629,569	3,549	633,118	633118
31 Construction Management					
31_23 Construction Contracts					
31_23.11 Supervision and Administration					
31_23.11.01 Prjt Office Supervn and Adminstn		84,200	842	85,042	
TOTAL Supervision and Administration		84,200	842	85,042	
TOTAL Construction Contracts	1.00	84,200	842	85,042	85042
31_25 Monitoring					
31_25.12 Monitoring					

	QUANTY	UOM	DIRECT	Escalatn	TOTAL COST	UNIT
31_25.12.14 Monitoring			18,700	0	18,700	
TOTAL Monitoring			18,700	0	18,700	
TOTAL Monitoring			18,700	0	18,700	
TOTAL Construction Management	1.00	EA	102,900	842	103,742	103742
TOTAL Old Trinity River DPR(Revised 2)			2,463,607	15,707	2,479,314	
Contingency					516,506	
TOTAL INCL OWNER COSTS					2,995,820	

ANNEX F
REAL ESTATE PLAN

REAL ESTATE PLAN

OLD TRINITY RIVER CHANNEL ECOSYSTEM RESTORATION PROJECT DALLAS COUNTY, TEXAS

1. PURPOSE

The following Real Estate Plan (REP) supports the feasibility study and describes the acquisition of lands, easements, and right of way (LER) to be acquired for the Old Trinity River Channel Ecosystem Restoration Project. The project is authorized under Section 1135 of Public Law 99-662, Water Resources Development Act of 1986, as amended (33 USC 2201). The City of Dallas will be the sponsor for this project. The project is located in west-central Dallas along the Elm Fork, West Fork, and the mainstream of the Trinity River. There are three distinct segments where environmental restoration measures are proposed: the Old Trinity River Channel, the Shadrack Channel and the Pavaho Sump. (Note: The term "sump" as is used in this report refers to land areas, outside the flood control levees, that are set aside for temporary storage of local drainage. Conduits through the levees connect these storage areas with the modified river channel within the floodway. Local rainfall runoff is stored in the "sumps" until the flows in the floodway recede.) This is the original Real Estate Plan for this project.

2. LAND, EASEMENT, AND RIGHT OF WAY FOR THE RECOMMENDED PLAN. THE CITY OF DALLAS WILL ACQUIRE LANDS AND EASEMENTS.

FEE LAND OWNERSHIP	EASEMENT OWNERSHIP
45.04 acres with minerals	65 acres

3. COST SHARE OF PROJECT

Estimated values of Lands, Easements, and Rights of Way:

ESTATE	ACRES	ESTIMATED VALUE
Fee Lands	45.04	$ 210,656
Minerals		$ 4,504
Damages		$ 19,662
Temporary Easements	65.00	$ 100,623
Contingency		$ 83,861
TOTAL		$ 419,306

Project Segments

Old Trinity River Channel		
Fee Land	$	177,690
Minerals	$	3,931
Damages	$	18,162
Temporary Easements	$	12,822
Contingency	$	53,151
Segment Total	**$**	**265,756**
Shadrack Channel Wetlands		
Fee Land	$	14,584
Minerals	$	362
Damages	$	1,500
Temporary Easements	$	29,497
Contingency	$	11,486
Segment Total	**$**	**57,429**
Pavaho Sump Wetlands		
Fee land	$	18,382
Minerals	$	211
Damages	$	-0-
Temporary Easements	$	58,304
Contingency	$	19,224
Segment Total	**$**	**96,121**

The cost-share for this restoration project is 75% Federal and 25% for City of Dallas.

4. NON-STANDARD ESTATES

There are no non-standard estates associated with this project.

5. EXISTING FEDERAL PROJECT

There is no existing Federal project that lies fully or partially within the LER required for this project.

6. FEDERALLY OWNED LAND

There are no Federally owned lands associated with this project.

7. NAVIGATIONAL SERVITUDE

This project is outside of the original Trinity River channel system. This project will have no effect on the navigational servitude of the Trinity River. All lands appraised and to be acquired are outside of navigational servitude area.

8. PROJECT AREA

See attached maps indicating project area. There are no dwellings, utilities, or facilities to be relocated within the project area at Government expense.

9. FLOODING OF PROJECT AREA

There will be no induced flooding to private property caused by the construction, operation, and maintenance of the Project.

10. BASELINE COST ESTIMATE FOR REAL ESTATE

Property values included in the cost estimate are based on a Supplemental Gross Appraisal dated April 8, 2002, prepared by Randy L. Roberts and approved by Rocky D. Lee, MAI, SRA., of the Real Estate Division, Fort Worth District. The Fort Worth District Planning and Control Branch staff estimated administrative costs. Contingencies have been added to the cost estimates as follows:

01.23.03.01 Real Estate Planning Documents, 10% based on reasonable certainty of costs.

01.23.01.02 Real Estate Acquisition Documents, 10% based on reasonable certainty.

01.23.03.03 Real Estate Condemnation Documents, 25% based on expectation of at least two condemnations.

01.23.03.05 Real Estate Appraisal Documents, 25% based on reasonable certainty of contract costs.

01.23.03.15 Real Estate Payment Documents, 25% based on contingencies assigned by the Appraiser in the Gross Appraisal.

01.23.03.17 Real Estate LERRD Accounting Documents, 25% based on reasonable certainty regarding accounting requirements.

Estimates are presented in the standard Code of Accounts from MCACES Models Database, October 1994. Costs are presented as follows:

ACCOUNT	DESCRIPTION	ESTIMATE	CONTINGENCY
01.23.03.01	RE Planning Documents	$10,000	$1,000
01.23.03.02	RE Acquisition Documents		
	Acquisition by Local Sponsor	$40,000	$4,000
	Review by Local Sponsor	$ 2,000	$ 200
01.23.03.03	RE Condemnation Documents		
	Condemnation by Sponsor	$63,600	$15,900
	Review by Sponsor	$ 4,000	$ 1,000
01.23.03.05	RE Appraisal Documents		
	Appraisal by Sponsor	$106,000	$26,500
	Review by Sponsor	$26,500	$ 6,625
01.23.03.15	RE Payment Documents		
	Payment by Sponsor	$ 335,445	$83,861
	Review by Sponsor	$ 10,000	$ 2,500
01.23.03.17	RE LERRD Accounting Documents	$ 2,000	$ 500
	TOTAL ADMIN AND PAYMENTS	**$ 599,545**	
	TOTAL CONTINGENCY		**$ 142,086**
	GRAND TOTAL	**$741,631**	

11. RELOCATION ASSISTANCE PROGRAM P.L. 91-646

There are no dwellings, facilities, or utilities to relocate in the project area; therefore there is no relocation assistance program.

12. MINERAL AND TIMBER ACTIVITY

There is no mineral exploration, production activity, or merchantable timber in the project area. The project area is zoned by the city and therefore no mineral, production, or timber activity is permitted.

13. COST SHARED PROJECT

The City of Dallas will acquire all required lands associated with this restoration project. The City of Dallas has authority to acquire the lands needed for the project.

14. ENACTMENT OF ZONING ORDINANCES

There are no special zoning ordinances proposed to be enacted in connection with this project.

15. LAND ACQUISITION

There are fifty-four land acquisitions required for completion of the project. The easement area of 65 acres is for disposal of sediment, etc, and storage area for equipment. Attached is a listing of the land to be acquired.

16. FACILITY OR UTILITY RELOCATIONS

There will be no relocation of facilities or utilities in connection with this project at Government cost. Our Attorney's Opinion states "The foot bridge located in Tipton Park is within navigable servitude and therefore the city of Dallas is responsible for the cost to relocate the bridge".

17. CONTAMINANTS ON REAL ESTATE ACQUISITIONS

There are no known HTRW lands on the project area.

18. OPPOSITION BY LANDOWNERS IN PROJECT AREA

No landowners in the project area have come forward to give positive or negative responses concerning this project.

19. LAND ACQUISITION PRIOR TO PCA

The project sponsor has been informed not to purchase any property prior to the PCA being signed.

20. RELEVANT ISSUES

There are no real estate issues relevant to planning, designing, or implementing this project.

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY OLD TRINITY RIVER CHANNEL ECOSYSTEM RESTORATION PROJECT

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? Yes

b. Does the sponsor have the power of eminent domain for this project? Yes

c. Does the sponsor have "quick-take" authority for this project? Yes

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? No

e. Are any of the lands/interests in land required for project owned by an entity whose property the sponsor cannot condemn? No

II. Human Resources Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P. L. 91-646, as amended? No

b. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? Yes

c. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? Yes

d. Can the sponsor obtain contractor support, if required in a timely fashion? Yes

e. Will the sponsor likely request USACE assistance in acquiring real estate? No

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? Yes

b. Has the sponsor approved the project/real estate schedule/milestones? Yes

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? Yes

b. With regard to this project, the sponsor is anticipated to be: Highly Capable

V. Coordination:

a. Has the assessment been coordinated with the sponsor? Yes

b. Does the sponsor concur with this assessment? Yes

Prepared By:

Russ Hendricks

Russ Hendricks
Real Estate Specialist
Project Manager
Fort Worth District

6 May 2003
Date

Reviewed and Approved By:

Bobby J. Camp

Bobby J. Camp
Assistant Chief, Real Estate Division
Fort Worth District

6 May 2003
Date

ESTATES

The following estates, as they appear in ER 405-1-12 Chapter 5 Figure 6, will be utilized for this project.

1. FEE.
The fee simple title to (the land described in Schedule A) (Tracts Nos. ____, ____ and ____), subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

15. TEMPORARY WORK AREA EASEMENT.
A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ____), for a period not to exceed ______________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove structures on the land and to perform any other work necessary and incident to the construction of the ___________________ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, stuctures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Tract No.	Tract No. Ext	Property Address	Legal Description	Partial or Whole Taking	Zoning
Old Trinity River Channel					
100	0	3650 Bernal Dr	7154 Tr 1	Partial	IR
101	1	3520 Bernal Dr	7149 Lot A Bernal to Old Trinity Riverbed	Whole	R-5(A)
101	2	Shadrack Dr	7148 Blk 7 Lots 3-13	Whole	R-5(A)
101	3	Shadrack Dr	7148 Blk 6 Lots 2-11	Whole	R-5(A)
101	4	Shadrack Dr	7148 Blk 8 Lots 8-25	Whole	R-5(A)
101	6	Bernal	7155 - City Park lands	Whole	
101	7	Bernal	7150 - City Park Lands	Whole	
102	1	3622 Homeland St	7148 Blk 5 Lot 12	Whole	R-5(A)
102	2	3614 Homeland St	7148 Blk 5 Lot 10	Whole	R-5(A)
102	3	3606 Homeland St	7148 Blk 5 Lot 8 & 7	Whole	R-5(A)
102	4	3611 Crane St	7148 Blk 5 Lot 4	Whole	R-5(A)
102	5	3619 Crane St	7148 Blk 5 Lot 2	Whole	R-5(A)
102	8	3606 Crane St	7148 Blk 4 Lot 8	Whole	R-5(A)
102	13	3606 Bickers St	7148 Blk 3 Lot 16	Partial	R-5(A)
102	14	3542 Bickers St	7148 Blk 3 Lot 14	Partial	R-5(A)
102	15	3534 Bickers St	7148 Blk 3 Lot 12	Partial	R-5(A)
103	1	3618 Homeland St	7148 Blk 5 Lot 11	Partial	R-5(A)
103	2	3611 Homeland St	7148 Blk 5 Lot 9	Whole	R-5(A)
104	1	3603 Crane St	7148 Blk 5 Lot 5 & 6	Whole	R-5(A)
104	4	3602 Crane St	7148 Blk 4 Lot 7	Whole	R-5(A)
104	5	3607 Bickers St	7148 Blk 4 Lot 5	Whole	R-5(A)
104	7	3538 Bickers St	7148 Blk 3 Lot 13	Partial	R-5(A)
104	8	3530 Bickers St	7148 Blk 3 Lot 11	Partial	R-5(A)
104	9	3606 Shadrack Dr	7148 Blk 8 Lot 2 & 3	Whole	R-5(A)
104	10	3618 Shadrack Dr	7148 Blk 8 Lot 5	Whole	R-5(A)
104	11	3628 Shadrack Dr	7148 Blk 8 Lot 7	Whole	R-5(A)
106	2	3602 Shadrack Dr	7148 Blk 8 Lot 1	Whole	R-5(A)
106	3	3614 Shadrack Dr	7148 Blk 8 Lot 4	Whole	R-5(A)
106	4	3622 Shadrack Dr	7148 Blk 8 Lot 6	Whole	R-5(A)
107	0	3603 Bickers St	7148 Blk 4 Lot 6	Whole	R-5(A)
110	0	3602 Bickers St	7148 Blk 3 Lot 15	Whole	R-5(A)
116	0	3435 Bickers St	7145 Blk 11 Lot 13	Partial	R-5(A)
123	0	2600 Bickers St	7135	Partial	PD
124	0	3804 Delhi St	7142 Blk 1 Lot 14	Partial	R-5(A) FP
125	0	3910 Delhi St	7141 Blk B Lots 7 & 8	Partial	R-5(A) FP
126	0	3918 Delhi St	7141 Blk B Lot 9	Partial	R-5(A) FP
131	0	3115 Angelina Dr	7138 Blk 2 Lot 26	Whole	R-5(A)
133	0	4010 Baker Ave	7138 Blk 2 Lot 23	Partial	R-5(A)
134	0	4016 Baker Ave	7138 Blk 2 Lot 22	Partial	R-5(A)
135	0	4022 Baker Ave	7138 Blk 2 Lot 21	Partial	R-5(A)
136	0	4024 Baker Ave	7138 Blk 2 Lot 20	Partial	R-5(A)
137	3	4030 Baker Ave	7138 Blk 2 Lot 19	Partial	R-5(A)
138	0	4036 Baker Ave	7138 Blk 2 Lot 18	Partial	R-5(A)
140	0	4105 Pointer St	7138 Blk 2 Lots 12 & 13	Partial	R-5(A) FP
143	0	2914 Angelina Dr	7138 Blk 6 Lots 1, 2 & 3	Partial	R-5(A) FP
144	0	3900 Bosque Ave	7136 Part of Tr 42	Whole	R-5(A)

Shadrack Channel					
106	5	3439 Bickers St	7145 Blk 11 Lot 14-16	Partial	R-5(A)
111	0	3531 Furey St	7145 Blk 15 Lot 5	Partial	R-5(A)
112	0	3535 Furey St	7145 Blk 15 Lot 4	Partial	R-5(A)
113	0	3539 Furey St	7145 Blk 15 Lot 3	Partial	R-5(A)
114	0	3543 Furey St	7145 Blk 15 Lot 2	Partial	R-5(A)
115	0	3547 Furey St	7145 Blk 15 Lot 1	Partial	R-5(A)
152	0	3551 Furey St	7145 un-numbered	Whole	R-5(A)
Pavaho Sump					
151	0	1320 Bickers St	7119 Blk 6 Lot 4 & W 67' Lot 5	Whole	R-5(A)

Old Trinity River Channel
Ecosystem Restoration Project
Local Cooperative Project

ATTORNEY'S REPORT OF COMPENSABILITY

I, Mark B. McMurry, am an attorney employed by the Department of the Army, Fort Worth District, Corps of Engineers, and am authorized to pass on the sufficiency of title to land under the delegation of authority issued by the Attorney General of the United States on 2 October 1970, as amended, and implemented by the Department of the Army. I have investigated the potential need for relocation of public improvements to the subject Old Trinity River Channel Ecosystem Restoration Local Cooperation Agreement Project affected by the project described in paragraph I. and hereby report as follows:

I. THE PROJECT

The proposed Old Trinity River Channel Ecosystem Restoration Local Cooperation Agreement Project is located within the City of Dallas, Texas, the anticipated sponsor. The feasibility study is being done under authority of Section 1135 of Public Law 99-662, the Water Resources Development Act of 1986, as amended, which allows the Secretary of the Army to review water resource projects to determine the need for modifications for such environmental purposes. The principal purpose is to improve environmental quality in three distinct segments of the existing Dallas Floodway Project: the Old Trinity River Channel, the Shadrack Channel and the Pavaho Sump. The Trinity River is a navigable stream from Riverside Drive in Fort Worth to the mouth of the river at the Gulf of Mexico.

In West Dallas, a portion of the old Trinity River channel parallels the modified main stem of the Trinity River, outside of the protected area of the south levee. This old river channel provides for local drainage as part of the Dallas Floodway Project sump system. The proposed project would improve the riparian habitat of this segment by creating new wetlands along the channel by planting desirable bottomland hardwood species in open areas along the channel banks, and by improvement of existing forest areas through planting of high quality tree and brush species and providing nesting and hiding structure. In addition, the proposed project will improve the drainage of the old river channel to the Dallas Floodway Project sump system.

II. FACILITIES AFFECTED

The environmental mitigation work along the Old Trinity River Channel portion of the project is located within the bounds of Tipton Park, a park owned by the local sponsor. The proposed project includes the relocation of a pedestrian bridge over the old Trinity River channel.

III. NECESSITY FOR RELOCATION

From the data and maps provided by the Fort Worth District, in partnership with the City of Dallas, Texas, and as a result of my investigation, the Old Trinity River Channel Ecosystem Restoration Local Cooperation Agreement Project will necessitate the alteration of the aforementioned facility.

IV. SOURCE OF TITLE

The proposed relocation of the pedestrian bridge will take place completely within the bounds of Tipton Park, which is owned by the City of Dallas, which is the local sponsor of this project. No acquisition of fee, easements or permits will be required.

V. GOVERNMENT'S LIABILITY

Under the Commerce Clause of the United States Constitution, the United States has a dominant servitude which resides in all navigable waters, the so-called "Navigable Servitude". *United States v. Holt State Bank,* 270 U.S. 49, 54-55 (1926). Under this doctrine, the United States has the right to take, damage or destroy private property, without payment of compensation, when the property is subject to this dominant servitude and the Government is acting in the interest of improvement or maintenance of navigation under the Commerce Power of the Constitution. *Union Bridge Co. v. United States,* 204 U.S. 364 (1907); *Louisville Bridge Co. v. United States,* 242 U.S. 409 (1917).

As of April 30, 1975, the Trinity River was determined to be navigable from River Mile 182.7 to 551.2. *Navigability Study: Trinity River, Tributaries (River Mile 182.7 to 715.0),* U.S. Army Corps of Engineers (April 1975). Navigability in law means navigability in fact. *Holt State Bank,* 270 U.S. at 56. Once navigable, a waterway is always considered navigable. If a waterway is susceptible of being used for navigation under normal conditions in the light of the effect of reasonable improvements, the waterway is considered navigable. *United States v. Appalachian Power Co.,* 311 U.S. 377 (1940). Former riverbeds and cut offs, such as the original Trinity River channel, remain navigable in law.

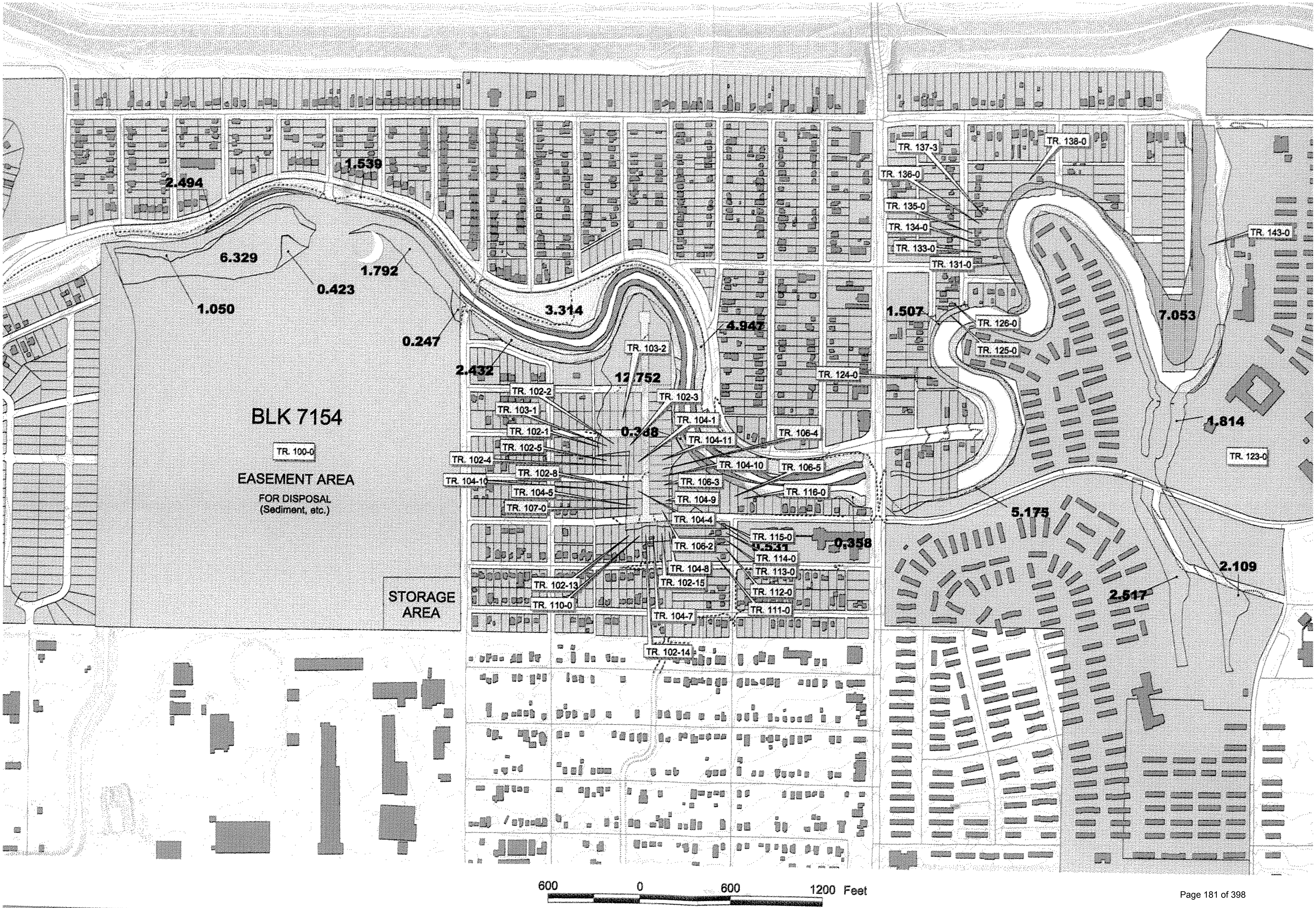
The Government is considered to be acting within its navigational servitude powers when it is acting in connection with the improvement or maintenance of navigation, when it is acting in connection with a power project, and when it is acting in connection with a flood control project. In the instant case, the environmental mitigation is being performed in connection with the Dallas Floodway Project. The project is being designed not only to improve the environmental quality of the old Trinity River channel, but it is also being designed to improve the flow of flood waters from Tipton Park and the surrounding residential areas to the Dallas Floodway Project sump station. The old bridge to be replaced is low and is known to trap debris, impeding the flow of floodwaters through the channel. The new bridge will be designed to facilitate the flow of floodwaters through the channel, among other things. It appears that the relocation of the bridge has a sufficient nexus with the flood control mission of the Dallas Floodway Project to invoke the government's power under the navigational servitude.

Pursuant to the Commerce Clause of the United States Constitution, the United States is not obligated to compensate the City of Dallas for relocation of the bridge over the old Trinity River channel. The bridge is located over the navigable rivers of the United States and the relocation is being undertaken in connection with a flood control project, namely the Dallas Floodway Project.

Respectfully submitted,

Mark B. McMurry
Attorney, Real Estate Division
Fort Worth District
U.S. Army Corps of Engineers

10 March 2003


BLK 7154
TR. 100-0
EASEMENT AREA
FOR DISPOSAL
(Sediment, etc.)
STORAGE
AREA
2.494
1.539
6.329
0.423
1.792
1.050
0.247
3.314
2.432
4.947
12.752
0.388
1.507
7.053
1.814
5.175
0.358
2.109
2.517
TR. 103-2
TR. 102-2
TR. 102-3
TR. 103-1
TR. 104-1
TR. 102-1
TR. 104-11
TR. 106-4
TR. 102-5
TR. 102-4
TR. 104-10
TR. 106-5
TR. 102-8
TR. 104-10
TR. 106-3
TR. 104-5
TR. 116-0
TR. 104-9
TR. 107-0
TR. 104-4
TR. 115-0
TR. 106-2
TR. 114-0
TR. 104-8
TR. 113-0
TR. 102-13
TR. 102-15
TR. 112-0
TR. 110-0
TR. 111-0
TR. 104-7
TR. 102-14
TR. 137-3
TR. 138-0
TR. 136-0
TR. 135-0
TR. 134-0
TR. 133-0
TR. 131-0
TR. 143-0
TR. 126-0
TR. 125-0
TR. 124-0
TR. 123-0
600
0
600
1200 Feet

ANNEX G
DRAFT PROJECT COOPERATION AGREEMENT

8/21/03

DRAFT

PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE CITY OF DALLAS, TEXAS
FOR MODIFICATION OF THE
OLD TRINITY PROJECT
(DALLAS FLOODWAY PROJECT)
DALLAS, TEXAS

THIS AGREEMENT is entered into this _________ day of ______________, 20 __, by and between the Department of the Army (hereinafter the "Government"), represented by the U.S. Army Engineer for the Fort Worth District (hereinafter the "District Engineer") and the city of Dallas (hereinafter the "Non-Federal Sponsor"), represented by the City Manager.

WITNESSETH, THAT:

WHEREAS, the Secretary of the Army completed construction of the Dallas Floodway Project (hereinafter the "Existing Project", as defined in Article I.A. of this Agreement) in 1959;

WHEREAS, modification of the Existing Project is authorized by Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662, as amended;

WHEREAS, the Government and the Non-Federal Sponsor desire to enter into a Project Cooperation Agreement for implementation of the Dallas Floodway Project Modification (hereinafter the "Project Modification", as defined in Article I.B. of this Agreement);

WHEREAS, Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, specifies the cost-sharing requirements applicable to this Project Modification;

WHEREAS, the Government and Non-Federal Sponsor have the full authority and capability to perform as hereinafter set forth and intend to cooperate in cost-sharing and financing of the implementation of the Project Modification in accordance with the terms of this Agreement.

NOW, THEREFORE, the Government and the Non-Federal Sponsor agree as follows:

ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

A. The term "Existing Project" shall mean the Dallas Floodway Project originally authorized by the River and Harbor Act of 1945and 1950. The "Existing Project" consists of improvement to approximately 23 miles of existing levees (constructed by local interests 1928-1932), Trinity River channel improvements, clearing the floodway channel, installation and modification of drainage structures, construction of pressure sewers and pump stations, and construction and modification of interior drainage (sump) facilities.

B. The term "Project Modification" shall mean (1) the restoration of 23.93 acres of emergent wetlands; (2) improvement of the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands; (3) the reforestation of 53.48 acres of open space to bottomland hardwoods; (4) the relocation of a pedestrian bridge (215-feet in length, 12-feet wide) in Tipton Park, and (5) construction of a concrete recreation trail (975-feet in length, and 6-feet in width) adjacent to the Pavaho sump wetland. All the project modification features are located in west Dallas in proximity of a portion of the Old Trinity River located downstream of the confluence of the West Fork Trinity River and the Elm Fork Trinity River, adjacent to the main stem of the Trinity River, about 8 miles west of downtown Dallas, Texas. The project modification is as generally described in the Detailed Project Report and Integrated Environmental Assessment For Old Trinity River Channel Ecosystem Restoration, Dallas, Texas, dated May, 2003, and approved by the **[TITLE OF THE APPROVING OFFICIAL]**, on __________, 200___.

C. The term "ecosystem restoration features" shall mean (1) the restoration of 23.93 acres of emergent wetlands; (2) improvement of the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands; (3) the reforestation of 53.48 acres of open space to bottomland hardwoods.

D. The term "recreation features" shall mean (1) the relocation of a pedestrian bridge (215-feet in length, 12-feet wide) in Tipton Park , and (2) construction of a concrete recreation trail (975-feet in length, and 6-feet in width) adjacent to the Pavaho sump wetland. All recreation features are located on ecosystem restoration lands.

E. The term "total project modification costs" shall mean all costs incurred by the Non-Federal Sponsor and the Government in accordance with the terms of this Agreement directly related to implementation of the Project Modification. Subject to the provisions of this Agreement, the term shall include, but is not necessarily limited to, feasibility phase planning costs; all engineering and design costs, including those incurred in the feasibility phase; the costs of investigations to identify the existence and extent of hazardous substances in accordance with Article XV.A. of this Agreement; the costs incurred by the Government for clean-up and response in accordance with Article XV.C. of this Agreement; costs of historic preservation activities in accordance with Article XVIII.A. of this Agreement; actual implementation costs; supervision and administration costs; costs of participation in the Project Coordination Team in accordance with Article V of this Agreement; costs of contract dispute settlements or awards; the value of lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas for which the Government affords credit in accordance with Article IV of this Agreement; and costs of audit in accordance with Article X of this Agreement. The term does not include any costs for operation, maintenance, repair, replacement, or rehabilitation; any costs due to betterments; or any costs of dispute resolution under Article VII of this Agreement.

F. The term "total project ecosystem restoration costs" shall mean that portion of the total project modification costs that the Government assigns to the ecosystem restoration features.

G. The term "total project recreation costs" shall mean that portion of the total project modification costs that the Government assigns to the recreation features. The Government shall also delineate that portion of total project recreation costs that result from recreation features constructed on ecosystem restoration features lands.

H. The term "financial obligation for implementation" shall mean a financial obligation of the Government, other than an obligation pertaining to the provision of lands, easements, rights-of-way, relocations, and borrow and dredged or excavated material disposal areas, that results or would result in a cost that is or would be included in total project modification costs.

I. The term "implementation" shall mean all actions required to carry out the Project Modification including all actions required for modification in operations of the Existing Project.

J. The term "non-Federal proportionate share" shall mean the ratio of the Non-Federal Sponsor's total cash contribution required in accordance with Article II.D.2. of this Agreement to total financial obligations for implementation as projected by the Government.

K. The term "period of implementation" shall mean the time from the effective date of this Agreement to the date that the District Engineer notifies the Non-Federal Sponsor in writing of the Government's determination that implementation of the Project Modification is complete.

L. The term "highway" shall mean any public highway, roadway, street, or way, including any bridge thereof.

M. The term "relocation" shall mean providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway or other public facility, or railroad when such action is authorized in accordance with applicable legal principles of just compensation. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

N. The term "fiscal year" shall mean one fiscal year of the Government. The Government fiscal year begins on October 1 and ends on September 30.

O. The term "functional portion of the Project Modification" shall mean a portion of the Project Modification that is suitable for tender to the Non-Federal Sponsor to operate and maintain in advance of completion of the entire Project Modification. For a portion of the Project Modification to be suitable for tender, the District Engineer must notify the Non-Federal Sponsor in writing of the Government's determination that the portion of the Project Modification is complete and can function independently and for a useful purpose, although the balance of the Project Modification is not complete.

P. The term "betterment" shall mean a change in the design and construction of an element of the Project Modification resulting from the application of standards that the Government determines exceed those that the Government would otherwise apply for accomplishing the design and construction of that element.

ARTICLE II - OBLIGATIONS OF THE GOVERNMENT AND THE NON-FEDERAL SPONSOR

A. The Government, subject to the availability of funds and using those funds and funds provided by the Non-Federal Sponsor, shall expeditiously implement the Project Modification, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

1. The Government shall afford the Non-Federal Sponsor the opportunity to review and comment on the solicitations for all contracts, including relevant plans and specifications, prior to the Government's issuance of such solicitations. The Government shall not issue the solicitation for the first contract for implementation until the Non-Federal Sponsor has confirmed in writing its willingness to proceed with the Project Modification. To the extent possible, the Government shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract modifications, including change orders, prior to the issuance to the contractor of a Notice to Proceed. In any instance where providing the Non-Federal Sponsor with notification of a contract modification or change order is not possible prior to issuance of the Notice to Proceed, the Government shall provide such notification in writing at the earliest date possible. To the extent possible, the Government also shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract claims prior to resolution thereof. The Government shall consider in good faith the comments of the Non-Federal Sponsor, but the contents of solicitations, award of contracts, execution of contract modifications, issuance of change orders, resolution of contract claims, and performance of all work on the Project Modification (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Government.

2. Throughout the period of implementation, the District Engineer shall furnish the Non-Federal Sponsor with a copy of the Government's Written Notice of Acceptance of Completed Work for each contract for the Project Modification.

B. The Non-Federal Sponsor may request the Government to accomplish betterments. Such requests shall be in writing and shall describe the betterments requested to be accomplished. If the Government in its sole discretion elects to accomplish the requested betterments or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs due to the requested betterments and shall pay all such costs in accordance with Article VI.C. of this Agreement.

C. When the District Engineer determines that the entire Project Modification is complete or that a portion of the Project Modification has become a functional portion of the Project Modification, the District Engineer shall so notify the Non-Federal Sponsor in writing and furnish the Non-Federal Sponsor with an Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (hereinafter the "OMRR&R Manual") and with copies of all of the Government's Written Notices of Acceptance of Completed Work for all contracts for the Project Modification or the functional portion of the Project Modification that have not been provided previously. Upon such notification, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project Modification or the functional portion of the Project Modification in accordance with Article VIII of this Agreement.

D. The Non-Federal Sponsor shall contribute 25 percent of total project ecosystem restoration costs in accordance with the provisions of this paragraph.

1. In accordance with Article III of this Agreement, the Non-Federal Sponsor shall provide all lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the Non-Federal Sponsor must provide for the implementation, operation, and maintenance of the ecosystem restoration features, and shall perform or ensure performance of all relocations that the Government determines to be necessary for the implementation, operation, and maintenance of the ecosystem restoration features.

2. If the Government projects that the value of the Non-Federal Sponsor's contributions under paragraph D.1. of this Article and Articles V, X, and XV.A. of this Agreement will be less than 25 percent of total project ecosystem restoration costs, the Non-Federal Sponsor shall provide an additional cash contribution, in accordance with Article VI.B. of this Agreement, in the amount necessary to make the Non-Federal Sponsor's total contribution equal to 25 percent of total project ecosystem restoration costs.

3. If the Government determines that the value of the Non-Federal Sponsor's contributions provided under paragraphs D.1. and D .2. of this Article and Articles V, X, and XV.A. of this Agreement has exceeded 25 percent of total project ecosystem restoration costs, the Government, subject to the availability of funds, shall reimburse the Non-Federal Sponsor for any such value in excess of 25 percent of total project ecosystem restoration costs. After such a determination, the Government, in its sole discretion, may provide any remaining Project ecosystem restoration features lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas and perform any remaining Project ecosystem restoration features relocations on behalf of the Non-Federal Sponsor. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government under this paragraph, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

E. The Non-Federal Sponsor shall contribute a minimum of 50 percent of total modification recreation costs in accordance with the provisions of this paragraph. To the extent that the Federal share of total project modification recreation costs exceeds an amount equal to 10 percent of the Federal share of total ecosystem restoration costs, the Non-Federal Sponsor shall contribute 100 percent of such additional costs.

F. The Non-Federal Sponsor may request the Government to provide lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or perform relocations on behalf of the Non-Federal Sponsor. Such requests shall be in writing and shall describe the services requested to be performed. If in its sole discretion the Government elects to perform the requested services or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs of the requested services and shall pay all such costs in accordance with Article VI.C. of this Agreement. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government under this paragraph, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

G. The Government, in accordance with Federal Laws, regulations, and policies, shall assign all costs included or to be included in total project costs to either total project ecosystem restoration costs, or total project recreation costs.

H. The Government shall perform a final accounting in accordance with Article VI.D. of this Agreement to determine the contributions provided by the Non-Federal Sponsor in accordance with paragraphs B., D., and E. of this Article and Articles V, X, and XV.A. of this Agreement and to determine whether the Non-Federal Sponsor has met its obligations under paragraphs B., D., and E. of this Article.

I. The Non-Federal Sponsor shall not use Federal funds to meet its share of total project modification costs under this Agreement unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

ARTICLE III - LANDS, RELOCATIONS, DISPOSAL AREAS, AND PUBLIC LAW 91-646 COMPLIANCE

A. The Government, after consultation with the Non-Federal Sponsor, shall determine the lands, easements, and rights-of-way required for the implementation, operation, and maintenance of the Project Modification, including those required for relocations, borrow materials, and dredged or excavated material disposal. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of the lands, easements, and rights-of-way that the Government determines the Non-Federal Sponsor must provide, in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with acquisition of such lands, easements, and rights-of-way. Prior to the end of the period of implementation, the Non-Federal Sponsor shall acquire all lands, easements, and rights-of-way set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each construction contract, the Non-Federal Sponsor shall provide the Government with authorization for entry to all lands, easements, and rights-of-way the Government determines the Non-Federal Sponsor must provide for that contract. The Non-Federal Sponsor shall ensure that lands, easements, and rights-of-way that the Government determines to be required for the operation and maintenance of the Project Modification and that were provided by the Non-Federal Sponsor are retained in public ownership for uses compatible with the authorized purposes of the Project Modification.

B. The Government, after consultation with the Non-Federal Sponsor, shall determine the improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the implementation, operation, and maintenance of the Project Modification. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and de-watering pumps and pipes. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions of such improvements in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with construction of such improvements. Prior to the end of the period of implementation, the Non-Federal Sponsor shall provide all improvements set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare plans and specifications for all improvements the Government determines to be required for the proper disposal of dredged or excavated material under that contract, submit such plans and specifications to the Government for approval, and provide such improvements in accordance with the approved plans and specifications.

C. The Government, after consultation with the Non-Federal Sponsor, shall determine the relocations necessary for the implementation, operation, and maintenance of the Project Modification, including those necessary to enable the removal of borrow materials and the proper disposal of dredged or excavated material. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of such relocations in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with such relocations. Prior to the end of the period of implementation, the Non-Federal Sponsor shall perform or ensure the performance of all relocations as set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare or ensure the preparation of plans and specifications for, and perform or ensure the performance of, all relocations the Government determines to be necessary for that contract.

D. The Non-Federal Sponsor in a timely manner shall provide the Government with such documents as are sufficient to enable the Government to determine the value of any contribution provided pursuant to paragraphs A., B., or C. of this Article. Upon receipt of such documents the Government, in accordance with Article IV of this Agreement and in a timely manner, shall determine the value of such contribution, include such value in total project modification costs, and afford credit for such value toward the Non-Federal Sponsor's share of total project modification costs.

E. The Non-Federal Sponsor shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 C.F.R. Part 24, in acquiring lands, easements, and rights-of-way required for the implementation, operation, and maintenance of the Project Modification, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and shall inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - CREDIT FOR LANDS, RELOCATIONS, AND DISPOSAL AREAS

A. The Non-Federal Sponsor shall receive credit toward its share of total project modification costs for the value of the lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Non-Federal Sponsor must provide pursuant to Article III of this Agreement, and for the value of the relocations that the Non-Federal Sponsor must perform or for which it must ensure performance pursuant to Article III of this Agreement. However, the Non-Federal Sponsor shall not receive credit for the value of any lands, easements, rights-of-way, relocations, or borrow and dredged or excavated material disposal areas that have been provided previously as an item of cooperation for another Federal project, including the Existing Project. The Non-Federal Sponsor also shall not receive credit for the value of lands, easements, rights-of-way, relocations, or borrow and dredged or excavated material disposal areas to the extent that such items are provided using Federal funds unless the Federal granting agency verifies in writing that such credit is expressly authorized by statute.

B. For the sole purpose of affording credit in accordance with this Agreement, the value of lands, easements, and rights-of-way, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, shall be the fair market value of the real property interests, plus certain incidental costs of acquiring those interests, as determined in accordance with the provisions of this paragraph.

1. Date of Valuation. The fair market value of lands, easements, or rights-of-way owned by the Non-Federal Sponsor on the effective date of this Agreement shall be the fair market value of such real property interests as of the date the Non-Federal Sponsor provides the

Government with authorization for entry thereto. The fair market value of lands, easements, or rights-of-way acquired by the Non-Federal Sponsor after the effective date of this Agreement shall be the fair market value of such real property interests at the time the interests are acquired.

2. General Valuation Procedure. Except as provided in paragraph B.3. of this Article, the fair market value of lands, easements, or rights-of-way shall be determined in accordance with paragraph B.2.a. of this Article, unless thereafter a different amount is determined to represent fair market value in accordance with paragraph B.2.b. of this Article.

a. The Non-Federal Sponsor shall obtain, for each real property interest, an appraisal that is prepared by a qualified appraiser who is acceptable to the Non-Federal Sponsor and the Government. The appraisal must be prepared in accordance with the applicable rules of just compensation, as specified by the Government. The fair market value shall be the amount set forth in the Non-Federal Sponsor's appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's appraisal, the Non-Federal Sponsor may obtain a second appraisal, and the fair market value shall be the amount set forth in the Non-Federal Sponsor's second appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's second appraisal, or the Non-Federal Sponsor chooses not to obtain a second appraisal, the Government shall obtain an appraisal, and the fair market value shall be the amount set forth in the Government's appraisal, if such appraisal is approved by the Non-Federal Sponsor. In the event the Non-Federal Sponsor does not approve the Government's appraisal, the Government, after consultation with the Non-Federal Sponsor, shall consider the Government's and the Non-Federal Sponsor's appraisals and determine an amount based thereon, which shall be deemed to be the fair market value.

b. Where the amount paid or proposed to be paid by the Non-Federal Sponsor for the real property interest exceeds the amount determined pursuant to paragraph B.2.a. of this Article, the Government, at the request of the Non-Federal Sponsor, shall consider all factors relevant to determining fair market value and, in its sole discretion, after consultation with the Non-Federal Sponsor, may approve in writing an amount greater than the amount determined pursuant to paragraph B.2.a. of this Article, but not to exceed the amount actually paid or proposed to be paid. If the Government approves such an amount, the fair market value shall be the lesser of the approved amount or the amount paid by the Non-Federal Sponsor, but no less than the amount determined pursuant to paragraph B.2.a. of this Article.

3. Eminent Domain Valuation Procedure. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted after the effective date of this Agreement, the Non-Federal Sponsor shall, prior to instituting such proceedings, submit to the Government notification in writing of its intent to institute such proceedings and an appraisal of the specific real property interests to be acquired in such proceedings. The Government shall have 60 days after receipt of such a notice and appraisal within which to review the appraisal, if not previously approved by the Government in writing.

a. If the Government previously has approved the appraisal in writing, or if the Government provides written approval of, or takes no action on, the appraisal within such 60-day period, the Non-Federal Sponsor shall use the amount set forth in such appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

b. If the Government provides written disapproval of the appraisal, including the reasons for disapproval, within such 60-day period, the Government and the Non-Federal Sponsor shall consult in good faith to promptly resolve the issues or areas of disagreement that are identified in the Government's written disapproval. If, after such good faith consultation, the Government and the Non-Federal Sponsor agree as to an appropriate amount, then the Non-Federal Sponsor shall use that amount as the estimate of just compensation for the purpose of instituting the eminent domain proceeding. If, after such good faith consultation, the Government and the Non-Federal Sponsor cannot agree as to an appropriate amount, then the Non-Federal Sponsor may use the amount set forth in its appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

c. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted in accordance with sub-paragraph B.3. of this Article, fair market value shall be either the amount of the court award for the real property interests taken, to the extent the Government determined such interests are required for the implementation, operation, and maintenance of the Project Modification, or the amount of any stipulated settlement or portion thereof that the Government approves in writing.

4. Incidental Costs. For lands, easements, or rights-of-way acquired by the Non-Federal Sponsor within a five-year period preceding the effective date of this Agreement, or at any time after the effective date of this Agreement, the value of the interest shall include the documented incidental costs of acquiring the interest, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such incidental costs shall include, but not necessarily be limited to, closing and title costs, appraisal costs, survey costs, attorney's fees, plat maps, and mapping costs, as well as the actual amounts expended for payment of any Public Law 91-646 relocation assistance benefits provided in accordance with Article III.E. of this Agreement.

C. After consultation with the Non-Federal Sponsor, the Government shall determine the value of relocations in accordance with the provisions of this paragraph.

1. For a relocation other than a highway, the value shall be only that portion of relocation costs that the Government determines is necessary to provide a functionally equivalent facility, reduced by depreciation, as applicable, and by the salvage value of any removed items.

2. For a relocation of a highway, the value shall be only that portion of relocation costs that would be necessary to accomplish the relocation in accordance with the design standard that the State of Texas would apply under similar conditions of geography and traffic load, reduced by the salvage value of any removed items.

3. Relocation costs shall include, but not necessarily be limited to, actual costs of

performing the relocation; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with performance of the relocation, but shall not include any costs due to betterments, as determined by the Government, nor any additional cost of using new material when suitable used material is available. Relocation costs shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

4. Any credit afforded for the value of relocations performed within the Project Modification boundaries is subject to satisfactory compliance with applicable Federal labor laws covering non-Federal construction, including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)). Crediting may be withheld, in whole or in part, as a result of the Non-Federal Sponsor's failure to comply with its obligations under these laws.

D. The value of the improvements made to lands, easements, and rights-of-way for the proper disposal of dredged or excavated material shall be the costs of the improvements, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such costs shall include, but not necessarily be limited to, actual costs of providing the improvements; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with providing the improvements, but shall not include any costs due to betterments, as determined by the Government.

ARTICLE V - PROJECT MODIFICATION COORDINATION TEAM

A. To provide for consistent and effective communication, the Non-Federal Sponsor and the Government, not later than 30 days after the effective date of this Agreement, shall appoint named senior representatives to a Project Modification Coordination Team. Thereafter, the Project Modification Coordination Team shall meet regularly until the end of the period of implementation. The Government's Project Manager and a counterpart named by the Non-Federal Sponsor shall co-chair the Project Modification Coordination Team.

B. The Government's Project Manager and the Non-Federal Sponsor's counterpart shall keep the Project Modification Coordination Team informed of the progress of implementation and of significant pending issues and actions, and shall seek the views of the Project Modification Coordination Team on matters that the Project Modification Coordination Team generally oversees.

C. Until the end of the period of implementation, the Project Modification Coordination Team shall generally oversee the Project Modification, including issues related to design; plans and specifications; scheduling; real property and relocation requirements; real property acquisition; contract awards and modifications; contract costs; the application of and compliance with 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)) for relocations; the Government's cost projections; final inspection of the entire Project Modification or functional portions of the Project Modification; preparation of the proposed OMRR&R Manual; anticipated requirements and needed capabilities for performance of operation, maintenance, repair, replacement, and rehabilitation of the Project Modification; and other related matters.

D. The Project Modification Coordination Team may make recommendations that it deems warranted to the District Engineer on matters that the Project Modification Coordination Team generally oversees, including suggestions to avoid potential sources of dispute. The Government in good faith shall consider the recommendations of the Project Modification Coordination Team. The Government, having the legal authority and responsibility for implementation of the Project Modification, has the discretion to accept, reject, or modify the Project Modification Coordination Team's recommendations.

E. The costs of participation in the Project Modification Coordination Team shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE VI - METHOD OF PAYMENT

A. The Government shall maintain current records of contributions provided by the parties and current projections of total project modification costs and costs due to betterments. At least quarterly, the Government shall provide the Non-Federal Sponsor with a report setting forth all contributions provided to date and the current projections of total project ecosystem restoration costs, of total project recreation costs, of total costs due to betterments, of the components of total project modification costs, of each party's share of total project modification costs, of the Non-Federal Sponsor's total cash contributions required in accordance with Articles II.B., II.D., II.E., II.F., and II.G. of this Agreement, and of the non-Federal proportionate share. On the effective date of this Agreement, total project modification costs are projected to be $2,995,800, total project ecosystem restoration costs are projected to be $2,725,600, and total project recreation costs are projected to be $270,200. The Non-Federal Sponsor's contribution required under Article II.D. of this Agreement (ecosystem restoration features) is projected to be $681,400 consisting of $741,600 for real estate, and a $60,200 reimbursement by the Government to the Non-Federal Sponsor for exceeding the 25% limit. The Non-Federal Sponsor's cash contribution required under Article II.E. (recreation features) is projected to be $135,100. Such amounts are estimates subject to adjustment by the Government and are not to be construed as the total financial responsibilities of the Government and the Non-Federal Sponsor.

B. The Non-Federal Sponsor shall provide the cash contribution required under Article II.D.2. and 2.E. of this Agreement in accordance with the following provisions: Not less than 30 calendar days prior to the scheduled date for issuance of the solicitation for the first construction contract, the Government shall notify the Non-Federal Sponsor in writing of such scheduled date and the funds the Government determines to be required from the Non-Federal Sponsor to meet its projected cash contribution under Article II.D.2. and II.E. of this Agreement. Not later than such scheduled date, the Non-Federal Sponsor shall provide the Government with the full amount of the required funds by delivering a check payable to "FAO, USAED, Fort Worth District" to the U.S. Army Corps of Engineers Finance Center, ATTN: CEFC-FD-C EROC M2, 5722 Integrity Drive, Millington, TN 38054-5005 ", or verifying to the satisfaction of the Government that the Non-Federal Sponsor has deposited the required funds in an escrow or other account acceptable to the Government, with interest accruing to the Non-Federal Sponsor, or presenting the Government with an irrevocable letter of credit acceptable to the Government for the required funds, or providing an Electronic Funds Transfer of the required funds in accordance with procedures established by the Government. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government deems necessary to cover: (a) the non-Federal proportionate share of financial obligations for implementation incurred prior to commencement of the period of implementation; and (b) the non-Federal proportionate share of financial obligations for implementation as they are incurred during the period of implementation. In the event the Government determines that the Non-Federal Sponsor must provide additional funds to meet the Non-Federal Sponsor's cash contribution, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required. Within 60 calendar days thereafter, the Non-Federal Sponsor shall provide the Government with the full amount of the additional required funds through any of the payment mechanisms specified above.

C. In advance of the Government incurring any financial obligation associated with additional work under Article II.B. or II.F. of this Agreement, the Non-Federal Sponsor shall provide the Government with the full amount of the funds required to pay for such additional work through any of the payment mechanisms specified in B. of this Article. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government deems necessary to cover the Government's financial obligations for such additional work as they are incurred. In the event the Government determines that the Non-Federal Sponsor must provide additional funds to meet its cash contribution, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required and provide an explanation of why additional funds are required. Within 30 calendar days from receipt of such notice, the Non-Federal Sponsor shall provide the Government with the full amount of the additional required funds through any of the payment mechanisms specified in B. of this Article.

D. Upon completion of the Project Modification or termination of this Agreement, and upon resolution of all relevant claims and appeals, the Government shall conduct a final accounting and furnish the Non-Federal Sponsor with the results of the final accounting. The final accounting shall determine total project modification costs, each party's contribution provided thereto, and each party's required share thereof. The final accounting also shall determine costs due to betterments and the Non-Federal Sponsor's cash contribution provided pursuant to Article II.B. of this Agreement.

1. In the event the final accounting shows that the total contribution provided by the Non-Federal Sponsor is less than its required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the Non-Federal Sponsor shall, no later than 90 calendar days after receipt of written notice, make a payment to the Government of whatever sum is required to meet the Non-Federal Sponsor's required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement by delivering a check payable to "FAO, USAED, Fort Worth District" to the U.S. Army Corps of Engineers Finance Center, ATTN: CEFC-FD-C EROC M2, 5722 Integrity Drive, Millington, TN 38054-5005, or providing an Electronic Funds Transfer in accordance with procedures established by the Government.

2. In the event the final accounting shows that the total contribution provided by the Non-Federal Sponsor exceeds its required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the Government shall, subject to the availability of funds, refund the excess to the Non-Federal Sponsor no later than 90 calendar days after the final accounting is complete. In the event existing funds are not available to refund the excess to the Non-Federal Sponsor, the Government shall seek such appropriations as are necessary to make the refund.

ARTICLE VII - DISPUTE RESOLUTION

As a condition precedent to a party bringing any suit for breach of this Agreement, that party must first notify the other party in writing of the nature of the purported breach and seek in good faith to resolve the dispute through negotiation. If the parties cannot resolve the dispute through negotiation, they may agree to a mutually acceptable method of non-binding alternative dispute resolution with a qualified third party acceptable to both parties. The parties shall each pay 50 percent of any costs for the services provided by such a third party as such costs are incurred. The existence of a dispute shall not excuse the parties from performance pursuant to this Agreement.

ARTICLE VIII - OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

A. Upon notification in accordance with Article II.C. of this Agreement and for so long as the Project Modification remains authorized, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project Modification or the functional portion of the Project Modification, at no cost to the Government, in a manner compatible with the Project Modification's authorized purposes and in accordance with applicable Federal and State laws as provided in Article XI of this Agreement and specific directions prescribed by the Government in the OMRR&R Manual and any subsequent amendments thereto.

B. The Non-Federal Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor owns or controls for access to the Project Modification for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project Modification. If an inspection shows that the Non-Federal Sponsor for any reason is failing to perform its obligations under this Agreement, the Government shall send a written notice describing the non-performance to the Non-Federal Sponsor. If, after 30 calendar days from receipt of the notice, the Non-Federal Sponsor continues to fail to perform, then the Government shall have the right to enter, at reasonable times and in a reasonable manner, upon property the Non-Federal Sponsor owns or controls for access to the Project Modification for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project Modification. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Government shall operate to relieve the Non-Federal Sponsor's obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to ensure faithful performance pursuant to this Agreement.

ARTICLE IX - HOLD AND SAVE

The Non-Federal Sponsor shall hold and save the Government free from all damages arising from the implementation, operation, maintenance, repair, replacement and rehabilitation of the Project Modification, and any Project Modification-related betterments, except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE X - MAINTENANCE OF RECORDS AND AUDIT

A. Not later than 60 calendar days after the effective date of this Agreement, the Government and the Non-Federal Sponsor shall develop procedures for keeping books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement. These procedures shall incorporate, and apply as appropriate, the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 C.F.R. Section 33.20. The Government and the Non-Federal Sponsor shall maintain such books, records, documents, and other evidence in accordance with these procedures and for a minimum of three years after the period of implementation and resolution of all relevant claims arising therefrom. To the extent permitted under applicable Federal laws and regulations, the Government and the Non-Federal Sponsor shall each allow the other to inspect such books, documents, records, and other evidence.

B. Pursuant to 32 C.F.R. Section 33.26, the Non-Federal Sponsor is responsible for complying with the Single Audit Act of 1984, 31 U.S.C. Sections 7501-7507, as implemented by Office of Management and Budget (OMB) Circular No. A-133 and Department of Defense Directive 7600.10. Upon request of the Non-Federal Sponsor and to the extent permitted under applicable Federal laws and regulations, the Government shall provide to the Non-Federal Sponsor and independent auditors any information necessary to enable an audit of the Non-

Federal Sponsor's activities under this Agreement. The costs of any non-Federal audits performed in accordance with this paragraph shall be allocated in accordance with the provisions of OMB Circulars A-87 and A-133, and such costs as are allocated to the Project Modification shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

C. In accordance with 31 U.S.C. Section 7503, the Government may conduct audits in addition to any audit that the Non-Federal Sponsor is required to conduct under the Single Audit Act. Any such Government audits shall be conducted in accordance with Government Auditing Standards and the cost principles in OMB Circular No. A-87 and other applicable cost principles and regulations. The costs of Government audits performed in accordance with this paragraph shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE XI - FEDERAL AND STATE LAWS

In the exercise of their respective rights and obligations under this Agreement, the Non-Federal Sponsor and the Government agree to comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).

ARTICLE XII - RELATIONSHIP OF PARTIES

A. In the exercise of their respective rights and obligations under this Agreement the Government and the Non-Federal Sponsor each act in an independent capacity, and neither is to be considered the officer, agent, or employee of the other.

B. In the exercise of its rights and obligations under this Agreement, neither party shall provide, without the consent of the other party, any contractor with a release that waives or purports to waive any rights such other party may have to seek relief or redress against such contractor either pursuant to any cause of action that such other party may have or for violation of any law.

ARTICLE XIII - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, nor any resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XIV - TERMINATION OR SUSPENSION

A. If at any time the Non-Federal Sponsor fails to fulfill its obligations under Article II.B., II.D., II.E., VI, or XVIII.C. of this Agreement, the Assistant Secretary of the Army (Civil Works) shall terminate this Agreement or suspend future performance under this Agreement unless he determines that continuation of work on the Project Modification is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project Modification.

B. If appropriations are not available in amounts sufficient to meet the Government's share of Project Modification expenditures for the then-current or upcoming fiscal year, the Government shall so notify the Non-Federal Sponsor in writing, and 60 calendar days thereafter either party may elect without penalty to terminate this Agreement or to suspend future performance under this Agreement. In the event that either party elects to suspend future performance under this Agreement pursuant to this paragraph, such suspension shall remain in effect until such time as the Government receives sufficient appropriations or until either the Government or the Non-Federal Sponsor elects to terminate this Agreement.

C. In the event that either party elects to terminate this Agreement pursuant to this Article or Article XV of this Agreement, both parties shall conclude their activities relating to the Project Modification and proceed to a final accounting in accordance with Article VI.D. of this Agreement.

D. Any termination of this Agreement or suspension of future performance under this Agreement in accordance with this Article or Article XV of this Agreement shall not relieve the parties of any obligation previously incurred. Any delinquent payment owed by the Non-Federal Sponsor shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13-week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

ARTICLE XV - HAZARDOUS SUBSTANCES

A. After execution of this Agreement and upon direction by the District Engineer, the Non-Federal Sponsor shall perform, or cause to be performed, any investigations for hazardous substances that the Government or the Non-Federal Sponsor determines to be necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (hereinafter "CERCLA"), 42 U.S.C.

Sections 9601-9675, that may exist in, on, or under lands, easements, and rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification, except for any such lands, easements, or rights-of-way that are owned by the United States and administered by the Government, and except for any such lands that the Government determines to be subject to the navigation servitude. The Government shall perform, or cause to be performed, all investigations on lands, easements, or rights-of-way that are owned by the United States and administered by the Government. For lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the District Engineer provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction. All actual costs incurred by the Non-Federal Sponsor or the Government for such investigations for hazardous substances shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

B. In the event it is discovered through any investigation for hazardous substances or other means that hazardous substances regulated under CERCLA exist in, on, or under any lands, easements, or rights-of-way, that the Government determines, pursuant to Article III of this Agreement, the Non-Federal Sponsor must provide for the implementation, operation, and maintenance of the Project Modification, the Non-Federal Sponsor and the Government shall provide prompt written notice to each other, and the Non-Federal Sponsor shall not proceed with the acquisition of the real property interests until both parties agree that the Non-Federal Sponsor should proceed.

C. The Government and the Non-Federal Sponsor shall determine whether to initiate implementation of the Project Modification, or, if already in implementation, whether to continue with work on the Project Modification, suspend future performance under this Agreement, or terminate this Agreement for the convenience of the Government, in any case where hazardous substances regulated under CERCLA are found to exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification. Should the Government and the Non-Federal Sponsor determine to initiate or continue with implementation after considering any liability that may arise under CERCLA, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination on lands, easements or rights of way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification, except for any such lands, easements, or rights-of-way owned by the United States and administered by the Government. Such costs shall not be considered a part of total project modification costs. In the event the Non-Federal Sponsor fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge the Non-Federal Sponsor's responsibilities under this paragraph upon direction by the Government, the Government may, in its sole discretion, either terminate this Agreement for the convenience of the Government, suspend future performance under this Agreement, or continue work on the Project Modification. The Government shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination on lands, easements, or rights of way owned by the United States and administered by the Government. All costs incurred by the Government shall be included in total project modification costs and cost shared in accordance with the terms of this Agreement.

D. The Non-Federal Sponsor and the Government shall consult with each other in accordance with Article V of this Agreement in an effort to ensure that responsible parties bear any necessary cleanup and response costs as defined in CERCLA. Any decision made pursuant to paragraph C. of this Article shall not relieve any third party from any liability that may arise under CERCLA.

E. As between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project Modification for purposes of CERCLA liability. To the maximum extent practicable, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project Modification in a manner that will not cause liability to arise under CERCLA.

ARTICLE XVI - NOTICES

A. Any notice, request, demand, or other communication required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and either delivered personally, or by telegram, or mailed by first-class, registered, or certified mail, as follows:

If to the Non-Federal Sponsor:

City Manager
1500 Marilla
Suite 4E/N
Dallas, Texas 75201

If to the Government:

District Engineer
U.S. Army Engineer District, Fort Worth
P.O. Box 17300
Fort Worth, Texas 76102-0300

B. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

C. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at the earlier of such time as it is actually received or seven calendar days after it is mailed.

ARTICLE XVII - CONFIDENTIALITY

To the extent permitted by the laws governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

ARTICLE XVIII - HISTORIC PRESERVATION

A. The costs of identification, survey and evaluation of historic properties shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

B. Pursuant to Section 7(a) of Public Law 93-291 (16 U.S.C. Section 469c(a)), the costs of mitigation and data recovery activities associated with historic preservation shall be borne entirely by the Government and shall not be included in total project modification costs, up to the statutory limit of one percent of the total amount the Government is authorized to expend for the Project Modification.

C. The Government shall not incur costs for mitigation and data recovery that exceed the statutory one percent limit specified in paragraph B. of this Article unless and until the Assistant Secretary of the Army (Civil Works) has waived that limit in accordance with Section 208(3) of Public Law 96-515 (16 U.S.C. Section 469c-2(3)). Any costs of mitigation and data recovery that exceed the one percent limit shall be included in total project modification costs and shall be cost shared in accordance with the provisions of this Agreement.

ARTICLE XIX - LIMITATION ON GOVERNMENT EXPENDITURES

Notwithstanding any other provisions of this Agreement, the Government's financial participation in the Project Modification is limited to $5,000,000. The Non-Federal Sponsor shall be responsible for all total project modification costs that exceed this amount. In lieu of further construction of the Project Modification at the Non-Federal Sponsor's expense, the Government shall, at the request of the Non-Federal Sponsor suspend construction or terminate this Agreement in accordance with Article XIV.B. of this Agreement. To provide for this eventuality, the Government may reserve a percentage of total Federal funds available for the Project Modification and an equal percentage of the total funds contributed by the Non-Federal Sponsor in accordance with Article II.D. of this Agreement as a contingency to pay costs of termination, including any costs of contract claims and contract modifications.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the District Engineer.

DEPARTMENT OF THE ARMY

BY:____________
John R, Minahan
Colonel, Corps of Engineers
District Engineer
Fort Worth District

DATE:____________________

CITY OF DALLAS, TEXAS
TEODORO J. BENAVIDES
City Manager

NOT FOR SIGNSTURE
BY: ________________________
Jill Jordan
Assistant City Manager

DATE: ______________________

APPROVED AS TO FORM:
MADELEINE B. JOHNSON

City Attorney

BY:___________________________

Larry Scalf
Assistant City Attorney

DATE:__________________

CERTIFICATE OF AUTHORITY

I, ____________________, do hereby certify that I am the principal legal officer of the city of Dallas, Texas, that the city of Dallas, Texas, is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the city of Dallas, Texas, in connection with the Old Trinity Modification Project, and to pay damages in accordance with the terms of this Agreement, if necessary, in the event of the failure to perform, and that the persons who have executed this Agreement on behalf of the city of Dallas, Texas, have acted within their statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this _______________ day of ______________ 20___.

MADELEINE B. JOHNSON
City Attorney

BY:_____________________
Larry Scalf
Assistant City Attorney

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

APPROVED AS TO FORM: MADELEINE B. JOHNSON City Attorney	CITY OF DALLAS, TEXAS TEODORO J. BENAVIDES City Manager
BY:____________________	BY:____________________
Larry Scalf Assistant City Attorney	Jill Jordan Assistant City Manager
DATE: ________________	DATE: ________________

CERTIFICATION OF LEGAL REVIEW

The Revised Draft Project Cooperation Agreement for the Old Trinity Section 1135 Project has been fully reviewed by the Office of Counsel, USAED, Fort Worth District, Fort Worth, Texas contains deviations from the model agreement and is legally sufficient.

Howard Thomas Allen
Office of Counsel

8/6/03

ANNEX H
U.S. FISH AND WILDLIFE
PLANNING AID LETTER

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

November 10, 2003

Colonel John R. Minahan
District Engineer
U.S. Army Corps of Engineers
(ATTN: Michael Votaw, CESWF-PER-EE)
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Wells:

This letter constitutes the U.S. Fish and Wildlife Service's (Service) final report on the Old Trinity River Channel Ecosystem Restoration project in Dallas, Dallas County, Texas. It is submitted under the authority, and in accordance with, Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) (FWCA). Our report has been coordinated with the Texas Parks and Wildlife Department as noted in the enclosed letter from Mr. Danny Allen of the Wildlife Division, dated July 22, 2002.

This ecosystem restoration study is being conducted by the U.S. Army Corps of Engineers (Corps) under the authority of Section 1135 of the Water Resource Development Act of 1986, as amended (22 USC 2201). The purpose of the study is to identify the environmental degradation caused by the construction and operation of the Dallas Floodway project and evaluate alternatives to restore degraded habitat.

The project involves restoring ecosystem values of shallow water, emergent wetlands, and riparian forest associated with the Old Trinity River channel about 8 miles west of downtown Dallas. The project area is specifically located just south of the Dallas Floodway between Sylvan Avenue to the east and Pluto Street to the west. Specific actions proposed include reestablishment of 53.48 acres of bottomland hardwood forest, improvement of 28.42 acres of existing forested habitat, abandonment and filling of an existing concrete channel, construction of embankments with installation of water control structures, and excavation and restoration of 23.93 acres of emergent wetlands within existing sump areas of the Dallas Floodway. Habitat assessments and observations were conducted within the study area by U.S. Fish and Wildlife Service personnel in May 1999.

Recommended Plan

The Corps' recommended plan involves three segments of the Old Trinity River channel (Old Trinity River West of Ledbetter Gate, Old Trinity River Between Ledbetter Gate and Westmoreland Road, and the Old Trinity River East of Westmoreland Road) and three drainage areas adjacent to the channel (Shadrack channel, Pavaho sump, and an unnamed tributary in Fish Trap Lake Park). Figure 1.

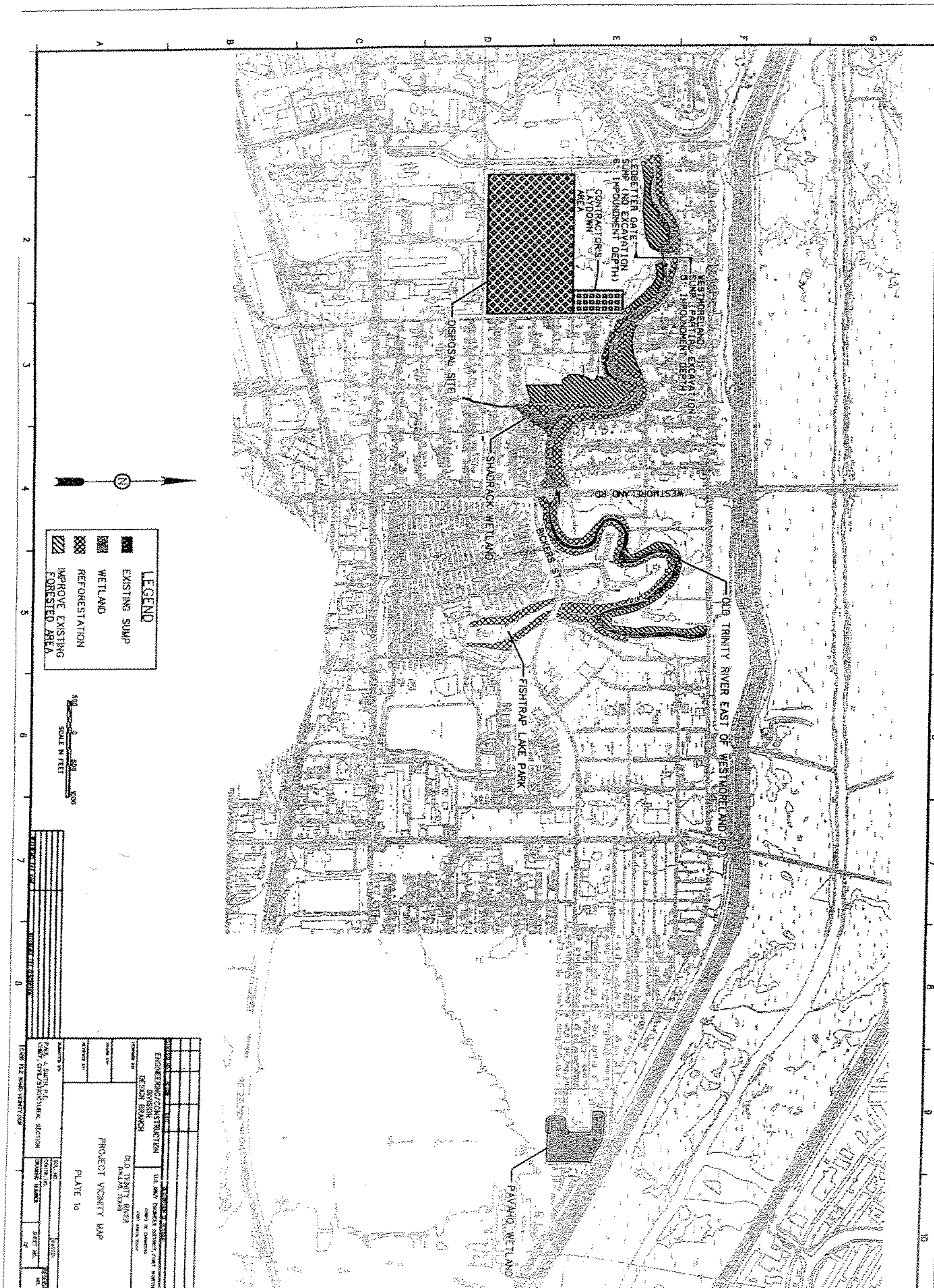
The recommended plan for the Ledbetter sump area consists of placing a gated water control structure within the channel between Gentry Drive and Mart Street to provide water level control to maximize optimum wetland habitat conditions. The maximum impoundment depth would be 6 feet. This structure would restore approximately 1.3 acres of emergent wetland with a maximum depth of 3 feet. The north bank of the Ledbetter sump and a small section of the southwest bank (4.48 acres), which is currently maintained as a grassland, would be reforested with native hardwood trees and shrubs. The existing forested area south of the sump (5.39 acres) would be improved by planting 5 one-inch caliber hardwood trees and 5 shrubs per acre.

The recommended plan proposes to restore approximately 8.36 acres of wetland habitat in the Westmoreland sump by placing a downward opening weir gate under Westmoreland Road to control water levels. Approximately, 11,000 cubic yards of material would be removed from the channel. The maximum depth within the sump area would be 5 feet, while the water depth in the emergent wetland area would be maintained at 3 feet or less. Approximately 22.4 acres of grasslands along both sides of the Westmoreland sump will be reforested with 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre. Approximately 17. 38 acres of existing forested areas along the southwest bank, Tipton Park, and west of Shadrack channel would be improved with planting of 5 one-inch caliper trees and 5 shrubs per acre.

Riparian forest would be restored (13.11 acres) or improved (5.65 acres) along the Old Trinity River channel east of Westmoreland Road to Canada Drive. The proposed plan includes 5.82 acres of reforestation along an unnamed tributary running south from Bickers Street through Fish Trap Lake Park. Reforestation would consist of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre.

The existing concrete Shadrack channel, located east of Furey Street, would be broken-up and filled-in. The recommended plan includes excavation of a new earthen channel, veering northeastward from the existing channel, that would flare into a 3.03 acre wetland cell. The excavated material would be used to fill the old channel. A water control structure would be constructed at the out-flow of the new wetland cell. The wetland impoundment depth would be 3 feet or less. The west and north sides of the wetland, approximately 1.09 acres, would be reforested with 40 one-inch caliper trees, 10 shrubs, and 100 seedlings.

Figure 1. Old Trinity River Channel Ecosystem Restoration Project.



The Pavaho sump would be enlarged by the excavation of material adjacent to the southwest edge of the sump area south of Bickers Street. This material could be used to create resting/nesting islands inside the sump. A weir gate would be constructed at the inlet of the sump located at the northeast corner on Canada Drive. This gate would provide water level control in the sump to facilitate management for optimum wetland habitat conditions. Approximately 8.64 acres of wetland with an average water depth of 3 feet or less would be created. Approximately 6.58 acres of reforestation around the sump using 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre is included in the recommended plan.

Habitat within 5.65 acres along the river channel from Westmoreland Road eastward to Sump and Pumping Plant D located north of Canada Drive would be improved by additional planting of trees, shrubs, and seedlings. Reforestation would also occur along this section and along an unnamed tributary running south from Bickers Street and bordering the east and west sides of Fish Trap Lake Park using 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre.

There are two recreational features included in this project: a foot bridge spanning the Old Trinity River in Tipton Park and a recreational trail connecting Bickers Park to the Pavaho sump wetland area.

Existing Fish and Wildlife Resources

A summary of the baseline habitat conditions of the project area and restoration recommendations, based on the Service's site investigations and field data analysis, were provided to the Corps in a June 2, 1999, planning aid letter. A copy of this letter is included in the Detailed Project Report (DPR) and Integrated Environmental Assessment for this project.

Using the Service's Habitat Evaluation Procedures (HEP), described in the planning aid letter, a habitat suitability index (HSI) value was determined for each of the habitat types in the project area. The riparian bottomland hardwood habitat has only a moderate (HSI) value of 0.56, because it contains very dense overstory and understory canopies of cedar elm and Chinese privet, respectively, with very few hard mast producing trees. Some locations lack large mature trees necessary for large cavities and snags that provide nesting and refuge sites for certain birds and mammals. The emergent wetlands in the project area provide good habitat conditions (0.70 HSI) for those species that utilize them. The grassland habitat in the project area is dominated by introduced herbaceous species which are mowed year-round, providing only moderate habitat value with an HSI of 0.56. Overall, the grasslands provide abundant food and cover for the eastern cottontail, but most of the herbaceous areas were too dense and tall for the eastern meadowlark and lacked sufficient perch sites for large raptors.

Endangered Species

Federally listed threatened or endangered species known to occur in Dallas County are the endangered interior least tern (*Sterna antillarum*), endangered black-capped vireo (*Vireo* *atricapillus)*, endangered golden-cheeked warbler (*Dendroica chrysoparia*), threatened piping plover (*Charadrius melodus*), and threatened bald eagle (*Haliaeetus leucocephalus*). Based on the habitats these species require and available information for the project area, we believe the proposed action is not likely to adversely affect these listed species.

Recommendations

As noted in our June 2, 1999 planning aid letter, we believe the Corps' proposed mitigation action would help restore natural habitats impacted by the Dallas Floodway project and many of the secondary impacts from urban development within the project area.

The lack of mature, hard-mast producing trees is probably the most limiting factor for the bottomland hardwood forest areas in the project area. Sites dominated by a dense overstory canopy of cedar elm, hackberry, and green ash and an understory of non-native species could be thinned to release and accommodate the planting of more desirable mast producing trees and shrubs, such as red oak, bur oak, pecan, Mexican plum, and coralberry. Large snags and dead trees should be left standing in place to provide cavities and refuge sites for wildlife. Measures to decrease the presence of non-native species and minimize re-infestation by non-native plant species should also be incorporated into the project plan. We concur with the list of native trees and shrubs to be used for the reforestation and habitat improvements in Table 6 in the DPR.

We also recommend consideration be given to the removal of livestock grazing at the north end of the old Trinity River channel close to Canada Drive. This site would require the establishment of a herbaceous ground cover to stabilize erosion and reduce sediment run-off into the Trinity River channel. The areas should also be planted with mast-producing trees and shrubs as proposed for other sites along the old channel.

The Service believes the actions proposed for the emergent wetland sites in the project area would provide suitable habitat for resident and migratory wetland-dependant species.

The herbaceous/grassland areas provide moderate habitat for only a few species. These areas are monotypic environments dominated by introduced grasses (e.g., bermudagrass and ryegrass) and are maintained by mowing. The food and cover available for wildlife in these areas could be improved by reducing mowing frequency and possibly conducting small controlled burns to encourage seed production and propagation of more desirable native herbaceous species, such as switchgrass, Indian grass, bluestems, Illinois bundleflower, etc.

Conclusion

Wetlands and riparian corridors are high priority fish and wildlife habitat and a resource of national concern. They serve as important sources of food, cover, and habitat for numerous species of resident and migratory fish and wildlife. Waterfowl and other migratory birds use wetlands and riparian corridors as stopover, feeding, and nesting areas.

The Service places a high priority on the conservation of riparian corridors due to the significant level of benefits they provide to a multitude of fish and wildlife species. In addition to the food, shelter, and habitat they provide to wildlife, these areas also furnish invaluable ecological services to the watershed and the community. They act as a buffer zone for pollutants and sediment entering the stream via storm water runoff. They also prevent erosion, and provide a pervious surface to facilitate the percolation of storm water to prevent flooding. Because the area surrounding the proposed project sites is highly developed, the ecological benefits a riparian corridor provides are extremely important. Riparian corridors along streams may be the only viable habitats left intact within their watersheds, and therefore, may contain the only substantial source of food, water, and shelter for the remaining wildlife inhabiting this urban environment.

Without implementation of the proposed plan, the existing forested areas would continue to be fragmented and developed, the grasslands would continue to be mowed, and the few existing wetland areas within the project area would continue to provide minimal habitat values. The proposed plan, with the inclusion of the above recommendations, would greatly improve benefits to fish and wildlife resources, especially wetland dependant species such as waterfowl, migratory shorebirds, and non-game passerine species. Reforestation and improvement of the riparian corridor along both sides of the old channel would substantially increase the amount of vital reproductive and migratory neotropical bird habitat. This project, with the inclusion of the recommendations listed above, would meet the goals and objectives of the North American Waterfowl Management Plan and the Partners in Flight program. For these reasons, we support implementation of the proposed Old Trinity River Channel Ecosystem Restoration plan.

We appreciate the opportunity to evaluate and provide assistance on this project. We hope this information is useful in your planning efforts. Please contact Carol S. Hale of this office at the above address or telephone number (817) 277-1100 if you have any questions or require additional assistance.

Sincerely,

Tom Cloud

Thomas J. Cloud, Jr.
Field Supervisor

enclosure

cc: Danny Allen, TPWD, Austin, Texas
Executive Director, TPWD, Austin, Texas

July 22, 2002

Thomas J. Cloud, Jr.
U.S. Fish and Wildlife Service
Ecological Services
Stadium Centre Building
711 Stadium Drive, Suite 252
Arlington, TX 76011

RE: Old Trinity River Channel Ecosystem Restoration Project, Dallas County

Dear Mr. Cloud:

Thank you for coordinating with this agency in the planning activities regarding the Old Trinity River Channel Ecosystem Restoration project proposed by the U.S. Army Corps of Engineers (COE). Texas Parks and Wildlife Department (TPWD) staff has reviewed the proposed project and offers the following comments.

The proposed project would restore the riparian corridor along the Trinity River in the Walker Neighborhood of the City of Dallas. The restoration activities would restore 18.5 acres of shallow water and emergent wetlands and 28.6 acres of riparian forest. The proposed project would also entail the improvement of 54.3 acres of riparian woodlands adjacent to the restoration site. Specific activities include the establishment of a high value riparian forest along the Old West Fork and adjacent tributaries, the construction of a water control structure to enhance emergent vegetation along Old West Fork, the contouring of a relic oxbow on the western end of the proposed project and construction of a water control structure to regulate wetland features, the removal of 750 feet of concrete channel on Shadrack Creek and the restoration of the natural channel with an emergent wetland complex, and the excavation of an existing sump downstream of Hampton Road to provide deeper pools and wetlands.

TPWD recommends utilizing methods described by Rosgen and Silvy (1996)[1] and Fischenich and Allen (1999)[2] to address the reconstruction of the Trinity River channel and the construction of water and erosion control structures within the channel. Methods identified in these references incorporate the use of vegetation, rock, and other natural structures to restore the river morphology and reduce excessive erosion impacts on stream banks. In addition to decreasing sediment loads and erosion in rivers, these methods also provide opportunities to develop and improve habitat for many aquatic species.

The Preliminary Restoration Plan indicates that there will be a water control structure on the relic oxbow; however, no information was provided on the nature

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

of the structure. If the proposed water structure does not entail a solid berm or similar structure, TPWD staff would like to recommend designing a structure that would require a minimal amount of maintenance and human intervention to function appropriately.

The invasion of non-native plant species is a statewide concern of TPWD, especially in riparian ecosystems. The Habitat Evaluation Procedure (HEP) conducted on May 5, 1999, indicated the presence of non-native invasive species such as Chinese privet in the riparian/bottomland hardwood habitat. The Restoration Plan should include measures to decrease the presence of non-native species along the riparian corridor and increase the diversity of native riparian species within the project area. In addition, the COE or the project sponsor should develop a management plan to minimize the re-infestation of non-native plant species. The management plan should also include a plan for maintenance of shrubs and seedlings and ensure, at a minimum, a survival rate of 80% for the first three years.

The disappearance of riparian vegetation is an increasing concern with TPWD. Riparian corridors have become increasingly valuable to many wildlife species as other habitat is lost. This is particularly evident in urban areas where the riparian corridor is often the only habitat left. Riparian corridors provide feeding, breeding, and nesting areas for many wildlife species and riparian habitats are used as travel corridors from one habitat patch to another. TPWD supports efforts to restore the diversity and function of adversely impacted riparian ecosystems.

I appreciate the opportunity to review and comment on this project and look forward to working with U.S. Fish and Wildlife Service and COE staff in the future. Please call me at (512) 389-4579 if we may be of further assistance.

Sincerely,

Danny Allen

Danny Allen
Wildlife Habitat Assessment Program
Wildlife Division

[1] Rosgen and Silvy. 1996. Applied River Morphology. Printed Media Companies, Minneapolis.

[2] Fischenich and Allen. 1999. Stream Management. WOTS Report EL-99-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

DLA:pmo.9347

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

REPLY TO
ATTENTION OF

Planning, Environmental &
Regulatory Division

October 22, 2003

Mr. Thomas Cloud, Jr.
United States Department of the Interior
Fish and Wildlife Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

Dear Mr. Cloud:

The United States Army Corps of Engineers, Fort Worth District (Corps), would like to thank you for the letter dated October 15, 2003, which provided the U.S. Fish and Wildlife Service (Service) comments on the Old Trinity River Ecosystem Restoration, Dallas, Texas Detailed Project Report (DPR) and Integrated Environmental Assessment (EA).

We appreciate the Service's interest and support in assisting the Corps to plan and implement ecosystem restoration projects in the Dallas area. These projects have the potential to provide valuable habitat for multiple species of wildlife and contribute to the overall effort to reduce the amount of riparian habitat fragmentation in the Trinity River basin.

Based on comments received during the public review period, including Service comments and planning aid assistance, the Corps has selected the recommended plan as identified in the DPR for implementation. As discussed, the recommended plan consists of restoration of 23.93 acres of emergent wetlands, improvement of the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, and the reforestation of 53.48 acres of open space to bottomland hardwoods.

We have no comments to offer on the Draft Fish and Wildlife Coordination Act Report provided by letter dated July 8, 2002 and ask the Service to finalize the U.S. Fish and Wildlife Service Coordination Act Report so that we might complete the EA and execute a Finding of No Significant Impact for this project. Thank you for your help in this matter. Please contact Marcia Hackett, Continuing Authorities Project Manager at (817)886-1373 if you have any questions or require additional information.

Sincerely,

William Fickel, Jr.
Chief, Planning, Environmental,
and Regulatory Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011
October 15, 2003

Colonel John R. Minahan
District Engineer
(Attn: Ms. Marcia Hackett, CESWF-PER-PF)
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Minahan:

The U.S. Fish and Wildlife Service (Service) has reviewed the May 2003, U.S. Army Corps of Engineers, Fort Worth District (Corps), Detailed Project Report and Integrated Environmental Assessment (EA) for the Old Trinity River Channel Ecosystem Restoration, Dallas, Texas. The purpose of this study, as stated in the EA, is to identify the environmental degradation caused by the construction of the Dallas Floodway project, evaluate alternatives to restore degraded habitat, and recommend a plan for implementation. The study area is located within the Trinity River 100-year floodplain, about 8 miles west of downtown Dallas, along the Old Trinity River channel downstream of the confluence of the West Fork Trinity River and the Elm Fork Trinity River. The project area consists of the restoration of 23.93 acres of emergent wetlands, improvement of the quality of the habitat on 28.42 acres of bottomland hardwood and mixed deciduous forest stands, and the restoration of 53.48 acres of open space to bottomland hardwoods.

We commend the Corps for pursuing habitat restoration in the Dallas area. We believe the Corps' recommended plan, as presented in the draft EA, will improve habitat diversity, quality, and quantity, while benefitting a variety of resident and migratory wildlife species. We also concur with your assessment that the proposed project would not adversely affect threatened and endangered species.

Overall, we concur with your analysis and conclusions and support the recommended plan. Restored riparian habitat in this area has the potential of becoming a valuable wildlife refuge in the midst of an area that has been anthropogenically degraded over an extended period of time. We agree that it is impossible to restore the area to its original ecological state, but this project would contribute to the overall effort to reduce the amount of riparian habitat fragmentation in the Trinity River basin.

We appreciate the opportunity to work with your agency during the project planning process and to provide comments on the draft EA. Please contact Carol Hale of my staff at (817) 277-1100 if you have any questions or require additional information concerning our comments.

Sincerely,

Tom Cloud

Thomas J. Cloud, Jr.
Field Supervisor

cc: Executive Director, TPWD, Austin, TX (Attn: Danny Allen)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

July 8, 2002

Colonel Gordon M. Wells
District Engineer
U.S. Army Corps of Engineers
(Attn: CESWF-EV-EE)
P.O. Box 17300
Fort Worth, Texas 76102-0300

Re: Draft Fish and Wildlife Coordination Act report on the U.S. Army Corps of Engineers' Old Trinity River Channel Ecosystem Restoration project in Dallas, Dallas County, Texas

Dear Colonel Wells:

Enclosed for your information and review is a copy of our draft Fish and Wildlife Coordination Act (FWCA) report for the proposed project. This investigation was conducted in May 1999 by the U.S. Fish and Wildlife Service Field Office in Arlington, Texas in cooperation with your Environmental Resources planning staff and the Texas Parks and Wildlife Department (TPWD). Our final FWCA report will be coordinated with the TPWD and submitted to accompany your final Detailed Project Report. Please provide any review comments on our draft report at your earliest convenience.

Please contact Carol S. Hale of my staff at the above address or telephone number (817) 277-1100 if you have any questions or require additional assistance.

Sincerely,

Tom Cloud

Thomas J. Cloud, Jr.
Field Supervisor

enclosure

Colonel Gordon M. Wells
District Engineer
U.S. Army Corps of Engineers
(Attn: CESWF-EV-EE)
P.O. Box 17300
Fort Worth, Texas 76102-0300

Draft

Re: Old Trinity River Channel Ecosystem Restoration in Dallas, Dallas County, Texas.

Dear Colonel Wells:

This letter constitutes the U.S. Fish and Wildlife Service's (Service) report on the Old Trinity River Channel Ecosystem Restoration project in Dallas, Dallas County, Texas. It is submitted under the authority, and in accordance with, Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) (FWCA) and is intended to accompany your Detailed Project Report. Our report has been coordinated with the Texas Parks and Wildlife Department.

This ecosystem restoration study is being conducted by the U.S. Army Corps of Engineers (Corps) under the authority of Section 1135 of the Water Resource Development Act of 1986, as amended (22 USC 2201). The purpose of the study is to identify the environmental degradation caused by the construction and operation of the Dallas Floodway project and evaluate alternatives to restore degraded habitat.

The project involves restoring ecosystem values of shallow water, emergent wetlands, and riparian forest associated with the Old Trinity River channel about 8 miles west of downtown Dallas. The project area is specifically located just south of the Dallas Floodway between Sylvan Avenue to the east and Pluto Street to the west. Specific actions proposed include reestablishment of 53.48 acres of bottomland hardwood forest, improvement of 28.42 acres of existing forested habitat, abandonment and filling of an existing concrete channel, construction of embankments with installation of water control structures, and excavation and restoration of 23.93 acres of emergent wetlandswithin existing sump areas of the Dallas Floodway. Habitat assessments and observations were conducted within of the study area by U.S. Fish and Wildlife Service personnel in May 1999.

Recommended Plan

The Corps' recommended plan involves three segments of the Old Trinity River channel (Ledbetter sump, Westmoreland sump, and the Old Trinity River East of Westmoreland Road) and three drainage areas adjacent to the channel (Shadrack channel, Pavaho sump, and an unnamed tributary in Fish Trap Lake Park).

The recommended plan for the Ledbetter sump area consists of placing a gated water control structure within the channel between Gentry Drive and Mart Street to provide water level control to maximize optimum wetland habitat conditions. The maximum impoundment depth would be 6 feet. This structure would restore approximately 1.3 acres of emergent wetland with a maximum depth of 3 feet. The north bank of the Ledbetter sump and a small section of the southwest bank (4.48 acres), which is currently maintained as a grassland, would be reforested with native hardwood trees and shrubs. The existing forested area south of the sump (5.39 acres) would improved by planting 5 one-inch caliber hardwood trees and 5 shrubs per acre.

The recommended plan proposes to restore approximately 8.36 acres of wetland habitat in the Westmoreland sump by placing a downward opening weir gate under Westmoreland Road to control water levels. Approximately, 11,000 cubic yards of material would be removed from the channel. The maximum depth within the sump area would be 5 feet, while the water depth in the emergent wetland area would be maintained at 3 feet or less. Approximately 22.4 acres of grasslands along both sides of the Westmoreland sump will be reforested with 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre. Approximately 17. 38 acres of existing forested areas along the southwest bank, Tipton Park, and west of Shadrack channel would be improved with plantings of 5 one-inch caliper trees and 5 shrubs per acre.

Riparian forest would be restored (13.11 acres) or improved (5.65 acres) along the Old Trinity River channel east of Westmoreland Road to Canada Drive. The proposed plan includes 5.82 acres of reforestation along an unnamed tributary running south from Bickers Street through Fish Trap Lake Park. Reforestation would consist of 40 one-inch caliper trees, 10 shrubs, and 100 seedlings per acre.

The existing concrete Shadrack channel, located east of Furey Street, would be broken-up and filled-in. The recommended plan includes excavation of a new earthen channel, veering northeastward from the existing channel, that would flare into a 3.03 acre wetland cell. The excavated material would be used to fill the old channel. A water control structure would be constructed at the out-flow of the new wetland cell. The wetland impoundment depth would be 3 feet or less. The west and north sides of the wetland would be reforested with 40 one-inch caliper trees, 10 shrubs, and 100 seedlings.

The Pavaho sump would be enlarged by the excavation of material adjacent to the southwest edge of the sump area south of Bickers Street. This material could be used to create resting/nesting islands inside the sump. A weir gate would be constructed at the inlet of the sump located at the northeast corner on Canada Drive. This gate would provide water level control in the sump to facilitate management for optimum wetland habitat conditions. Approximately 8.64 acres of wetland with an average water depth of 3 feet or less would be created. Approximately 6.58 acres of reforestation around the sump using 40 one-inch caliper trees, 10 shrubs, and 100 seedlings is included in the recommended plan.

Existing Fish and Wildlife Resources

A summary of the baseline habitat conditions of the project area and restoration recommendations, based on the Service's site investigations and field data analysis, were provided to the Corps in a June 2, 1999, planning aid letter. A copy of this letter is enclosed for your reference.

Using the Service's Habitat Evaluation Procedures (HEP), described in the planning aid letter, a habitat suitability index (HSI) value was determined for each of the habitat types in the project area. The riparian bottomland hardwood habitat has only a moderate (HSI) value of 0.56, because it contains very dense overstory and understory canopies of cedar elm and Chinese privet, respectively, with very few hard mast producing trees. Some locations lack large mature trees necessary for large cavities and snags that provide nesting and refuge sites for certain birds and mammals. The emergent wetlands in the project area provide good habitat conditions (0.70 HSI) for those species that utilize them. The grassland habitat in the project area is dominated by introduced herbaceous species which are mowed year-round, providing only moderate habitat value with an HSI of 0.56. Overall, the grasslands provide abundant food and cover for the eastern cottontail, but most of the herbaceous areas were too dense and tall for the eastern meadowlark and lacked sufficient perch sites for large raptors.

Endangered Species

Federally listed threatened or endangered species known to occur in Dallas County are the endangered interior least tern (*Sterna antillarum*), endangered black-capped vireo (*Vireo atricapillus)*, endangered golden-cheeked warbler (*Dendroica chrysoparia*), threatened piping plover (*Charadrius melodus*), and threatened bald eagle (*Haliaeetus leucocephalus*). The mountain plover (*Charadrius montanus*) is proposed as threatened. Based on the habitats these species require and available information for the project area, we believe the proposed action is not likely to adversely affect these listed species.

Recommendations

As noted in our June 2, 1999 planning aid letter, we believe the Corps' proposed mitigation action would help restore natural habitats impacted by the Dallas Floodway project and many of the secondary impacts from urban development within the project area.

The lack of mature, hard-mast producing trees is probably the most limiting factor for the bottomland hardwood forest areas in the project area. Sites dominated by a dense overstory canopy of cedar elm, hackberry, and green ash and an understory of non-native species could be thinned to release and accommodate the planting of more desirable mast producing trees and shrubs, such as red oak, bur oak, pecan, Mexican plum, and coralberry. Large snags and dead trees should be left standing in place to provide cavities and refuge sites for wildlife.

We also recommend consideration be given to the removal of livestock grazing at the north end of the old Trinity River channel close to Canada Drive. This site would require the establishment of a herbaceous ground cover to stabilize erosion and reduce sediment run-off into the Trinity River channel. The areas should also be planted with mast-producing trees and shrubs as proposed for other sites along the old channel.

The Service believes the actions proposed for the emergent wetlands sites in the project area would provide suitable habitat for resident and migratory wetland-dependant species.

The herbaceous/grassland areas provide moderate habitat for only a few species. These areas are monotypic environments dominated by introduced grasses (e.g., bermudagrass and ryegrass) that are maintained by mowing. The food and cover availability in these areas could be improved for wildlife by reducing mowing frequency and possibly conducting controlled burns to encourage seed production and propagation of more desirable native herbaceous species, such as switchgrass, Indian grass, bluestems, Illinois bundleflower, etc.

Conclusion

Wetlands and riparian corridors are high priority fish and wildlife habitat and a resource of national concern. They serve as important sources of food, cover, and habitat for numerous species of resident and migratory fish and wildlife. Waterfowl and other migratory birds use wetlands and riparian corridors as stopover, feeding, and nesting areas.

The Service places a high priority on the conservation of riparian corridors due to the significant level of benefits they provide to a multitude of fish and wildlife species. In addition to the food, shelter, and habitat they provide to wildlife, these areas also furnish invaluable ecological services to the watershed and the community. They act as a buffer zone for pollutants and sediment entering the stream via storm water runoff. They also prevent erosion, and provide a pervious surface to facilitate the percolation of storm water to prevent flooding. Because the surrounding area is highly developed, the ecological benefits this area provides are extremely important. The riparian corridor along streams may be the last section of corridor left intact within their watersheds and, therefore, may contain the only substantial source of food, water, and shelter necessary for the remaining wildlife inhabiting this urban environment.

Without implementation of the proposed plan, the existing forested areas would continue to be fragmented and developed, the grasslands would continue to be mowed, and the few existing wetland areas within the project area would continue to provide minimal habitat values. The proposed plan, with the inclusion of the above recommendations, would greatly improve benefits to fish and wildlife resources, especially wetland dependant species such as waterfowl, migratory shorebirds, and non-game passerine species. Reforestation and improvement of the riparian corridor along both sides of the old channel would substantially increase the amount of vital reproductive and migratory neotropical bird habitat. This project, with the inclusion of the recommendations listed above, would meet the goals and objectives of the North American Waterfowl Management Plan and the Partners in Flight program. For these reasons, we support implementation of the proposed Old Trinity River Channel Ecosystem Restoration plan.

We appreciate the opportunity to evaluate and provide assistance on this project. We hope this information is useful in your planning efforts. Please contact Carol S. Hale of this office at the above address or telephone number (817) 277-1100 if you have any questions of require additional assistance.

Sincerely,

Thomas J. Cloud, Jr.
Field Supervisor

Draft

enclosure

cc: Danny Allen, TPWD, Austin, Texas
Executive Director, TPWD, Austin, Texas

APPENDIX F

ENVIRONMENTAL RESOURCES

ENVIRONMENTAL SETTING

General Description

The proposed project area is located within a highly developed metropolitan area, leaving the flood plain areas adjacent to the river of major environmental concern. Constructed in 1957 with Federal funds, The Dallas Floodway Project is located immediately upstream of the study area. The Floodway project consisted of channelizing and constructing levees along both sides of the Trinity River from Mountain Creek downstream to the Atchison, Topeka, and Santa Fe (AT&SF) Railroad bridge. The environmental characteristics within this area were significantly modified by the project's construction, but since that time some of the riparian vegetation and wildlife habitat has re-established naturally. From the AT&SF Railroad bridge downstream to the Highway 635 and Interstate 20 Trinity River crossing, the proposed project area consists mainly of bottomland hardwoods, wetlands associated with interior drainage areas, old oxbow scars, and gravel mining operations, open water ponds, and open grasslands located on upland sites developed from reclaimed mine areas and abandoned row-crop agriculture plots, commonly used for grazing livestock.

Climate

The Trinity River watershed is located in a region of temperate mean climatological conditions, experiencing occasional extremes of temperature and rainfall of relatively short duration. According to the National Oceanic and Atmospheric Administration (NOAA 1997) Station at Fort Worth, Texas, the 30 year mean rainfall amount is 33.7 inches per year with the most recent ten year (1987-1996) average being 37.88 inches. The extreme annual rainfall values since 1887 are a maximum of 53.54 inches occurring in 1991 and a minimum of 17.91 inches occurring in 1921. The maximum precipitation in a 24 hour period was 9.57 inches in September 1932. Precipitation is distributed fairly uniformly throughout the year, with the exception of a slight peak in the spring and a low in mid-to-late summer (Yelderman 1993). The mean relative humidity is 65 percent and the average temperature is 65.8°F. Recent temperature extremes range from -1°F in December 1989 to 115°F in June 1980. The average freeze dates are March 23, which is the last in spring and November 13, which is the first to occur in the fall. The temperature falls below freezing an average of 41 days a year, but this drop is usually followed by daily thaws. The length of the growing season is approximately 235 days.

The major storms experienced in the study area are produced by heavy rainfall from frontal-type storms which generally occur in the spring and summer months, but major flooding can also be produced by intense rainfall associated with localized thunderstorms. These thunderstorms may occur at any time during the year, but they are more prevalent in spring and summer months.

Air Quality

The proposed Dallas Floodway Extension (DFE) project would be located within the Environmental Protection Agency's Air Quality Control Region (AQCR) 215 for Texas. AQCR 215 consists of 19 counties including Dallas, Denton, and Tarrant Counties, Texas. AQCR 215 is classified as a non-attainment area for ozone (O_3) and attainment/unclassifiable for other National Ambient Air Quality Standards including lead (Pb), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter of aerodynamic shape less than or equal to 10 micrometers in diameter (PM10) (40 Code of Federal Regulations 52.2308(a)).

In 1995 and 1996 the Texas Natural Resource and Conservation Commission (TNRCC), Office of Air Quality, reported that the average annual criteria pollutant concentrations for the city of Dallas, Texas, were as follows: lead - 0.03 ug/m3, PM10 - 29 ug/m3, carbon monoxide - 0.75 parts per million (ppm), sulfur dioxide - 0.003 ppm, ozone - 0.023 ppm, nitrogen dioxide - 0.017 ppm (Personal Communication: Mr. Larry Butts, Office of Air Quality, TNRCC, Austin, Texas).

Air quality is closely related to trees. Trees can reduce or increase energy use by providing shade, alter air flow, lower air temperatures through transpiration and directly remove or contribute to atmospheric pollution (McPherson et al. 1994, Nowak et al. 1997). Two computer models (Citygreen™, Version 2.0, American Forests and the United States Department of Agriculture's Urban Forest Effects (UFORE)) were initially used to describe the effects which trees have on the removal of the five gaseous criteria pollutants in the DFE. Both Citygreen and UFORE simulation models utilize standard field, air pollution, and meteorologicial data to quantify forests effect (Nowak et al. 1997); however, the Citygreen model used established pollution uptake coefficients of averaged data collected at monitoring sites located in Chicago, Illinois; Baltimore, Maryland; Milwaukee, Wisconsin; and Austin, Texas (Citygreen Users Manual 1997). The UFORE model that was used, derived pollutant uptake coefficients from information collected during 1994, at monitoring sites located in Dallas (four pollutants) and Fort Worth (one pollutant), Texas (Personal Communication: Dr. David J. Nowak, USDA Forest Service, Northeastern Forest Experiment Station, Syracuse, New York). In the interest of using the most accurate information available, the UFORE model was utilized to describe the environmental setting and to evaluate the proposed project and alternative environmental impacts mentioned later in this appendix.

The UFORE estimates of the annual pollution removal rates of trees (in tons/year) currently in the Great Trinity Forest area are 13.30 for carbon monoxide, 11.74 for sulfur dioxide, 32.93 for nitrogen dioxide, 77.16 for PM10, and 145.19 for ozone (Table 1). The estimated total removal rates of air pollutants by trees presently in the Dallas and the existing and future without project for the detailed project area are also summarized in Table 1. It is assumed that herbaceous vegetation also has some pollutant uptake capabilities since they functionally similar to trees, however, refereed published material describing these coefficients is lacking. Because of this it was not possible to determine pollution removal capabilities of the herbaceous plants in the study analysis.

Table 1

The annual removal of regulated air pollutants by trees in areas related to the proposed project calculated using USDA's UFORE[1] computer model. The removal values in the table are expressed in tons/year.

Area	Carbon Monoxide	Sulfur Dioxide	Nitrogen Dioxide	Particulate Matter (10um)	Ozone
Existing Great Trinity Forest	13.30	11.74	32.93	77.16	145.19
Existing City of Dallas[2]	137.72	128.92	355.96	955.24	1,491.82
Detailed Project Area Existing Conditions	1.41	1.24	3.48	8.17	15.37
Detailed Project Area Future Without	2.02	1.78	4.99	11.70	22.02

1- Urban Forest Effects (UFORE) is the computer model developed by Dr. David J. Nowak of the United States Department of Agriculture (USDA) Forest Service, Northeastern Forest Experiment Station.

2-Based on City size of 331 square miles with a tree cover of 28.2% (Nowak et al., 1996)

Vegetational Cover

The proposed project is located in the Blackland Prairie vegetative ecoregion (Correll and Johnston 1970; Gould 1975; Simpson 1988). Running from the Red River south to near San Antonio, the Blackland Prairie stretches in a well defined band for roughly 300 miles and owes its name to the deep, dark calcareous clay soils which cover it. Under natural conditions, Blackland Prairies are dominated by grasses such as little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum avenaceum*), and sideoats grama (*Bouteloua curtipendula*) with narrow fringes of bottomland hardwoods being found along rivers and streams (Nixon and Willett 1974).

Within the proposed project area, the topography is gently rolling to nearly level and elevations are approximately 400 feet above sea level (USFWS, 1989). The predominant soil is classified as frequently flooded Trinity Clay (Coffee et al. 1980). Tree species common to this area include elm (*Ulmus sp.)*, sugarberry (*Celtis spp.)*, pecan (*Carya illinoensis)*, oak (*Quercus sp.*), black willow (*Salix nigra)*, cottonwood (*Populus deltoides*), and osage orange (*Maclura pomifera)*.

Bottomland Vegetation

Bottomlands occur in the transition zone between aquatic and upland ecosystems. Bottomland hardwood systems are considered to be Texas' most diverse ecosystem. Prior to European settlement, Texas had approximately 16 million acres of bottomland hardwood riparian habitat. Today the state has less than 5.9 million acres (Texas Center for Policy Studies 1995).

Bottomlands serve several important functions. They contribute to the state's biodiversity. According to the Texas Environmental Almanac (1995), 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 herbaceous plants occur in Texas' bottomlands. They are also known to support 116 species of fish, 31 species of amphibians, 54 species of reptiles, 273 bird species and 45 species of mammals. At least 74 species of threatened and endangered animals depend directly on bottomland hardwood systems and over 50 percent of neotropical songbirds not listed as endangered or threatened are associated with these systems. Besides providing critical wildlife and bird habitat, bottomland hardwood systems 1) serve as catchment and water retention areas in times of flooding; 2) help control erosion; 3) contribute to the nutrient cycle, and 4) play a vital role in maintaining water quality by serving as a depository for sediments, wastes and pollutants from runoff. Despite these important functions, bottomland hardwoods ecosystems are one to the most endangered ecosystems in the United States (MacDonald et al. 1979). For all these reasons, the bottomland vegetation system is of great environmental concern in the analysis of the proposed project area.

In addition, according to Nixon and Willett (1974), the bottomland hardwood forests associated with the Sabine, Neches, Trinity, and San Jacinto river were classified as distinct vegetational types by Bray (1906) and Collier (1964). They occupy large areas and are considered by Bray (1906) and Braun (1950) to be westward extensions of hardwood forests typical of river bottom areas to the southeast.

Botanical surveys show that black willow and cottonwood are dominant in the upstream Dallas Floodway portion while downstream from the AT&SF Railroad bridge to the Dallas County line, the dominant tree species are mature black willow, cedar elm (*U. crassifolia)*, sugarberry, green ash (*Fraxinus pennsylvanica)*, pecan, American elm (*U. americana*), box elder (*Acer negundo)*, cottonwood, red mulberry (*Morus rubra)*, and osage orange. The dominant understory woody, shrub and vine species consist of immature trees of the same species as those listed above along with western soapberry (*Sapindus drummondii),* swamp privet (*Lagustrum spp.),* common greenbrier (*Smilax rotundifolia),* honeysuckle (*Lonicera spp.),* and poison ivy (*Rhus toxicodendron).* There is little herbaceous groundcover, but, in areas with dense canopy cover, the dominant species are poison ivy, wild onion (*Allium canadense*), violets (*Viola ssp.*), *Aster sp.*, Virginia creeper (*Parthenocissus quinquefolia)* and Canadian wild rye (*Elymus canadensis*). In areas where the canopy cover is more open, the tree species are the same, but the percent cover of herbaceous vegetation increases with the dominant species being marsh elder (*Iva annua),* ragweed (*Ambrosia trifida),* and a couple members of the sedge family (*Carex cherokeensis and C. crus-corvi*). A more comprehensive list of plant species found within the proposed project area can be found in Table 2 located at the end of this appendix.

Wetland Vegetation

According to the Texas State Almanac (1995), interior wetlands which include bottomland hardwood forests (above), riparian vegetation, inland freshwater marshes, and the playa lakes of West Texas account for 80 percent of the total wetland acreage in Texas and the vast majority are located on private property. In the last 200 years, Texas has lost over 60 percent of these inland wetlands due to agriculture conversion, timber production, reservoir construction and urban and industrial development.

Much of the land within the proposed project area has been highly disturbed by human activities which have altered the topography of the local landscape. These include removal of topsoil (used as cover material for the nearby Linfield Landfill), removal of dirt (used as fill material for the construction of nearby road and railroad beds), mining of gravel by commercial business enterprises and construction activities associated with encroaching industries, commercial businesses, residential neighborhoods, and parklands. Many of these areas have also been impacted by illegal dumping activities over the years. Substantial quantities of concrete and building materials, asphalt shingles, roofing tiles, household furniture and appliances, and old tires were observed during reconnaissance visits.

In many cases the alteration of the topography within the proposed project area has led to the development of wetlands and these, along with isolation of oxbow scars from the main stem of the Trinity River, have led to wetlands being scattered throughout the flood plain in isolated depressions or very low gradient drainages.

The essential characteristics that define a wetland are constant or recurrent, shallow inundation or saturation at or near the surface of the substrate and the presence of physical, chemical, and biological features that reflect these conditions. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation.

Hydrophytes are herbaceous plants capable of growing in an environment that is periodically but continuously flooded for more than 5 days during the growing season (Hammer 1992; Mitsch and Gosselink 1986). Obviously, these include some plant species that are primarily terrestrial, but capable of surviving short periods of flooding or saturated soil conditions. Reconnaissance surveys of the depressional and low gradient wetlands found within the proposed project area during the spring and summer of 1997 showed very little evidence of emergents -- plants that typically grow in shallow water such as cattails (*Typha*), bulrush (*Scripus*), and sedges (*Carex*), and no evidence of submerged or floating plants such as pondweed (*Potomogeton*) and duckweed (*Lemna*), respectively. The dominant types of vegetation growing along the edges of these depressional wetlands were marsh elder and ragweed, both terrestrial species that are known to inhabit low, moist, disturbed areas (Mahler 1988). Within the forested portion of the proposed project area, black willow, cottonwoods and green ash were often found growing in the shallow water or along the edge of these wetlands.

The vegetation found on gravel mining and other excavation sites varied depending on: 1) the extent to which the site was disturbed during excavation operations; 2) whether any restoration and/or mitigation measures were undertaken following shut down of operations; 3) the amount of time that has past since the disturbance; and 4) the current soil makeup and moisture regime. One area which had been mined for its top five feet of soil was characterized by an open field with low, shallow water or saturated soil areas in the middle dominated by sedges, surrounded with higher upland sites dominated by terrestrial grasses and marsh elder and scattered with a few trees. The growth of these trees was obviously being stunted. This was probably caused by a combination of factors including a lack of nutrients normally found in topsoil and because the remaining soil, characterized by a few inches of silty clay over sandy clay, would be incapable of retaining moisture following rain events. The trees would be growing under almost continual drought conditions. Others of these disturbed sites are characterized by quickly colonizing weedy species such as giant ragweed, annual sunflower, and goldenrod. Willow and cottonwoods are the most common colonizing tree species in the most recently disturbed sites. If left undisturbed the sites would probably continue to succeed into areas characterized by the same species that are noted in the bottomland vegetation section.

Wetland delineation surveys have determined that much of the bottomland hardwood forest located within the proposed project area are jurisdictional wetlands under Section 404 of the Clean Water Act. The area that would be impacted by the foot print of either the NED or Chain of Wetlands alignment is approximately 50 percent jurisdictional. The lower NED alignment would cross the White Rock Creek flood plain which was determined to be over 90% jurisdictional forested wetlands. The foot print of the lower swale alignment for the chain of wetlands crosses jurisdictional wetlands over the first half of the alignment only. Permanent water in the form of water hazards at the golf course have been determined to be non jurisdictional.

From a planning perspective, all regulatory wetlands in the area, whether currently forested or not, are becoming forested. The future without a project analysis, therefore, includes all of these jurisdictional areas as forested wetlands. The goal of the U.S. Fish and Wildlife Service for Resource Category 2 habitats (in this case, both bottomland hardwoods as well as jurisdictional forested wetlands) is the same as the Corps of Engineers and planning team's goal, which is to first avoid and minimize impacts and then require in-kind and equal mitigation to the extent possible. Since the mitigation strategy and goals for forested wetland and non jurisdictional bottomland hardwood forest are the same, it was determined that mapping of the numerous small, interwoven individual wetland locations would not add additional clarification within the project study area for planning purposes. Additional information about wetland considerations is addressed further in this appendix in discussions relating to compliance with Section 404 of the Clean Water Act , including the Evaluation of the proposed project in accordance with the Section 404 (b)(1) Guidelines.

Grasslands

Open grasslands located on drier sites developed from reclaimed mine areas and abandoned row-crop agriculture fields have commonly been used for grazing livestock. The vegetation found on these sites is characteristic of disturbed or old field bottomland pastures. Common grass species include purple threeawn, King Ranch bluestem, sideoats grama, Japanese brome, tumble windmillgrass, bermuda grass, jungle rice, barnyard grass, plains lovegrass, perennial ryegrass, Texas wintergrass, Dallisgrass, annual bluegrass, and Johnson grass. Dominant herbaceous species include giant ragweed, annual sunflower and goldenrod. These old field sites can be expected to continue to succeed to scrub/shrub and eventually bottomland hardwood forests. In field reconnaissance trips, a several sites, noted on old aerial photographs as being an open field, are now covered by a dense stand of green ash or cedar elm saplings.

Open Water Areas

These are bodies of water that retain water on a continuous basis. Many of the open water ponds within the proposed project area are former gravel or other type of excavation pits. A considerable amount of open water is located within the Sleepy Hollow Golf Course as water hazards. In most cases there is little or no emergent vegetation and no evidence of any submersed or floating plants, especially within the pelagial, or open water zone. This lack is due to a combination of reasons. The banks of these water bodies tend to be relatively steep making it difficult for vegetation to become established. A second reason is the continuous presence of water of varying depths prohibits the growth of most plant species which are not able to tolerate prolonged and/or deep water conditions. A final reason is the lack of light penetration needed to support this type of vegetation. Many of these ponds are shaded by a dense cover canopy of surrounding trees. In addition, the water in the ponds located within the flood plain is extremely turbid due to the continual addition and stirring of sediments resulting from rainfall events and runoff. Because the Trinity is an urban river and a main artery for a series of reservoirs, the amount and quality of water it receives is influenced by more factors than just upstream and local rainfall amounts. The discharge of effluent from wastewater treatment plants, watershed runoff from impervious surfaces during storms, and overflows from the series of manmade reservoirs which tie into it are major factors and all contribute to turbidity.

Within densely forested areas, cottonwoods, green ash, and black willows, along with an occasional box elder can be observed growing along the perimeter of these ponds. In more open sites, the dominant vegetation is marsh elder and ragweed.

Land Use and Vegetative Cover Mapping

Several iterations have been conducted during the planning process to map and estimate acreages of vegetative cover and land uses within the study area. One mapped area includes an estimate of the vegetation within what has been termed the "Great Trinity Forest". This area roughly includes the Trinity River main stem flood plain lying between the existing Dallas Floodway and

Interstate Highway 20 crossing and within the White Rock Creek flood plain upstream to Interstate Highway 30. Within this area, approximately 5956 acres in size, 5456 acres (92%) are woodland including bottomland hardwoods, mixed Deciduous, and wetlands/bottomland hardwoods. The remaining 500 acres (8%) are composed of water, grassland, scrub/shrub, and urban areas.

The land use within this area (Table 3) was determined from use of 1992 satellite imagery and boundaries were established from comparison of aerial photos and an estimate of the geographic limits of the Great Trinity Forest as defined above. Vegetative cover types have been verified from field visits, however considerable land use change has occurred around the perimeters of the proposed project area and within portions of the flood plain near the Central Wastewater Treatment plant. Therefore, the acreage figures represent a comprehensive estimate to approximate the overall study area.

TABLE 3
UPPER TRINITY RIVER PROPOSED PROJECT
GREAT TRINITY FOREST LAND COVER ESTIMATE

Trinity Forest LAND COVER Types	Acres	% Cover
Water	233	3.9
Bottomland Hardwoods	4198	70.5
Pasture/Unmanaged Grasslands	121	2.0
Mixed Deciduous	213	3.6
Scrub/Shrub	63	1.1
Agriculture	37	0.6
Low Density Urban & Residential	13	0.2
Urban/Roads/Bare Ground	15	0.3
Bare Ground	3	0.1
Wetlands/Bottomland Hardwoods	1045	17.5
Unclassified/Bare Ground	3	0.1
Managed Grassland	12	0.2
TOTAL	5956	100.1

Additional refinement of the vegetative cover was accomplished by onsite evaluation and mapping of vegetative cover within areas that would be impacted by the foot prints of proposed project features. The mapping included delineation of bottomland hardwoods into essentially two levels of importance based upon their overall values to fish and wildlife resources. The higher quality bottomland hardwood areas generally consisted of those areas with old growth forest which included hard mast trees such as pecan, red oak or burr oak. These higher quality bottomland hardwoods are referenced as Pecan-Oak bottomland hardwoods for the remainder of this report. Medium quality bottomland hardwood consisted of less mature stands of trees lacking hard mast producers and are referred to as Ash-Elm bottomland hardwoods . The Ash-Elm bottomland hardwood areas were found to be dominated by homogenous stands or mixtures of green ash, willow, cottonwood, cedar elm and box elder. Most of these sites were initially delineated by evaluation and comparison of 1960's vintage and later aerial photographs of the area. Field verification was accomplished by field visits and by measurement of forest parameters that were used to model habitat quality. Additional verification was obtained during site visits to identify and quantify tree densities on several plots within the study area. This information was ultimately digitized onto an ortho-photo and used to define the vegetative cover and land use within the areas that would be impacted by alternative project features. The cover mapping used for analysis is shown on Figure 1. Table 4 shows the land cover classification used for evaluation of the locally preferred project, including the chain of wetlands, Lamar and Cadillac levees and associated sumps and the proposed channel realignment to protect Interstate Highway 45.

Table 4
Land Cover Tabulations (Digitized from Ortho-photo)

Type	Acres	Percent		
Pecan-Oak	251.02	18.47		
Ash-Elm	326.46	24.02	Forested Subtotal	
MGFB	496.18	36.51	577.48	42.49%
Urban/Exposed Ground	108.34	7.97		
Landfill/Disturbed	16.58	1.22		
Wetland (CWWTP)	9.09	0.67		
Building	7.58	0.56		
Water	143.69	10.57		
Total	1358.94	100.00		

The general area that would be impacted by the proposed project features contain a smaller area and percentage of bottomland hardwoods than were identified within the general study area, reflecting the planning strategy to locate project features in areas that would minimize impacts to this important resource.

Wildlife Resources

Similar to the plant species of the flood plain, the wildlife species found within the proposed project area vary considerably. As noted above, the proposed project is enclosed within a fully developed metropolitan area and much of the area has been highly impacted by human activities. The degree and extent of the changes in habitat have directly influenced the numbers and species of wildlife found in the area. Predator control, modification of habitat, indiscriminate hunting, use of pesticides, and various forms of air, water, and land pollution have been responsible for modified distribution of fish and wildlife populations throughout the area.

The river channel, wetlands, open water areas, and bottomland hardwood forests support a variety of wildlife species for cover, food, and den or nesting sites. Bird species which were observed or have been reported in the area include migratory warblers, sparrows, meadowlark, mourning dove, crow, red-tailed hawk, red-shoulder hawk, American kestrel, herons, egrets, mallard, wood duck, blue-winged teal, green-winged teal, lesser scaup, grackle, scissor-tailed flycatcher, kingbird, logger-head shrike, black bird, swallows, blue jay, chickadees, downy woodpecker, red-belly woodpecker, and barred owl. Amphibians, reptiles, and mammals common to the area include frogs, toads, snakes, turtles, cottontail rabbit, cotton rat, field mice, opossum, raccoon, bobcat, beaver, nutria, and coyotes.

Aquatic Resources

The main stem of the Trinity River which flows through the proposed Dallas Floodway Extension (DFE) Project area receives drainage from several rapidly urbanizing sections of the Dallas-Fort Worth Metroplex. The effluent from these municipalities has resulted in a historical degradation of water quality as the river flows from west to east. Generally, the aquatic resources in the DFE segment of the river are characteristic of the upper Trinity River Basin, however, the poorer water quality has resulted in a shift from a diverse healthy aquatic fauna to a more pollution tolerant community.

Although several current studies indicate that water quality has been improving in the upper Trinity River, it appears that aquatic organisms are continuing to be contaminated by a wide variety of pollutants of industrial and municipal origin (Arnold 1989, Kleinsasser and Linam 1990, Davis 1991). The water is generally turbid, especially during high flow episodes due to elevated silt loading. The poor water quality in DFE section of the Trinity River can be attributed to low dissolved oxygen concentrations incurred from low flows, high water temperatures, and elevated biochemical oxygen demands (Tidwell 1982, Davis 1984). High concentrations of ammonia-nitrogen and phosphorus also contribute to the poor water quality in the DFE segment of the river.

Habitat for fisheries is scarce in the DFE segment of the Trinity River. The river channel has not been significantly altered, except around the railroad and highway bridge crossings. Bridge pilings provide some colonization areas for aquatic invertebrates and spatial reference points for fishes to congregate. The river channel banks are steep and nude with numerous deadfall logs and debris that have accumulated during high flow periods. The river bed provides little or no structure and is primarily comprised of silty mud. In most areas, a large canopy of cottonwood and willow trees provides fair to good shading of the river's surface.

A low diversity of aquatic invertebrate and fish species characterizes the proposed DFE project area. The invertebrate community is dominated by the more pollution tolerate pulmonate gastropods, chironomids, and tubificid worms. Fish faunal resources in this segment of the Trinity River are primarily the more pollution tolerant species, such as common carp (*Cyprinus carpio*), river carpsucker (*Carpiodes carpio*), longnose gar (*Lepisosteus osseus*), freshwater drum (*Aplodinotus grunniens*), bullhead catfish (*Ictalurus* sp.), gizzard shad (*Dorosoma cepedianum*), mosquitofish (*Gambusia affinis*), and various species of sunfish (*Lepomis* sp.) and shiners (*Notropis* sp). Although few in number due to inadequate aquatic habitat and poor water quality, the sportfish occurring in the proposed project area are largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), crappie (*Pomoxis* sp.) and white bass (*Morone chryops*). A comprehensive listing of fish in the main stem of the Trinity River south of the Metroplex can be found in "Final Regional Environmental Impact Statement for Trinity River & Tributaries, 1987".

Water Quality

Every 2 years, the Texas Natural Resource Conservation Commission (TNRCC) publishes data on field measurements and water chemistry for the waters of the State. The portion of the river which lies in the proposed project area is in the upper part of segment 805 as designated by TNRCC. While the water quality of the Trinity River continues to improve, there still remain 4 areas of concern in segment 805. These are nitrite+nitrate, orthophosphorus, total phosphorus and fecal coliform. These concentrations were outside criteria or screening levels 92.5%, 97.67%, 94.59% and 38% of the time, respectively. Historically, dissolved oxygen levels have been a serious problem but these have shown great improvement and are now rarely lower than the standards criteria of 5.00 mg/l.

Flow rates vary greatly. Typically, the lowest flows are in the dry summer months and highest flows are associated with spring floods. Low flow rates and high temperatures are conditions under which there may be water quality problems such as high algal growth and low dissolved oxygen.

Effluent from several wastewater treatment plants discharge into tributaries of the Trinity River in the Dallas/Fort Worth metroplex. The effluent from the Central Wastewater Treatment Plant (CWWTP), on the uppermost part of the mainstem (segment 805) in the city of Dallas, is discharged into a small lake first before flowing into the Trinity. This plant meets and often exceeds stringent effluent discharge requirements as stated in the discharge permit issued by the state (personal communication, Donna Long, City of Dallas). In the last three years, 15 chronic toxicity tests have been conducted on the organism *Ceriodaphnia dubia* in 100% effluent. All test results were negative. This is an indication that, under present circumstances, the effluent may be used in the wetlands to provide fish and wildlife habitat (personal communication, Jim Davenport, TNRCC - Water Quality Division, Standards and Assessment Section).

THREATENED AND ENDANGERED SPECIES

The following information indicates that several federally protected species may occasionally migrate through the proposed project area. In addition Black-capped vireo is known to nest in southwestern Dallas County along the juniper forested area associated with that area. In addition least tern has been documented nesting within the Southside Waste Water Treatment (SSWWT) facility grounds several miles southeast of the proposed project area. The SSWWT is located across the river from the proposed disposal site for excess clean materials resulting from excavation of materials from the Chain of Wetlands. The site has been investigated by the Corps of Engineers and the U.S. Fish and Wildlife Service and was approved for disposal of dredge material from the White Rock Lake restoration project.

Table 5
FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES WHOSE MIGRATORY CORRIDOR INCLUDES DALLAS COUNTY TEXAS
(Source U.S. Fish and Wildlife Service, March 1993)

American peregrine falcon,	*Falco peregrinus anatum*	Endangered
Arctic peregrine falcon	*Falco peregrinus tundrius*	Threatened
Bald eagle	*Haliaeetus leucocephalus*	Endangered
Black-capped vireo	*Vireo atricapillus*	Endangered
Interior least tern	*Sterna antillarum*	Endangered
Piping plover	*Charadrius melodus*	Threatened
Whooping crane	*Grus americana*	Endangered

ENVIRONMENTAL NEEDS

The Dallas-Fort Worth Metroplex has extensive development within its main core area and expansion continues into surrounding counties. The need to provide for protection against ravaging floods to developed areas has increased as the new development continues to increase runoff from continually increasing areas of impervious surfaces associated with rooftops, parking lots, and highways. In addition local drainage programs tend to increase the speed of runoff thereby necessitating continuing improvement of flood control features. Within the Metroplex, the Corps of Engineers has constructed Lakes Benbrook, Joe Pool, Grapevine, Lewisville, and Ray Roberts which are multipurpose projects providing flood damage reduction benefits to the area. In addition, the Corps has constructed the Fort Worth and Dallas Floodways which are segments with levees and a main flood conveyance channel that provide needed protection for the downtown business districts of the respective cities.

These projects with exception of Joe Pool and Ray Roberts were constructed prior to legislation was enacted requiring environmental review and prior to Corps authorities to mitigate environmental losses. Review of information available indicates that while providing needed flood damage reduction and water supply for the Metroplex, these projects also forever altered the landscape. The most significant losses that occurred were to the bottomland hardwood areas that existed as riparian forested stringers along the main stem river reaches and tributaries. In addition, many small emergent wetland areas along the streams were either inundated and lost or were removed through the grading and leveling process of channel construction in the leveed reaches. Reduction of flooding brought about by these large projects has also increased secondary development throughout the region. Prior to the mid 1970's there were no regulatory processes to protect or require mitigation of any of these wetland losses.

In 1985 the Corps of Engineers began a study to address the impacts of unrelated development projects along the Trinity River and it tributaries in Dallas, Denton, and Tarrant Counties. The Final Regional Environmental Impact Statement completed in 1987 indicated that within the 73,000 acre study area only 570 acres of herbaceous wetlands were identifiable within the 100 year flood plain and 745 acres were within the Standard project flood plain. Even without a definitive historic record of emergent wetlands losses within the area prior to the major Corps construction activities, it is clear much losses have occurred. These losses to wetlands adjacent to the riparian woodlands in the form of scars, seeps and cutoffs also impacted many species of migratory shore birds, wading birds reptiles and amphibians. From a resource protection stand point, it could be easily argued that efforts should be placed on maintaining and improving the integrity of bottomland hardwood forests because of their ecological significance, their visibility and appeal to observers and the long time frame required to reestablish a mature forest. Emergent wetlands also have ecological significance and because they can be established comparatively quicker than forests, the annualized benefits can be quite high. In addition emergent wetlands can be established in conjunction with other proposed project features without compromising flood reduction benefits or actually inducing flood damages.

ALTERNATIVE PLAN FORMULATION

In general, the planning process followed during development of the recommended plan was predicated on following the objective of minimizing impact to bottomland hardwoods. Planning leading to the determination of a 1200 foot wide swale, the National Economic Development Plan (NED), reduced channelization plans during further consideration due to adverse environmental effects. A vegetative management plan was considered but eliminated because it would have seriously diminished stream aquatic, riparian and bottomland hardwood habitats that have high national priority for protection. An array of "swale" alternatives, including, the NED plan, although causing losses to bottomland hardwoods was designed and aligned to avoid the highest quality forested habitats to the extent possible. The swale plans did not receive endorsement by the entire environmental community but appropriate mitigation plans were found to be feasible for the proposals.

The Chain of Wetlands (CoW) alternative alignment was developed from a smaller swale plan around desires expressed by the sponsor following extensive public involvement. A major planning objective by the Corps and sponsor included the commitment to continue avoidance of bottomland hardwood forest particularly high quality forested areas and minimization of impact to all bottomland hardwood forested areas. The CoW alignment within the upper reach has been moved to the west as far as technically and economically justifiable. The alignment of the Cadillac Heights (100-yr and SPF) and SPF Lamar Levees has also been extensively considered and it has been determined that other reasonable alignments would not produce less impacts to important resources. Alternatives evaluated for the I-45 bridge protection included no action, fortifying the piers in the channel and river realignment. Only the realignment was found to provide long term protection.

The final array of alternatives was developed from combination of plans. The locally preferred plan, or LPP, includes the CoW, the Lamar and Cadillac Heights Levees providing standard project flood protection, and the I-45 channel realignment. The apparent Tentative Federally Supportable Plan (TFSP) includes the features of the LPP, except that only 100-yr protection for the Cadillac Heights would be provided.

A non-structural alternative was developed that considers the feasibility of buying residences and businesses with the Cadillac Heights area. The non structural plan was considered only for the areas that previous studies had shown that some level of buy out could be justified. The remainder of the plan named the non structural includes the chain of wetlands and the Lamar Levee. It was found economically justified to acquire structures up to the 10 year flood elevation. Details of that plan are included in the Economic Appendix. Minimal disturbance to existing resources would occur for the non structural element of the proposed project. In the areas where structures would be removed, the soil would be stabilized with grasses. The most likely future use of the area would be as parkland supporting low density recreation.

ENVIRONMENTAL CONSEQUENCES

As was noted in the bottomland vegetation section of this appendix, because of the losses of bottomland hardwood ecosystems in Texas and in the United States, the bottomland forest is of environmental concern in the analysis of the proposed project area. A coordinated effort was made by the Corps of Engineers and the City of Dallas in consultation with state and federal resource agencies to design a flood control project that would be feasible in terms of economics yet minimize the impacts to the valuable bottomland hardwood resources in the proposed project area. The following narrative and graphics show the impacts of the various potential alternatives on the bottomland hardwood forests within the proposed project area.

Micro-Climate Effects

One of the concerns raised by concerned citizens and environmental groups was the impact that removing trees would have on surrounding areas. McPherson, Nowak, and Rowntree (1994) in a report for the U.S. Forest Service document that , by transpiring water, blocking winds, shading surfaces, and modifying storage and exchanges of heat among urban surfaces, trees affect local climate and human thermal comfort. These benefits are also documented in Mapping Micro-Urban Heat Islands Using Satellite Imagery (Lowry and Aniello 1993) for Dallas County, but it must be understood that the microclimate effects of trees to conserve energy and lower temperature are very localized in nature. Without directly being covered by the shade provided by trees or close enough to take advantage of the benefits provided by trees as natural windbreaks, microclimate effects are negligible. Therefore, the removal of trees in conjunction with any of the potential alternatives for the proposed DFE flood control project is expected to have little or no impact on microclimate effects of those trees to surrounding residential, industrial and business neighborhoods.

It is also important to remember that none of the potential alternatives call for the addition of any impervious surfaces which might be expected to add radiant heat thereby increasing local temperatures. The replacement of trees by herbaceous vegetation would not have this effect.

Air Quality

Future Without Project Alternative- The "Future Without Project Alternative" would cause no significant adverse impacts to air quality within the proposed project area. Regional trends in air quality indicate that regulated pollutant levels are slightly increasing. Flooding episodes and flood plain regulations imposed by the City of Dallas within the proposed project area would restrict further urban and commercial development. In the absence of urban and commercial growth, mobile and stationary pollution emitting sources would decrease as would their associated pollutants. Addition of Parkways planned by others along existing and proposed levees could result in increases in pollutant levels.

The development of additional tree canopy in the area would provide beneficial impacts through biogenic removal of regulated gaseous air pollutants. UFORE estimates of pollution removal capabilities with this alternative indicate trees in the entire DFE area would have the capacity to assimilate 13.85 tons/year of carbon monoxide, 12.23 tons/year of sulfur dioxide, 34.30 tons/year of nitrogen dioxide, 80.37 tons/year of PM10, and 151.23 tons/year of ozone or approximately 10.1% of the total capacity of trees in the Dallas, Texas, area. The additional tree canopy that would develop would provide a slight improvement of approximately 4.1% in air pollutant removal capability above the existing conditions (Table 1).

National Economic Development (NED) Alternative- The implementation of the NED alternative would cause minor adverse impacts to the quality of air within the proposed project area. Utilization of diesel-fueled heavy equipment, would result in minimal amounts of exhaust fumes, smoke, and dust during construction activities. There would be no stationary emitting sources and no on site storage of petroleum or petroleum based by-products to cause additional negative impacts to air quality. Disposal of cleared vegetation or other debris by burning during the construction would be accomplished only as permitted by the TNRCC. Required maintenance activities required for the NED alternative would contribute little additional mobile air emissions.

The reduction in tree canopy area from clearing activities for swale development would result in negative impacts through removal of biogenic sources which extract regulated gaseous air pollutants. UFORE estimates of pollution removal capabilities by trees in the entire DFE proposed project area with this alternative implemented, indicate there would be an vegetation assimilation capacity of 12.07 tons/year of carbon monoxide, 10.66 tons/year of sulfur dioxide, 29.89 tons/year of nitrogen dioxide, 70.03 tons/year of PM10, and 131.78 tons/year of ozone or approximately 8.8% of the total capacity of trees in the Dallas, Texas, area. The reduction in tree canopy would decrease the air pollutant removal capability below the existing conditions by 9.2% (Table 1).

The NED plan would call for revegetation of the cleared swale area. The planted vegetation would provide a small amount of air pollutant assimilative capacity and to a limited extent, ameliorate the air quality impacts caused from tree removal.

Locally Preferred Plan (LPP) Alternative - The implementation of the LPP alternative would cause minor adverse impacts to the quality of air within the proposed project area. Utilization of diesel-fueled heavy equipment, would result in minimal amounts of exhaust fumes, smoke, and dust during construction activities. There would be no stationary emitting sources and no on site storage of petroleum or petroleum based by-products to cause negative impacts to air quality. Disposal of cleared vegetation or other debris by burning during the construction would be accomplished only as permitted by the TNRCC. Required maintenance activities required for the LPP alternative would contribute few additional mobile air emissions.

The reduction in tree canopy area from clearing activities for wetlands and levee development would result in negative impacts through removal of biogenic sources which extract regulated gaseous air pollutants. UFORE estimates of pollution removal capabilities of trees in the detailed project area under future conditions as listed in Table 1 indicated there would be an vegetation assimilation capacity of 2.02 tons/year of carbon monoxide, 1.78 tons/year of sulfur dioxide, 4.99 tons/year of nitrogen dioxide, 11.70 tons/year of PM10, and 22.02 tons/year of ozone or approximately 1.5% of the total capacity of trees in the Dallas, Texas, area. The impacts of tree removal to these assimilative capacities as a result of implementing the elements of the LPP Alternative are delineated in Table 5.

Tentative Federally Supportable Plan (TFSP) Alternative - The TFSP alternative is similar in impacts to that of the LPP. The difference between the two alternatives is the size of the Cadillac Heights Levee. Neither of the two Cadillac Heights levee alternatives impact large areas of existing forest and therefore their impacts to air quality are minimal.

Table 5

The impact of proposed project measures on annual removal rates (tons per year) of regulated air pollutants by trees as determined by using the USDA's UFORE[1] computer simulation model.

Site	Carbon Monoxide	Sulfur Dioxide	Nitrogen Dioxide	Particulate Matter (10*um*)	Ozone
CoW, North	-0.15	-0.14	-0.38	-0.89	-1.67
CoW, South	-0.09	-0.08	-0.21	-0.49	-0.93
Cadillac Heights Levee (SPF)	-0.02	-0.02	-0.06	-0.13	-0.25
Cadillac Heights Levee(100yr)	-0.01	-0.01	-0.01	-0.03	-0.06
Lamar Street Levee	-0.13	-0.11	-0.32	-0.76	-1.42
I- 45 Channel Diversion	-0.02	-0.02	-0.05	-0.13	-0.24
Impact for (LPP)	-0.41	-0.37	-1.02	-2.40	-4.51
Impact for (TFSP)	-0.40	-0.36	-0.97	-2.30	-4.32
Impact for Non Structural Alternative [2]	-0.37	-0.33	-0.91	-2.14	-4.02
Preservation value of proposed Mitigation Area	+2.24	+1.99	+5.58	+13.09	+24.60
Conversion of Grasslands to Forest in TFSP Mitigation Area	+0.55	+0.48	+1.36	+3.18	+5.98
Conversion of Grasslands to Forest in LPP Mitigation Area	+0.57	+0.50	+1.41	+3.30	+6.21

[1] - Urban Forest Effects (UFORE) is the computer model developed by Dr. David J. Nowak of the United States Department of Agriculture (USDA) Forest Service, Northeastern Forest Experiment Station, Syracuse, New York.
[2]-Locally Preferred Project with partial buy out in lieu of Cadillac Heights Levee

In addition, the LPP and TFSP plan would call for development of wetlands and replanting of grasses within the cleared swale and turfing of levee areas with grasses. The new vegetation would also provide a small amount of air pollutant assimilative capacity and to a limited extent, ameliorate the air quality impacts caused from tree removal.

Non-Structural Alternative- Air quality impacts associated with implementing the "Non-structural Alternative" would be very similar to those impacts previously described for the LPP and TFSP. The differences in air quality impacts between the LPP and the Nonstructural Alternative would result from the reduction in construction activity associated with the Cadillac Heights levee. Not building this levee as part of the proposed project would reduce the use of heavy equipment for earth moving activities which may cause minor adverse impacts to the air quality through emission of exhaust fumes, dust, and smoke. This alternative would also allow the tree canopy to remain and develop in the areas where the levee construction would have impacted. The remaining tree canopy would provide air quality benefits through air pollutant removal. the use of heavy equipment for earth moving activities or vegetation clearing, or the elimination of plants which remove pollutants.

Mitigational Areas - The tree canopy in the areas delineated for mitigation would provide beneficial impacts through removal of regulated gaseous air pollutants.

Mitigation plus LPP - The addition of the tree canopy in the mitigational areas to that of the canopy area in the LPP Alternative, would increase the total pollutant removal capability over each area individually.

Mitigation plus TFSP -The additional of tree canopy in the mitigation areas for this plan would also increase the total pollutant removal capacity.

As can be seen, the impacts from development of either the LPP or TFSP to all parameters is minimal. In addition acquisition and preservation of the proposed fish and wildlife mitigation area would greatly exceed the losses from implementation of the proposed project features. The proposal to implement mitigation feature of hastening the conversion of existing grasslands within the mitigation areas to bottomland hardwood forest by intensive tree plantings would result in more gains in air quality purification than would be lost by the proposed project features, individually or cumulatively.

Impacts on Bottomland Hardwood Forests

One of the main concerns of citizens and environmental groups has been the impacts of the various potential alternatives on the bottomland hardwood forests located within the proposed DFE project. Table 6 delineates the impacts for the construction alternatives in terms of tree species and numbers.

Table 6
Bottomland Hardwood Forest Impact Analysis

	NED Plan	CoW	Lamar Levee	Cadillac Levee (SPF)	Cadillac Levee (100-yr)	Non Struct-ural	I-45 Diver-sion	TFSP	LPP
Total Acres of Trees	503.9	89.9	53.3	9.4	2.4	143.2	9.0	154.6	161.6
Total Acres - Pecan-Oak BLH	146.6	5.9	10.6	0.0	0.0	16.5	4.1	20.6	20.6
Total Acres - Ash-Elm BLH	357.3	84.0	42.7	9.4	2.4	126.7	4.9	134	141
Average Number of Trees per Acre-Pecan-Oak	196	196	196	196	196	196	196	196	196
Average Number of Trees per Acre-Ash-Elm	218	218	218	218	218	218	218	218	218
Total Number of Trees Impacted-Pecan-Oak (000's)	28.7	1.1	2.0	0.0	0.0	3.2	0.8	4.0	4.0
Total Number of Trees Impacted-Ash-Elm (000's)	77.9	18.3	9.3	2.0	0.5	27.6	1.1	29.2	30.7
Total Number of Trees Impacted(000's)	106.6	19.4	11.3	2.0	0.5	30.8	1.9	33.2	34.7

Pecan-Oak and Ash-Elm bottomland hardwood forest designations were taken from data derived from vegetation cover and land use maps.
Average number of trees per acre was estimated from data collected in the field. These figures were then used to estimate the number of trees impacted by the various alternatives.

Future Without Project Alternative- The long term survivability of the bottomland hardwood forest within the proposed project area would depend on the City of Dallas' Flood Plain Management Plan and any future development, natural disturbances (e.g.,prolonged flood events, tornados) and encroachment by human activities. Current regulations and public concern indicate however that the bottomland hardwood forest would increase in size and quality over time.

Non-structural Alternative- The small number of trees in the Cadillac Heights area which would be impacted by this alternative would probably not be removed as part of any Corps of Engineer activities, but they could be impacted by any future development and prolonged flooding of the area.

National Economic Development Plan (NED) Alternative- This alternative would have major adverse impacts on the bottomland hardwood forest ecosystem now found in the proposed project area. One hundred forty seven acres of Pecan-Oak and 357 acres of Ash-Elm bottomland hardwoods would be lost and the quality of the surrounding bottomland hardwood habitat would be greatly compromised. Fragmentation of forested habitat often eliminates its suitability for certain species who need a more continuous range in order to survive. It also opens up more fringe area to be inhabited by species who would not normally be found in a bottomland hardwood system. This also leads to losses in bottomland hardwood dwelling species who are then not able to adequately compete against the new invader species.

Locally Preferred Plan (LPP) Alternative- This alternative would impact a portion of the bottomland hardwood forest found within the study area, but the impacts would be located in that portion of the proposed project area that has already seen significant impact by human activities such as gravel, dirt, and topsoil mining, landfills, and years of illegal dumping activities. Another consideration is that the bottomland habitat impacted by the LPP would for the most part be located in an area which is of lesser habitat quality than the NED plan. Implementing the LPP instead of the NED plan would save over 73 percent of the bottomland hardwood acres that have been identify as being within the proposed project area. And perhaps more importantly, over 90 percent of the bottomland hardwood forest acres determined to be high quality (Pecan-Oak bottomland hardwood forest) habitat would be protected. Roughly 50 percent of the land that would be impacted by the LPP would be considered wetlands by U.S. Army Corps of Engineer determinations.

Tentative Federally Supportable Plan (TFSP) Alternative- This alternative is similar in impacts to that of the LPP. The lesser length of the 100- yr Cadillac Levee would eliminate impacts to 7 acres of existing forested lands that would occur with implementation of the LPP.

AQUATIC RESOURCES

Water Quality

Future Without Project Alternative- Water quality in the Trinity River within the segment of the Dallas Floodway Extension (DFE) would continue to improve. In addition to more stringent Federal and state regulations aimed at reducing water pollution, comprehensive watershed management programs in the upper watershed of the Trinity River are being initiated by local governments and municipalities. An objective of the these programs is to restore the river and flood plain back to its natural condition. A functional benefit and output of this program has been an overall improvement in all aspects of water quality throughout the entire Trinity River system, including the DFE segment.

Non-structural Alternative- The water quality of the Trinity River would not be altered as a result of the implementing the nonstructural alternative. Future development or utilization of the areas involving the nonstructural alternative could strongly influence water quality in the DFE segment of the Trinity River.

National Economic Development (NED) Alternative- Water quality impacts resulting from the development of a 1200 foot bottom width overland swale would occur from the removal of trees and soil disturbances. A reduction in number of trees within the flood plain would temporarily increase water turbidity and nutrient loads during construction from rain events. This impact would be temporary and would cease after turfing. Water temperature of temporarily stored waters in the off channel swales could increase slightly because of reduced canopy shading and the decreased dissolved oxygen levels that could result temporarily impact water quality in the River during the first minutes of a flushing event.

Locally Preferred Plan (LPP) and TFSP Alternatives- Placement of levees in the DFE could increase the velocity of river water during flood events, however, the levees would not be constructed without a compensating swale which would tend to balance velocities. The levees would only function during extreme flooding events in which case the velocity increases would be negligible. Sump areas would extend water retention times of storm water runoff, allowing for turbidity reduction and possible contaminant removal prior to entering the Trinity River. During nonflood and no rainfall periods the levees and sumps would not affect water quality in the Trinity River. Temporary impacts to turbidity from runoff during construction could occur.

The chain of wetlands would provide both beneficial and adverse impacts to the water quality of the Trinity River. As proposed, the wetlands would beneficially impact the water quality of the river by assimilating nitrogen, phosphorus, and any heavy metals from the Central Waste Water Treatment Plant stream which would be used to hydrate the wetlands. The wetlands would also provide beneficial filtration and cleanup of wastewater prior to groundwater recharge. During conditions of low sunlight, high water temperature, no wind, and low wetland exchange rate, dissolved oxygen concentrations in the chain of wetlands would be very low and the Biochemical Oxygen Demand (BOD) of the water very high from the organic matter generated. Under these conditions, the water flowing from the wetlands into the Trinity River would provide adverse impacts to the water quality of the river at the point of entry and downstream from oxidation of the wetland organic matter. Construction of the wetland outflow points on the river channel would cause temporary impacts by increasing the turbidity of the water. Channelizing the Trinity River at Interstate 45 bridge would result in a short-term increase in river turbidity. A temporary increase in Biochemical Oxygen Demand (BOD) or Chemical Oxygen Demand (COD) may also occur depending upon the molecular composition of the disturbed river sediment. The reduction in light transmittal from elevated turbidity would temporarily shade oxygen-producing phytoplankton and cause lower dissolved oxygen levels.

Aquatic Habitat, Aquatic Invertebrates, and Fisheries

Future Without Project Alternative- With the development of comprehensive watershed management plans in the upper watershed, the aquatic habitat of the main stem of the Trinity River would continue to improve corresponding to the improvement in the water quality. The diversity and number of aquatic invertebrate and fish species would increase in the DFE segment of the river as the pollution sensitive aquatic organisms return to occupy former niches.

Non-structural Alternative- The condition of the aquatic habitat and fisheries resources following implementation of the proposed nonstructural alternative would not be changed in the DFE segment of the Trinity River. Beneficial or negative impacts to the aquatic habitat, aquatic invertebrates and fishes would be highly dependent on future development of these areas.

National Economic Development (NED) Alternative- Impacts resulting from the development of a 1200 foot bottom width, overland swale would occur from the changes in water quality associated with tree removal and soil disturbances. Temporary decreases in aquatic habitat quality would occur under environmental conditions incurred from the implementation of the NED alternative. It is not anticipated that there would be a significant corresponding reduction in the species diversity of aquatic invertebrates and fish.

Locally Preferred Plan (LPP) and TFSP Alternatives- Placement of levees in the DFE would provide no appreciable positive or negative impacts to aquatic habitat or fisheries resources. Sump areas would improve the water quality characteristics of storm water run-off entering the Trinity River and subsequently enhance the aquatic habitat for aquatic invertebrates and fish.

The chain of wetlands would provide both beneficial and negative impacts to the aquatic habitat and fisheries resources of the Trinity River. The improvement in water quality provided by the chain of wetlands would enhance the aquatic habitat and beneficially impact fish and aquatic invertebrate communities. The chain of wetlands would provide new habitat for fish and aquatic invertebrate species which prefer water velocities lower than the flow rates which occur in the main stem of the river. Rip rap armoring at wetland discharge points on the river would provide substrate for colonization by communities of aquatic invertebrates, and food, refuge, and spawning areas for fish. Rock placement to protect the stream bank at the outfalls would produce a structural bottom feature which would benefit fish by providing a congregational point for bait fish and higher predatory fish species. Aquatic habitat in the wetlands and the river would be adversely impacted if environmental conditions (low sunlight, high water temperatures, no wind, and low wetland exchange rates) which generate poor water quality prevail. Management of the wetlands would occur to minimize any impacts to the main stem river. Construction of the wetland outflow points on the river channel would cause temporary negative impacts to aquatic species not tolerant of elevated turbidity levels.

Channelizing the Trinity River at Interstate 45 bridge would result in a short-term increase in river turbidity and decrease in dissolved oxygen concentrations which would adversely impact the aquatic habitat. This would temporarily impact aquatic invertebrate and fish species not tolerant of elevated turbidity levels or reduced dissolved oxygen concentrations. Moving the river channel to avoid bridge pilings would adversely impact the aquatic habitat by removing a feature which would provide structure for colonization of by aquatic invertebrate communities, and a feeding area and congregational focal point for fish.

CUMULATIVE IMPACTS

This section analyzes the proposed project in the context of current and future trends in the Upper Trinity River Basin. The purpose of this section is to assess the cumulative impacts of the proposed action, when combined with other known actions in the vicinity of the Dallas Floodway Extension area. The proposed action, including environmental mitigation, makes little or no contribution to regional trends that are of concern in assessing cumulative impacts.

Land Use

Urbanization has greatly influenced land use patterns within the Dallas area. Upstream development has also led to land use modification within the floodplain of the Trinity River and major tributaries, such as White Rock Creek. As additional runoff from upstream areas has increased the frequency of flooding within the study area, land use has shifted away from agriculture, except for a few areas of pasture land. Voluntary programs leading to the removal of some residences in the more frequently flooded areas have also influenced land changes. Most abandoned areas have revegetated with grasses, followed by young forests. The proposed project would reduce flooding within the project. The project would directly remove forests that have developed during the past 30 to 40 years; however, these losses would be mitigated resulting in a larger area of preserved and reestablished forests. It is anticipated that some intensification of residential and light industrial development would occur within the area immediately protected by the chain of wetlands and levees.

Cultural and Historic Resources

Any impacts to cultural and historical resources would be mitigated, according to provisions of the National Historic Preservation Act. Therefore, the proposed action would make no contributions to cumulative impacts of the area.

Noise

All noise impacts directly attributable to the project would be temporary in nature. Levees would tend to interfere with the distribution of some noises. Some noise associated with roadway traffic could be redistributed to the area should the Texas Department of Transportation decide to utilize existing and proposed levees for reliever roads.

Climate and Air Quality

The proposed project would have only minor impacts to local temperature and air quality parameters. There would be no measurable impacts to climate. Cumulative impacts to air quality would be insignificant, since environmental mitigation would result in an overall increase in the size of preserved and restored forested areas.

Hydrology and Water Resources

An analysis to determine the impacts of the proposed project to areas downstream of the project indicate negligible effects. Potential peak discharge increases downstream of the project are approximately 1 percent for the 100-year event and 3 percent for the SPF.

Ecological Resources

The most significant resource within the proposed project area has been identified as the bottomland hardwood forest ecosystem located in an area referred to as the "Great Trinity Forest". While the proposed project would impact only a small area of the forest, the proposed environmental mitigation plan could provide a catalyst to ultimate acquisition and management of over 1,000 acres of the area which is either currently forested, or could be converted to bottomland hardwood forest through intensive management. In addition, the proposed environmental restoration project, which includes the development of emergent wetlands, helps reverse the trend of losses to this important resource.

ENVIRONMENTAL RESTORATION

The proposal to modify the flood swale to provide restoration of shallow water and emergent wetlands was developed to provide values to fish and wildlife resources, primarily migratory waterfowl, shore and wading birds that utilize the Trinity River corridor as part of the spring and migratory flights. The wetlands would be managed primarily as moist soil units that would optimize production of insects, seeds, tubers and vegetative structures to support several wildlife species during times of critical energy needs. Evaluation of existing constructed wetland features in the area indicated that it was desirable to consider the possibility to use a permanent water source such as the existing Central Wastewater Treatment Plant effluent to assure that water for flooding the wetland cells would be available when needed for wildlife usage. An analysis comparing construction of the wetlands with and without a dependable water supply was made.

The design for the proposed restoration plans was developed based upon extensive input from U. S. Fish and Wildlife Service (USFWS), literature on wetland development in the Trinity River Basin, and from consultation with other biologists within the Corps of Engineers familiar with development of wetlands within this ecoregion for promotion of fish and wildlife benefits. Aside from development of gradual side slopes and provision of a deep permanent water pool, the major characteristics which promote optimized environmental benefits are the ability to regulate water levels with control structures and ability to provide flooding at proper periods during the year. The wetlands as proposed for the Chain of Wetlands (COW) with control structures and a pumping system designed to deliver water from a continually available source reflect optimized conditions based upon the available local expertise.

Table 7 reflects development of the wetlands without the capability to provide water from a local permanent water source. Based upon existing hydraulic models, it was determined that a flow of approximately 8,000 cubic feet per second would provide overbank flows sufficient to flood the wetlands. Based upon watershed characteristics, it was determined that the overbank flood events would coincide with local rainfall sufficient to fill the wetlands and is thus a good estimator for frequency of flooding without use of a pumping system. Hydraulic and hydrologic analyses indicate that approximately 67 % of the time, there would be sufficient water available under natural conditions during the spring and early summer to flood the wetlands and stimulate initial growth of emergent and moist soil plants along the perimeter of the wetlands. However, it was found that only 5 % of the time a flooding event would occur during August to irrigate and promote optimum seed production of wetland plants. Approximately 40% of the time flooding would occur during the October to January period when food and cover produced by the wetlands vegetation is critical for migratory waterfowl and shorebirds. From these data, the average habitat suitability was adjusted to reflect the effect of reduced flooding on the wetlands. It could additionally be argued that the actual average size of the wetlands would also diminish significantly. Looking at suitability values only, there would remain an increase in average annual habitat units in this alternative but approximately 83 % of the values would be attributed to the grassland portion of the complex and less than 16 % of the values would be attributable to the wetland portion. The average habitat value of the permanent water feature is almost totally lost because of the low frequency of flooding that naturally occurs during the summer months.

The wetland complex as proposed with dependable water supply available (Table 8) provides significant increased fish and wildlife resources values as indicated by the increases in habitat values of the permanent water, emergent wetlands and grassland portions of the complex. The plan provides for development of 123 acres of emergent wetland providing over 117 average annual habitat units and more than triples total resource values over the flood damage reduction swale as it would exist without the proposed emergent wetland complex development alternative. By contrast, the Chain of Wetlands without a dependable source of water would provide for development of only 83 acres of emergent wetland providing only 19 average annual habitat units for the priority emergent wetland resources (see Table 7). This represents an increase of 67% in acres and a 616% increase in average annual habitat units of emergent wetlands attributable to a dependable water source.

COST EFFECTIVENESS AND INCREMENTAL ANALYSIS

While an economic standard has been set that requires a flood damage reduction plan to have economic costs be no more than the economic benefits, a similar scale does not exist for environmental restoration proposals due to the fact that although costs are measured in dollars expended, benefits are measured in terms of environmental outputs such as habitat units, acres etc. that preclude development of a benefit to cost ratio to eliminate undesirable, non supportable project alternatives. Cost effectiveness and incremental analysis techniques as reported by Robinson, et al. 1995, are useful tools for the decision maker to eliminate poor alternatives and to guide the thought process in determining what project alternatives are supportable when environmental output levels continue to increase with increased expenditure of economic resources.

Cost Effectiveness of Emergent Wetland Restoration. The procedures outlined by Robinson, et al. (1995) were followed to evaluate the environmental benefits and costs of the two broad environmental restoration alternatives for the proposed Chain of Wetlands. These alternative management plans include providing necessary water when need to optimize fish and wildlife benefits to the proposed emergent wetland complex. This analysis evaluates the benefits that would be derived from the wetland complex relying on naturally occurring weather events versus a pumped supply to provide water for the wetlands. Output information used in the analysis are derived from Tables 7 and 8. Implementation costs information for the environmental restoration measures was developed by cost estimating. It was determined that no costs from opportunities foregone should be attributable to the proposals. Annual costs were derived using the initial costs of $5,651,253 for the wetlands without dependable water supply and $5,854,112 for the proposed wetlands with a dependable water supply. A 7-1/8% interest rate was used, assuming a 50-year project life and assuming that it would take approximately 1 year to construct the wetlands. An operation and maintenance cost of $50,000 was estimated for the COW with dependable water and $35,000 for the COW without dependable water.

Table 7
Chain of Wetlands Habitat Evaluation, with Water Supply not available for Management

	Upper Swale						Lower Swale					
	Area (acres)		HSI		Habitat units		Area(acres)		HSI		Habitat Units	
	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands
Grassland/ Forbland	105	65.77	0.25	0.56	26.25	36.83	165.99	114.44	0.25	0.56	41.50	64.08
Permanent Water		3.25		0.2	0	0.65		4.93		0.20	0	0.99
Emergent Wetlands		**35.98**		0.23	0	**8.28**		**46.62**		0.23	0	**10.72**
Total					26.25	45.76					41.50	75.79
Grand Total											**67.75**	**121.55**

Notes: *"With Flood Control Only" reflects on-site conditions if only the flood control portion of the swale were constructed.*
"Projected with Chain of Wetlands" reflects projected conditions with wetland restoration superimposed on flood control project.
"Grand Total" is the sum of the Upper and Lower Swale Values

Table 8
Chain of Wetlands Habitat Evaluation, with Water Supply Available for Management

	Upper Swale						Lower Swale					
	Area (acres)		HSI		Habitat units		Area(acres)		HSI		Habitat Units	
	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands	With Flood Control Only	Projected with Chain of Wetlands
Grassland/ Forbland	105	33.3	0.25	0.90	26.25	29.97	165.99	68.96	0.25	0.90	41.50	62.06
Permanent Water		18.03		0.95	0	17.13		27.40		0.95	0	26.03
Emergent Wetlands		**53.71**		0.95	0	**51.02**		**69.59**		0.95	0	**66.11**
Total					26.25	98.12					41.50	154.20
Grand Total											**67.75**	**252.32**

Notes: "With Flood Control Only" reflects on-site conditions if only the flood control portion of the swale were constructed.
"Projected with Chain of Wetlands" reflects projected conditions with wetland restoration superimposed on flood control project.
"Grand Total" is the sum of the Upper and Lower Swale Values

Pertinent information related to the cost effectiveness for the two action alternatives and the no action alternative are displayed in Table 9. Initial analysis indicates that both action alternatives are cost effective in that both provide benefits and that the slightly more expensive plan with dependable water supply provides higher environmental output than the less expensive plan.

Table 9
Cost Effectiveness of the Chain of Wetlands

	ANNUAL COST	AAHU OUTPUT	INCREMENTAL COST	CHANGE IN OUTPUT AAHU	INCREMENTAL COST/AAHU
No action	0	67.75	N/A	N/A	N/A
No pump station for dependable water	$466,857	121.55	$466,857	+53.8	$8678 / AAHU
With pump station for dependable water	$497,360	252.32	$ 30,503	+130.77	$ 233 / AAHU

The plan without dependable water supply provides a net increase in benefits over the no action alternative at an average annual cost of $8,678 per average annual habitat unit (AAHU), which appears to be more costly on average than would be expected in this ecoregion. The benefits of addition of dependable water supply are clearly demonstrated by the analysis. For an additional annual cost of $30,503, an additional 130.77 AAHUs can be developed. Further, evaluation of the data indicates that the best buy is the alternative providing dependable water enabling optimum management of the wetland complex. The no action plan as well as the alternative providing the swale with the wetlands without the capability to provide water when needed provide habitat, the majority of which is associated with the grassland portion of the complex. This scenario with minimal resource values attributable to the wetlands proper does not provide restoration of priority habitat and should not be considered further. The emergent wetland restoration plan which includes provision of a dependable water supply appears to be justified based upon the analysis conducted.

Incremental Analysis of Emergent Wetlands by Cell

Since both action alternatives are considered to be cost effective, further analysis is necessary to determine the optimum extent of environmental restoration through construction of emergent wetlands that is warranted. As in the analysis used to demonstrate that provision of dependable water was desirable and justifiable, an analysis was conducted to determine if the entire COW was justifiable or if only a portion of the complex should be constructed and managed. The COW as proposed and evaluated could contain from one to seven cells (See Figure 2) that would be connected to the water source, and a series of water distribution and control structures would be used to manage the emergent wetlands for optimum habitat output. For this analysis the uppermost or northern wetland cell was named Cell A and the cells were named in alphabetical order downstream, with the most southerly located cell named Cell G. The following general information provides a breakdown of the size of each wetland complex, including shallow water emergent wetland, deep water and surrounding native grasslands that provide the overall restoration values.

CELL	A	B	C	D	E	F	G
SIZE (ACRES)	12.43	25.04	51.7	15.86	16.22	69.08	80.65

Assumptions made in the analysis were based upon engineering and environmental constraints. The source of the dependable water supply proposed to be used is located near the center of the COW at the Central Wastewater Treatment Plant. The flow of water through the COW as proposed would be upstream from Cell C then gravity fed through Cell B and onto Cell A before exiting the system into the receiving waters of the Trinity River. Downstream the flow would be gravity fed from Cell D through E, F, an G in that order if constructed. From an engineering and environmental perspective it was determined that it would be unreasonable to build wetland cells at either end without the intermediate cells due to the high cost of providing water distribution channels or pipelines along long reaches without providing any corresponding environmental benefits along the water distribution area.

The first costs for construction of each cell were determined based upon quantities of material moved and construction of pump and other water supply costs. Subsequent to the analysis, it was determined that the first costs utilized, which included a cultural resources mitigation cost was in error. However, since the cultural resources mitigation costs were initially applied in proportion to the quantity of material excavated from each cell, the analysis conducted would not be effected. See the main report for the environmental restoration costs attributable to the project. Operation and management costs were estimated for the total proposed project and for each combination of wetland cells evaluated. Economy of scale was taken into consideration during formulation of initial and annual cost estimations. Environmental output benefits determined to be attributable to the project as proposed with water supply available as indicated in Tables 8 and 9 were assigned to the wetland cells based upon their relative size and other features including location and values added due to proximity of other resources within the project area.

Due to the complexity of the analysis, the software program "Automated Procedures for Conducting Cost Effectiveness and Incremental Cost Analyses (Beta Version 2.6) was used. The tabular outputs from the analysis are attached to the end of this appendix. As indicated, the analysis was conducted with only one limitation in alternative measure combinations. This limitation was that Cell B wouldn't be constructed unless Cell C was constructed and that Cell A wouldn't be constructed without Cells C and B. Downstream, the procedure precluded analysis of Cell G without D through F being in place, etc. This limitation, as explained, appears logical in that construction of cells remotely located from the water supply would be inordinately expensive due to the need to develop the water supply along the route without any environmental benefits being developed along the same route. This also reduced the number of possible Cell combinations from 128 to 20 for further evaluation.

Least-cost combinations- Whether by computer or manual analysis, the next step in the process encompasses determining least-cost combinations for each level of output. The first iteration eliminated Plan with combination of Cells B, C, D and E because the Plan with the combination of Cells D, E and F provided the same level of output at a lower annual cost.

Cost-Effective Least-Cost Combinations- This analysis eliminated all other combinations of measures that were not cost effective. The measures eliminated were those for which another measure exists that produces a higher level of output at less cost. The Plans eliminated through this analysis were Cells D and E; Cells C and D; Cells C, D and E; Cells B, C, and D; Cells A, B, and C; Cells A, B, C, D and E; and Cells D, E, F and G. Twelve plans were carried further for the next level of analysis.

Cost-Effective Least-Cost Combinations with Incremental Analysis- This step of the process sorts plans by cost, conducts an incremental analysis based upon incremental cost and incremental output and then subjects the plans to a cost-effective least-cost analysis based upon incremental average cost and incremental outputs. Five more alternative plans were eliminated by this portion of the analysis. Seven plans, including the no action measure, were carried further into the final incremental analysis (Table 10).

Combinations for Final Incremental Analysis- The prior processes of the analysis resulted in the elimination of all plans that are not cost effective. All six of the remaining cost effective action and the no action plans were subjected to a final incremental analysis as shown in Table 10 are cost effective. The plans are sorted and shown by increasing annual cost. It should be noted that each successive plan also shows continuing increasing environmental output.

Table 10
Incremental Analysis, Final Array of Alternatives, for Proposed Chain of Wetlands - Analysis by Cell

PLAN	ANNUAL COST	AAHU OUTPUT	INCREMENTAL COST	INCREMENTAL OUTPUT AAHU	INCREMENTAL COST/AAHU
No action	0	68	N/A	N/A	N/A
Cell D	$ 63,349	75	$ 63,349	+ 7	$9,050
Cell C	$ 94,688	99	$ 31,339	+24	$1,306
Cells D and E	$180,927	135	$ 86,239	+36	$2,396
Cells C, D, E and F	$255,615	166	$ 74,688	+31	$2,409
Cells A, B, C, D, E and F	$332,532	196	$ 76,917	+30	$2,564
Cells A, B, C, D, E, F and G	$497,360	252	$164,828	+56	$2,943

Ecosystem Restoration Plan Selection

The planning goal for ecosystem restoration for the proposed project area was to develop a wetland complex that provides maximum wetland and related deepwater and grassland habitat gains within the confines of the proposed swale area in a cost effective manner. The proposed restoration plan should not cause additional unacceptable impacts within the project area to fish and wildlife resources, nor should it cause impacts to flood damage reduction benefits within the study area or preclude the development of any additional flood damage reduction actions that might be needed in the future. The seven cells that were designed individually meet all criteria except they do not maximize total restoration output of important habitat (emergent wetland) that could be achieved. The cost effectiveness and incremental cost analysis was conducted to assist in making the determination if the plan that does maximize total habitat output (plan with all seven cells) is cost effective and, based upon its incremental cost, should be supported as the recommended environmental restoration plan.

By analysis, it has been determined that the plan with all seven cells is cost effective, as were the other five action plans and these alternatives were carried forward for the final incremental analysis

(Table 10). All seven of the final alternatives are viable alternatives that must be carefully evaluated under the question " is this level of output worth it?" The analysis conducted shows that for the six action plans that remained after prior screening, environmental benefits increased with each successive increment of wetlands added. Additional increments of wetland restoration if designed would likely also continue to show increased output, however, other planning constraints would be exceeded. For example, additional emergent wetlands could be designed for location off the flood control swale but this could only occur at the expense of bottomland hardwood habitat that is nationally recognized for its importance. Restoration activities should not result in damages that would require environmental mitigation. Studies in the upstream area of the existing Dallas Floodway have only recently begun under separate authorities and it would be imprudent to design emergent wetlands in that area prior to completion of necessary engineering studies to determine needs for that reach of the system.

Therefore, within the constraints of this project and planning area, it appears that the development of the complete COW would achieve the goal of maximizing emergent wetland habitat within this area without violating other developed criteria. The remaining question of whether the plan is supportable needs to be further scrutinized. Going beyond the no action alternative is relatively simple in that a determination has been made that environmental needs are present in the basin that can be obtained by project construction. The output of 68 AAHUs for the no action alternative is based upon the native grassland complex that would result from construction of the flood damage reduction swale and would essentially provide no benefits attributable to emergent wetlands, the priority output. The next increment, or the first action proposal, construction of Cell D alone, produces only 7 AAHU at a relatively high cost due to the initial high cost of providing the water supply infrastructure and the relatively small size of the Cell. The next measure, construction of Cell C provides an additional 24 AAHU at a cost of $1306 per AAHU. Additionally, these two increments represent the first in a logical implementation sequence upon which all other cells are dependent.

The remaining alternatives, as listed, continue to provide additional output. Again the average cost of $2,564 per added AAHU for the plan which includes wetland Cells A through F, and intermediate plans are judged to be worth the additional expense to gain the additional environmental output. The final alternative which includes all cells, causes need for additional thought in determining whether it is worth the additional expense in adding Cell G to provide an additional 56 AAHUs at an incremental average cost of $2943. For comparison purposes, an analysis conducted for a similar emergent wetland complex developed on Corps lands for mitigation of another project indicates that the incremental addition of this cell to the plan is warranted. That project was designed by the Corps and implemented with funds from another agency with a need to keep costs as minimal as possible. This analysis, which did not include real estate costs, showed an annual cost of over $3000 per AAHU gained. Under these comparative conditions it would appear that the final increment proposed, which would cost less per AAHU than in the comparative example, is supportable.

Following guidance by Robinson, et al., the tendency to select the plan that minimizes average cost, or in other words, is most efficient in production has been bypassed. Instead a rational decision has been made based upon careful examination of the costs and benefits of all potential combinations of wetland cells. The final array of alternatives were examined in the same manner as if a NED plan were being searched for. In our evaluation, the incremental environmental outputs continued to rise with increased expenditure of economic resources. The cap or limit to development of additional alternatives with more wetlands was based upon environmental constraints that precluded development of additional emergent wetlands.

In addition, very few opportunities of this magnitude exist to develop emergent wetlands as proposed in the COW, particularly when considering the other non-habitat benefits such as water quality, aesthetics and sightseeing and possibly other recreational benefits that could be attributable to the emergent wetland complex features of this multi-objective plan. The increase in habitat that would be obtained by addition of Cell G appears to environmentally, economically, and socially justifiable and it is recommended that the entire wetland complex with Cells A through G be included in the environmental restoration plan.

Fish and Wildlife Impacts and Environmental Mitigation

The District has reviewed the proposed project features and has determined that mitigation sequencing has been appropriately followed. Planning leading to the determination of the NED plan eliminated channelization plans from further consideration due to adverse environmental effects and a vegetative management plan was considered but eliminated because it would have seriously diminished stream aquatic, riparian and bottomland hardwood habitats that have high national priority for protection. An array of "swale" alternatives, including, the NED plan, although causing significant losses to bottomland hardwoods was designed and aligned to avoid the highest quality forested habitats to the extent possible. The swale plans did not receive endorsement by the entire environmental community but appropriate mitigation plans were found to be feasible for the proposals.

The Chain of Wetlands (CoW) alternative alignment was developed from a smaller swale plan around desires expressed by the sponsor following extensive public involvement. A major planning objective by the Corps and sponsor included the commitment to continue avoidance of high quality forested areas and minimization of impact to any bottomland hardwood forested areas. The CoW alignment within the upper reach has been moved to the west as far as technically and economically justifiable. The alignment of the Cadillac Heights and Lamar Levees has also been extensively considered and it has been determined that no other reasonable alignments would produce less impacts to important resources.

Based upon experience and lessons learned dealing with levees in the area has determined that the more gradual slope of the proposed levees, although causing slight additional impact due to a widened foot print is necessary to reduce slumping, possible failure and otherwise high operation and maintenance costs. Any additional adjustments to the proposed project features that would reduce environmental impacts to significant resources have been judged to have immediate or long term costs that are not warranted.

Table 11 provides a breakdown by proposed project feature indicating the extent of impacts to important resources that would occur if the proposed project or feature were implemented.

A large number of broad mitigation alternatives were developed and considered by the planning team. The formulation process consisted of the following sequential steps: avoidance and minimization of impacts, identification of positive project impacts which offset the adverse project impacts, identification of project lands which through various management strategies would achieve some mitigation, identification of adjacent public lands which could be managed for mitigation, identification of adjacent private lands which could be acquired and managed for mitigation, and management and/or acquisition of off-site (not adjacent to the project) public and private lands. The planning team eliminated several of these strategies from detailed consideration by consensus because of their unavailability or inability to meet mitigation objectives. For example, it was determined that intensive management of most project lands (or adjacent public lands) would not significantly increase their habitat values over what would be achieved without intensive management. Hydrologic considerations (conveyance requirements) restricted the use of other project lands, such as the golf course, from revegetation and intensive management to obtain additional mitigative value. The team also considered acquisition and management of lower quality habitats far removed from the project site but eliminated this concept from further consideration because it failed to meet the planning objective of preserving and maintaining habitat values within the urban Trinity River floodplain.

Table 11

Impacts by proposed project feature and for TFSP, LPP, NED and Non Structural Alternatives to Important Resources (In Acres).

	NED	CoW	Lamar Levee	Cadillac Levee (SPF)	Cadillac Levee (100 yr)	Non Structural	I-45 Diversion	TFSP	LPP
Pecan-Oak Bottomland Hardwood	*175.6	5.9	10.6	0.0	0.0	16.5	4.1	20.6	20.6
Ash-Elm Bottomland Hardwood	*427.7	84.0	42.7	9.4	2.4	124.9	4.9	134	141
Mixed Grass Forblands	196.7	125.5	44.5	41.7	10.6	170.0	0.0	180.6	211.7
Open Water	24.3	37.8	4.9	1.0	0.0	42.7	7.6	50.3	51.3

**Includes area affected by habitat fragmentation caused by NED alternative within White Rock Creek floodplain.*

All features of the proposed project have been reviewed to determine what measures could be implemented that would reduce impacts and consequently reduce the need to acquire additional lands for environmental mitigation purposes. The area between the proposed levees that would be acquired for project purposes are currently extensively forested. Within this area the largest area of contiguous highest quality forest is already in public ownership and the long term without the project scenario is that only low density non-intrusive recreation, primarily in the form of undeveloped trails, would exist in the area. Forested areas in private ownership within the study area are currently protected by extensive regulations, Section 404, CDC process, and City ordinance, requiring that losses be mitigated. Non forested areas are currently converting through natural processes to bottomland hardwoods with exception of some mowed areas upstream from and adjacent to the Central Wastewater Treatment Plant and the IH 45 crossing. The future "without project" evaluation, therefore indicates that this area would continue to increase in forest cover and habitat value over time.

Based upon these assumptions, management options to further increase values of proposed project lands were considered, however, it has been determined that minimal gains could be accomplished within the area and there is an overall concern that the area may require slight vegetative management in the future to preserve the hydraulic efficiency of the proposed project. In any event it wouldn't be prudent to expend funds to develop a slight increased habitat value that would have only short term benefits. The HEP, however, does attribute slight value increases as part of the proposed project, thereby lessening the total mitigation requirement.

The potential to use proposed sumps for tree planting was also investigated. It was established that tree plantings could be accomplished, however, there are several constraints that would minimize wildlife value of these efforts to the point that it was not deemed appropriate to develop mitigation measures involving the sumps. Foremost of the considerations is that the sumps would require periodic maintenance to remove accumulations of silt and other materials deposited from runoff. These maintenance activities would require complete disruption of any forest that might develop. With a minimum 75 year time period required for forest maturation, the use of the sumps is unfeasible for fish and wildlife mitigation for bottomland hardwood forests. In addition the sumps would be separated from the riparian zone by the proposed levees which would further act to minimize any values that might be obtained by tree growth. Sumps may may be modified by planting trees around the edges and a few within the center however these plantings would result more in aesthetic than environmental mitigation purposes.

The proposed project reach downstream, in particular the golf course area, was also reviewed to determine if mitigation could be accomplished on proposed project lands. It was determined that planting vegetation on those areas would reduce the hydraulic efficiency to an unacceptable level. The acquired project areas would be maintained as currently vegetated. One area from which the topsoil has been previously removed by others adjacent to the lower reach of the CoW, has been identified as having potential for use as a disposal site for excess material from the proposed project. This site would become multipurpose project lands that have potential for reforestation to meet some of the mitigation requirements. The site was included in detailed mitigation evaluations.

Fish and Wildlife Service Recommended Mitigation Plan Development

Using these assumptions for with and without project conditions, the Corps of Engineers, U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department modeled future with and without project conditions to determine impact to fish and wildlife habitat. The Services Habitat Evaluation Procedures were used to evaluate several plans to satisfy mitigation requirements for bottomland hardwood forest habitats impacted by the proposed project. The Corps provided an analysis of impacts to vegetation cover caused by separable project features. According to our studies the proposed project features of the LPP(the CoW, Lamar levee and sumps, Cadillac Levee)and the I-45 channel diversion would result in impacts to 21 acres of Pecan-Oak forest (High Quality), 141 acres of Ash-Elm (Medium Quality) forest, and 212 acres of mixed grass forbland. The HEP indicated that the LPP and 1-45 channel diversion features would result in losses of 14 Average Annual Habitat Units (AAHU) to Pecan-Oak forest and 91 AAHU to Ash-Elm forest over a 50 year period of analysis when compared to the future without project conditions.

Three potential mitigation tracts were identified which remain in private ownership and were evaluated for their potential to offset the losses to fish and wildlife habitat that would result from implementation of the LPP and the I-45 Diversion. These tracts are located within the Trinity River flood plain near the proposed project (See Figures 2 and 3). These tracts contain grasslands that have potential for conversion to bottomland hardwoods and areas of Ash-Elm and Pecan-Oak bottomland hardwood forested habitat that can be managed to improve their future habitat values.

Using the models for species evaluated, measures were developed to optimize habitat conditions on these tracts through conversion of existing grasslands to bottomland hardwoods and the improvement of existing forest stands. While the largest gains in habitat values over the life of the analysis occurs from grassland conversion, the cost associated with this conversion, including land acquisition is the most expensive per acre. Also within the tracts identified there is a limited amount of grassland available for conversion. Table 12 indicates the costs and average annual benefits associated with the three mitigation plans evaluated. Target mitigation values are based on habitat losses of 14 Average Annual Habitat Units (AAHU) to Pecan-Oak forest and 91 AAHU to Ash-Elm forest.

Table 12
Incremental Mitigation Analysis
Fish and Wildlife Service Recommended Plan

	Average Annual Habitat Units		Mitigation Cost Average Annual at 7 1/8%	Annual Cost / AAHU*
Mitigation Plan Alternative	Pecan-Oak Bottomland Hardwood(HQ)	Ash-Elm Bottomland Hardwood(MQ)		
No Mitigation	0	0	0	--
Plan A	+9	+43	$307,589	$5,915
Plan B	+9	+55	$330,347	$5,162
Plan C	+14	+92	$444,472	$4,193

*Average Annual Habitat Unit

Mitigation Plan A consists of modifying existing habitat at a tract located east of the Trinity River, in a corridor adjacent to Loop 12. The management plan to develop bottomland hardwood habitat consists of converting 86 acres of grassland to bottomland hardwood, preservation of 10 acres of grassland and habitat improvement on 753 acres of existing bottomland hardwood.

Plan B consists of adding an additional tract, a 34 acre area located on the west side of the Trinity, adjacent to the proposed lower Chain of Wetlands. This site is the site identified as potential multipurpose, surplus soil disposal and mitigation area. The management proposal is to convert the entire tract to bottomland hardwood.

Plan C is a combination of Plan B and addition of a 271 acre tract near IH 635, within the flood plain near the southern end of Dallas city limits boundary. Management in this tract would include conversion of 88 acres of grassland to bottomland hardwood and improvement of habitat quality on 173 acres and preservation of an additional 10 acres of grassland. Plan C would consist of a total 1154 acres with prescribed management practices that would fully mitigate projected losses to bottomland hardwoods attributable to the currently proposed project including the I-45 realignment. In addition to providing full mitigation of these resources, Plan C presents the best buy in terms of cost per gain in habitat value. Plans A and B are more costly per gain and do not provide the mitigation required to offset losses.

Table 13 displays the development and management techniques associated with the features to obtain the mitigation potential proposed with mitigation Plan C. These features were used to develop the cost estimates shown in the incremental analysis included in Table 12. Table 14 indicates the calculated proportion of the mitigation required in acres to offset fish and wildlife habitat impacts due to each proposed project measure based upon the US Fish and Wildlife Services recommended mitigation plan. The NED cost was determined during earlier planning.

Table 13

Habitat development features to mitigate impacts to bottomland hardwood the Dallas Floodway Extension-LPP, including CoW, SPF Lamar Levee and sumps, SPF Cadillac Heights Levee, and I-45 Channel Diversion based upon U.S Fish and Wildlife Service planting plans.

A. Acquisition

1. 926 ac BLH
2. 228 Mixed grass/forbland

B. Initial Development

1. Habitat Improvement of existing BLH's
   a. Selective thinning 463 acres.
   b. Mast trees (containerized at rate of 5 trees Per acre on 235 acres) 1175 trees
   c. Tree Planting with site prep 1175 trees
   d. Shear, rake, pile and bed 50 acres
   e. Passerine and squirrel nest boxes, acquire and install 270 boxes

2. Conversion of mixed grassland to BLH's
   a. Shredding/disking 208 acres
   b. Mast trees (containerized at rate of 40 trees /acre On 208 acres) 8320 trees
   c. Fruiting shrubs (containerized at rate of 10 shrubs/acre On 208 acres) 2,080 shrubs
   d. Tree planting with site prep 8,320 trees
   e. Shrub planting with site prep 2080 shrubs
   f. Hardwood seedlings (100 seedlings/acre for 208 acres) 20,800 seedlings
   g. Seedling planting 208 acres
   h. Passerine nest boxes 208 boxes

3. Fencing 6 miles
4. Signs

Table 14

Mitigation required by feature, LPP, Non Structural and NED Alternatives based upon U.S. Fish and Wildlife mitigation planting plan

CoW	635 Ac	$ 3,056,477
Lamar Levee/sump	392 Ac	$ 1,886,833
SPF Cadillac Levee	58 Ac	$ 279,173
100 yr Cadillac Levee	1 4.5 Ac	$ 69,793
I45 Diversion	69 Ac	$ 314,412
NON STRUCTURAL	1027 Ac	$ 4,961,022
LPP	1154 Ac	$ 5,554,607
TFSP	1110.5 Ac	$ 5,327,515
NED	3200 Ac	$14,296,736

Corps Analysis of Other Mitigation Alternatives

Areas remote to project area. An analysis of potential locations to conduct fish and wildlife mitigation was conducted, including potential mitigation sites within the main stem Trinity River and East Fork of the Trinity flood plains. The search included review of existing documented information, interviews with representatives of the City of Dallas and Dallas County. A broad search was conducted based upon known locations of existing or potential bottomland hardwood forest lands within the upper and middle Trinity River basin. The U.S. Fish and Wildlife Service (1991) conducted an inventory of lands within the basin that could be preserved or improved with management. This document was used as a guide to determine the ability of off-project locations to meet general planning mitigation objectives as well as meet requirements to offset losses fish and wildlife habitat as determined through use of the Service's Habitat Evaluation Procedures. The Service's report identified three general locations within the East Fork of the Trinity River Basin downstream of Lake Ray Hubbard containing existing tracts of bottomland hardwood forest and five locations along the main stem of the Trinity River between the confluence of the East Fork of the Trinity River and the upstream limits of Lake Livingston that had potential to be managed to achieve environmental mitigation. In addition numerous agricultural tracts adjacent to the East Fork were identified that could be converted or restored to bottomland hardwood habitat. Currently, these agricultural lands are protected by levees that are owned and maintained by levee districts.

East Fork Trinity River. The potential mitigation sites along the East Fork are approximately 20 straight line miles east of the proposed project location and the potential sites along the main stem are located between 40 and 90 straight line miles south of the proposed project. Subsequent reevaluation of the forested tracts and agricultural properties on the East Fork indicated that the tracts available were either too small to provide the necessary mitigation, were already designated as mitigation for numerous unrelated Section 404 permitted activities in the basin or had such social and economic constraints that they were inappropriate for acquisition and management for environmental mitigation. As an example, the agricultural lands along the East Fork, could be converted to bottomland hardwood, however, for the mitigation lands to function appropriately, the existing privately owned agricultural levees would have to be breached and new levees constructed to provide continued protection to the remaining agricultural lands not incorporated into the environmental mitigation. Assuming that conversion of approximately 500 acres of farmland to bottomland hardwood forest would provide the environmental mitigation to offset losses caused by the proposed project, approximately 4700 feet of existing levee would have to be breached and 14,100 linear feet of new levee designed to meet the existing level of protection. Existing levees usually average about 15 feet in height and have an eight foot top width. Repair costs for the agricultural levees in this area currently average approximately $1,000 per linear foot. Even if economy of scale would result in a reduction in the cost per linear foot to 50% of that required for repair, the new levees could still cost more than $7,000,000, excluding any cultural resource or HTRW investigation or mitigation costs that might be necessary. In addition, productive farm lands could cost as much as flood plain lands within the immediate project area. The alternative of utilizing agricultural lands adjacent to the East Fork, although initially appealing to pursue, was ruled out also because of the high cost for initial acquisition, construction and in addition, a high level of management would be required on the part of the project sponsor at a site located approximately 30 road miles from the proposed project site.

Trinity River Alternatives. Five locations were evaluated within the main stem Trinity River flood plain downstream of Dallas County and three sites within the immediate project area were evaluated for the cost effectiveness of providing the environmental mitigation. All of these sites were identified by the evaluation team including the US Fish and Wildlife Service as having potential for habitat improvement and therefore could provide some or all of the mitigation needed for the proposed project. In evaluation of these tracts, the cost of land acquisition and the cost of providing labor to manage the habitat improvements, including travel costs were utilized to determine if it is more cost effective to acquire lands that have an initial lower cost but higher operation and maintenance or to acquire lands closer to the proposed project that would have a higher initial acquisition cost but reduced operation and maintenance cost due to the proximity to the sponsors center of operation. Labor and material costs to plant or conduct other work to obtain the habitat gains were not included in this analysis, however, the potential sites were evaluated to see from a theoretical standpoint that the site could provide the average annual habitat units of bottomland hardwood forest values determined through use of the Service's Habitat Evaluation Procedures that would be needed to compensate for the proposed project impacts.

The tracts evaluated included the Big Lake site, located in Anderson County. This site is located approximately 100 road miles from the city of Dallas. The tract is approximately 9446 acres in size and it has been reported to be under the ownership of a single owner. It is not know if the owner would willingly sell only a portion of the tract. The tract could provide an estimated 1000 acres of land necessary to provide the necessary mitigation.

The tract located at the confluence of Catfish and Beaver Creeks also located in Anderson County would provide only a portion of the habitat needed to offset losses from the proposed project. The site is 1510 acres in size and is located adjacent to a State Wildlife Management Area, however the existing vegetation of the site is 75% marsh land. The site by itself could not provide the entire mitigation needed because converting existing high value marsh land which is likely jurisdictional wetland to bottomland hardwood forest would not meet policy objectives nor would it be met favorably by environmental agencies. It is unlikely that only the 25% that could be managed for mitigation purposes could be acquired separately. This tract is located approximately 60 road miles from the City of Dallas.

At the confluence of Buffalo and Linn Creeks, in Freestone County, a small 532 acre tract exists that is approximately 74% covered by high value bottomland hardwood forest. The remainder of the tract is in upland forest and agriculture. Even intense management would not result in sufficient habitat improvements to provide the necessary mitigation and it is unknown if only the bottomland hardwood site could be acquired. This tract is also located about 63 miles from the proposed project location.

The Middle Trinity Terrace is a 13,516 acre tract of severely cut-over bottomland hardwood forest comprised almost entirely of cedar elm and sugarberry. Management potential is good for this tract located in Navarro and Henderson Counties. The site is approximately 65 road miles from the proposed project site.

The Hagen bottoms is a 921 acre tract located in Anderson County. This tract is composed of approximately one-half cropland that could be converted to bottomland hardwood forest and the remainder of the tract is shrub swamp and bottomland hardwood forest. The tract appears most favorable in initial composition and comparable in size to the mitigation tract recommended by the U.S. Fish and Wildlife Service in their report on the proposed Dallas Floodway Extension project. The tract is located approximately 95 road miles away from the proposed project area.

The three tracts located adjacent to the main-stem Trinity River adjacent and just downstream of the proposed project combined totals 1154 acres in size . The combined tracts contain approximately 926 acres of bottomland hardwood forest and 228 acres of grassland that could be managed and converted respectively to provide mitigation for the project as proposed. These three sites are located close enough to the project area that operation and management expenses could be handled as an extension of the responsibilities of the sponsor's existing staff. Table 15 shows an estimate of the cost breakdown for the alternative sites including operation and maintenance including labor to oversee the mitigation areas. Labor and materials to do actual site preparation, establishment of the mitigation forest and provision of fencing to protect the mitigation area and acquisition and placement of nest boxes are not included in this analysis which is shown to identify the cost effectiveness of utilizing potential mitigation lands adjacent to the area or to establish the mitigation area at a remote location which would have a lower initial acquisition cost.

Table 15
Cost Effectiveness Analysis of Alternative Mitigation Sites

COST ANALYSIS							
NVESTMENT COST		Big Lake	Catfish/	Buffalo/	Middle Trinity	Hagen	Proposed
			Beaver Crk	Linn Crks	Terrace	Bottoms	for LPP
	FIRST COST	$1,260,000	$1,268,400	$446,880	$1,260,000	$1,768,320	$3,779,52
	ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.0712
	PROJECT LIFE (years)	100	100	100	100	100	10
	CONSTRUCTION PERIOD (months)	12	12	12	12	12	1
	INTEREST DURING CONSTRUCTION	$48,117	$48,438	$17,065	$48,117	$67,529	$144,33
	INVESTMENT COST	$1,308,117	$1,316,838	$463,945	$1,308,117	$1,835,849	$3,923,85
VERAGE ANNUAL CHARGES							
	INTEREST	$93,203	$93,825	$33,056	$93,203	$130,804	$279,57
	AMORTIZATION	$96	$96	$34	$96	$134	$28
	OPERATIONS & MAINTENANCE	$216,153	$165,692	$124,904	$207,126	$174,072	$20,00
	REPLACEMENTS	$0	$0	$0	$0	$0	$
	TOTAL ANNUAL CHARGES	$309,452	$259,613	$157,994	$300,425	$305,010	$299,86
NCREMENTAL ANALYSIS							
	AAHU (BLH)GAIN OVER NO ACTION	99.7	25	50	99.7	99.7	99.
	ANNUAL COST/AAHU GAIN	$3,103.83	$10,384.52	$3,159.88	$3,013.29	$3,059.28	$3,007.6

It needs to be made clear that the information developed to compare the cost efficiency of acquiring potential mitigation lands downstream within the Middle Trinity Basin as opposed to acquiring the lands jointly evaluated by the Corps and the U.S. Fish and Wildlife Service and recommended by the U.S. Fish and Wildlife Service, is based upon review of existing information documented during the Lower Trinity River study and does not reflect the degree of technical precision that was obtained during detailed studies of the lands recommended by the U.S. Fish and Wildlife Service. The actual management (tree planting, thinning, fencing, number of nest boxes to be provided) may vary substantially, however, these needs and their subsequent costs cannot be determined without detailed on-site evaluations including field data for the Habitat Evaluation Procedures. It should also be noted that the $20,000 O&M estimated for the District's recommended mitigation plan was developed jointly with the U.S. Fish and Wildlife Service and presumes that due to the proximity of the sites to the sponsor's center of business, that the oversite and routine care of the mitigation features can be handled by currently employed staff as a slight increase in exist duties.

Therefore our review of operation and management responsibilities of an approximate 1000 acre forested wetland mitigation site located within the Trinity flood plain, downstream from Dallas is based upon the difference in land costs and labor and travel costs. After discussion with Corps of Engineer employees representing Real Estate and Operations, it was determined that to reasonably assure that a forested site would respond to prescribed treatments in an manner appropriate to producing fish and wildlife mitigation, an observable physical presence is necessary on-site over the term of the mitigation project life. Fire, disease, vandalism, and timber rustling (firewood, heartwood, saplings, etc.) could devastate a forested mitigation site rapidly unless the property receives continual care and frequent observation. There are a number of ways that this oversite could be achieved.

The options for evaluated for the sponsor who is responsible for O&M include the following :

a. Contract with Texas Parks and Wildlife Department
b. Establish a residence at management area
c. Use existing or hired City of Dallas project manager and hired labor that would travel back and forth.

Based upon past experience, it is highly unlikely that Texas Parks and Wildlife Department would manage a relatively small forested mitigation area. Establishment of a permanent residence would involve additional start up costs and subsequent O&M. In addition, it is anticipated that an on-site manager would still be required to frequently travel to and from Dallas for coordination with other City officials on a frequent basis.

A decision was made to base operations and maintenance costs on having a full time manager and an assistant devoting varying amounts of time to the project. The team would travel back and forth between Dallas and the mitigation site three times per week during construction and in particular during the life of the project to establish a presence in adjacent communities and assure operation and maintenance needs are observed and appropriately addressed. We believe that the information developed adequately and accurately represents the additional current operations and maintenance costs that would be necessary to maintain a forested mitigation site remotely located from the sponsor's center of business.

Of the five remotely located sites economically evaluated, three appear to have potential to provide mitigation for fish and wildlife values, however, the distance away from the Dallas Floodway Extension project impacts ability to successfully manage at a reasonable cost. Of the three having best potential, the Hagen Bottoms Site appears most similar in size and existing vegetative cover breakdowns to the mitigation lands evaluated in Dallas County adjacent to the proposed project. The operations and maintenance costs were estimated for this site based upon three round trips per week plus additional local travel totally 34,320 miles per year. At existing current rates of $0.31 per mile, the mileage costs total $10, 639 per year. Total labor was estimated at $163,433 per year which includes a full time manager at a fully burdened cost of $114,400 per year and an assistant for slightly less than three quarters of a man year at a fully burdened rate of $67,200 per year. Future energy costs and labor costs were not considered but it can safely be presumed that the costs would increase over the life of the mitigation management. Operations and maintenance costs for other sites was calculated from a similar approach.

The results of the evaluation indicates that although land can be acquired at locations remote from the proposed project area at a lower initial cost, the benefits of such a proposal are overcome by the additional operation and management costs during the life of the project. It should be noted that the Catfish/Beaver Creeks area and the Buffalo/Linn Creeks areas do not meet the mitigation (AAHU) requirements to offset losses attributable to the proposed project either singular or when combined with each other. In addition, management of separate tracts so remote from the project site is not desirable from an economic or logistic stand point. The recommended mitigation plan was formulated consistent with project planning objectives and with mitigation policy. Use of mitigation lands in the project study area adjacent to the project causing the damages helps to meet the planning goal of protecting and restoring habitat values within the study area. Further mitigation policy prescribes that a sequence be used in identifying mitigation areas. That sequence calls for first looking for opportunities in project land, then in the immediate project area adjacent to the project causing the damages, and finally if the first options are not available, to look off site (but preferably within the same watershed). While mitigation cannot be accomplished on project lands, the recommended mitigation plan adjacent to the project is cost effective, incrementally justified and fully supported by the resource agencies and project sponsor. It should be also noted that even if the economic evaluation had shown that any of the alternate mitigation sites were slightly more cost effective, the remote sites likely would be found unacceptable to resource agencies and the sponsor. In addition, the proposed removal of trees as part of the project influence many other factors that would not be mitigated by selection of a remote location. For example, Dallas County is in a non-attainment area for ozone, and intensified regulatory requirements are in place currently, that are proposed to be even more strict within the next year. Our analysis indicates that the removal of trees as proposed by our project would have a slight effect on the potential removal of ozone from the local area. Replacement of the trees through the District's proposed fish and wildlife mitigation plan would result in an overall improvement of ozone reducing capability in the study area. Location of the mitigation site in Anderson County would not. As a result of this analysis, it has been determined that acquisition of mitigation lands near to the proposed project as requested by the sponsor and recommended by the Fish and Wildlife Services is economically justifiable.

Habitat Management cost effectiveness

Grassland Conversion to Forest. An almost unlimited combination of tree planting techniques could be evaluated to determine cost effectiveness for various grassland to forest conversion and forest stand improvement techniques. It was determined that only those combinations where it is possible to reliably estimate the effect of the planting combination on the net result in terms of habitat improvement (Habitat Units). An analysis to show cost effectiveness of different planting schemes is presented in Table 16.

Table 16
Vegetation Management Cost Effectiveness

REFORESTATION TECHNIQUES	COST PER ACRE	AVERAGE ANNUAL HABITAT GAIN (AAHU) PER ACRE	COST PER AAHU GAIN
Plan 1. 40 containerized trees and 10 shrubs per acre	$3857	0.71	$5,432
Plan 2. 10 containerized trees, 5 shrubs and 100 seedlings per acre	$1,050	0.65	$1,615
Plan 3. 5 containerized trees, 5 shrubs and 200 seedlings per acre	$ 900	0.67	$1,343
Plan 4. 300 mast tree seedlings and 150 shrub seedlings per acre	$ 500	0.64	$ 781

The analysis indicates that the most cost effective means of forest regeneration within the floodway is derived by following the scheme as outline in Plan 4. Planting of 300 mast tree seedlings and 150 shrub seedlings per acre will provide one average annual habitat unit for every $781 of initial cost investment. However, Plan 1 represents the planting regime recommended by the US Fish and Wildlife Service and was the basis for their recommended mitigation plan of 1154 acres to mitigate the proposed project losses. Since Plan 4 provides only 90 % (0.64/0.71)of the mitigation provided for grassland to forest conversion by Plan 1, an additional 11% of grassland would need to be added to the project to provide the habitat values needed. The Fish and Wildlife Service's recommended mitigation plan contained 228 acres of grassland, an additional 11% increase would result in the need to acquire and convert an additional 25 acres of grassland at an approximate cost of $2500 per acre. The Services plan for converting 208 acres of grassland to bottomland hardwood forest was estimated to cost approximately $624,000 excluding land costs. Addition of 25 acres including land cost and utilizing the mitigation planting technique that appears to be most cost effective for all 233 acres results in a cost to convert grassland to forest of approximately $195,010.

Habitat Improvement of Existing Forest. The Service also recommended in their mitigation plan that 5 containerized mast trees should be planted per acre in lands acquired that contain existing bottomland forest. For several reasons, we have determined that we have determined that planting with bare root seedlings should not be considered as a management option in these existing wooded areas. Shading from existing non-hard-mast trees would preclude their growth and we have determined that no habitat gain would occur from bare root seedlings within the existing forest. The planting with containerized trees at a rate of 5 trees per acre along with appropriate site preparation is recommended for the forested areas that are designated for habitat improvement.

Corps Mitigation Recommendation

Based upon the alternative analyses conducted, it appears that the mitigation plan recommended by the US Fish and Wildlife Service will meet the goal of no net loss of bottomland hardwood habitat. It also appears that location of the mitigation within the Trinity main-stem flood plain near the project is justifiable and appropriate since operation and maintenance costs for sites located farther downstream overcome the benefits of lower initial acquisition cost.

We have determined that the vegetation management plan proposed by the Service in existing forested areas is justifiable; however, it has been determined that planting of bare root mast tree and shrub seedlings is more cost effective than planting containerized trees and shrubs where conversion of grassland to bottomland hardwood forest is proposed. Our analysis indicates that although per acre costs are lower, the average annual habitat gains per acre are only 90% of that achieved by the planting regime recommended by the Service. Therefore an additional 25 acres of grassland should be acquired and converted to bottomland hardwood forest by planting with bare root seedlings. The Corps recommended mitigation plan would result in a significant initial cost savings over that proposed by the US Fish and Wildlife Service and would meet the planning objective of no net loss of bottomland hardwood forest habitat. It is proposed that the additional 25 acres of grassland be acquired adjacent to the area identified on Figure 3 as "Other Public Lands" located between US Highway 175 and the Trinity River and immediately upstream of the mitigation area proposed by the Service that adjoins Loop 12.

Table 17 displays the development and management techniques associated with the mitigation proposed for the LPP as proposed by the Corps. Table 18 shows a breakdown of mitigation required by feature and alternative utilizing the Corps mitigation proposal.

Table 17

Habitat development features to mitigate impacts to bottomland hardwood the Dallas Floodway Extension-LPP, including CoW, Lamar Levee and sumps, Cadillac Heights Levee, and I-45 Channel Diversion based upon Corps of Engineers planting plans.

A. Acquisition

1. 926 acres of Bottomland Hardwood Forest
2. 253 acres of Mixed grass/forbland

B. Initial Development

1. Habitat Improvement of existing BLH's
   a. Selective thinning 463 acres.
   b. Mast trees (containerized at rate of 5 trees Per acre on 235 acres) 1175 trees
   c. Tree Planting with site prep 1175 trees
   d. Shear, rake, pile and bed 50 acres
   e. Passerine and squirrel nest boxes, acquire and install 270 boxes

2. Conversion of mixed grassland to BLH's
   a. Shredding/disking 223 acres
   b. Hardwood seedlings (300 seedlings/acre for 223 acres)
   c. Shrub seedling planting(150 seedlings/acre for 208 acres
   d. Passerine nest boxes 223 boxes

3. Fencing 6 miles
4. Signs

Table 18

Mitigation required by feature, LPP, TFSP and Non Structural Alternatives based upon Corps of Engineers proposed mitigation planting plan.

CoW	649 Ac	$ 2,567,230
Lamar Levee/sump	400 Ac	$ 1,574,600
SPF Cadillac Levee	59 Ac	$ 238,450
100 yr Cadillac Levee	1 5 Ac	$ 25,913
I45 Diversion	71 Ac	$ 279,110
NON STRUCTURAL	1027 Ac	$ 4,420,940
LPP	1179 Ac	$ 4,659,390
TFSP	1135 Ac	$ 4,446,853

Executive Order 11988 - Flood Plain Management

The spirit and intent of Executive Order 11988 have been considered in preparation of this action. There are no feasible alternatives to conducting activities within the 100-year flood plain of the Trinity River and measures have been considered to minimize impacts to the flood plain through project design. Additionally, the City of Dallas currently has several programs for management of the Trinity River 100-year flood plain following proposed project implementation. The City is a participant in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program and the Community

Rating System (CRS). The City maintains a Corridor Development Certificate from the North Texas Council of Governments, has a Flood Warning System for the Trinity River Basin and a Flood Plain Ordinance which regulates development in the flood plain (Personal Communication: Mr. Loyd Denman, City of Dallas, Department of Flood Plain Management and Erosion Control).

Future flood plain impacts would be controlled through the development of a comprehensive Flood Plain Management Plan (FPMP). An FPMP would be developed by the City which in accordance with Section 202(c) of the Water Resources Development Act of 1996 and the guidance provided by the Secretary of the Army. The FPMP would be developed within one after the signing of the Project Cost Sharing Agreement and implemented within one year after completion of construction of the proposed project.

Section 404 Clean Water Act

The Corps of Engineers has been directed by Congress under Section 404 of the Clean Water Act (33 USC 1344) to regulate the discharge of dredged and fill material into all waters of the United States, including adjacent wetlands. The intent of Section 404 is to protect the nation's waters from indiscriminate discharge of material capable of causing pollution, and to restore and maintain the chemical, physical and biological integrity of these areas. Although the Corps of Engineers does not issue itself permits for proposed activities which would affect waters of the United States the Corps must meet the legal requirements of the Act. Section 404 (r) of the Clean Water Act, waives the requirement to obtain a State Water Quality Certificate provided information on the effects of the discharge of dredged or fill material into waters of the United States, including the application of the Section 404(b)(1) guidelines are included in an environmental impact statement (EIS) on the proposed project and the EIS is submitted to Congress before the actual discharge takes place prior to authorization or appropriation of funds for proposed project construction. A Section 404(b)(1) analysis has been completed and is attached in full as an addendum to this appendix. It is intended to submit the completed GRR and integrated EIS to Congress prior to appropriation of funds for construction occurs.

Sections 9 and 10 Rivers and Harbors Act

Section 9 (33USC 401) and Section 10 (33USC 403) of the Rivers and Harbors Act of 1899 direct the Corps to regulate all work or structures in or affecting the course, condition, or capacity of navigable water of the United States. The main stem Trinity at Dallas is navigable, however, no commercial navigation occurs on the Upper Trinity reach. Recreational use in the form of canoeing and fishing and pleasure boating occurs but to a limited extent and then only during less than flood flow events. The project features proposed would have minimal affect to navigation. The foot print of the Chain of Wetlands would lie on the flood plain adjacent to the main stem. The COW would only function during overbank flow events and during normal operation of the wetlands the hydrologic connections would be to tributary streams. The created wetlands would utilize water from the local waste water treatment plant. Only minimal evaporative losses in water would occur. No impacts to navigational capacity should occur from this feature. The proposed Lamar and Cadillac levees would also lie within the flood plain. Their influence on hydology and hydraulics would also only occur during flood events.

The proposed realignment of the River to protect the I-45 bridge would cause temporary disruption to navigation. The proposed project construction would be phased to allow free flow of the river through the existing channel until the new alignment is almost completed. The lower end of the new channel would then be excavated and connected to the main stem and then the upper connection would be made. Free flow down the new channel would occur quickly and navigation capacity would be restored, prior to backfilling the old channel.

The Corps of Engineers completed an Environmental Impact Statement and a Record of Decision (ROD) in 1988 that addressed the cumulative impacts of a number of unrelated independent proposed actions within the Upper Trinity River basin. The authority for the study was based upon the Corps regulatory requirements. The results of the EIS indicated strongly that there are potential cumulative impacts associated with individual flood plain developments that are both measurable and significant. Public comment and discussion focused on the undesirability of additional regional increases in flood hazards for either the 100-year or Standard Project Flood and that flood plain management should stabilize the flood hazard at existing levels through regulation and efforts of both the Corps and local organizations should be used to reduce flood hazard over the long term. The ROD provided a framework of criteria that would become the basis for the Regulatory Program within the Regional EIS study area. The Regulatory Program includes those actions proposed by the Corps of Engineers that are subject to Section 404, Section 9 or 10 compliance.

Hydraulic criteria applicable to the Dallas Floodway Extension area include that no rise in the 100-year or SPF elevation would be allowed, the maximum allowable loss in storage capacity for the 100-year and SPF discharges will be 0% and 5% respectively, alterations of the flood plain may not create or increase an erosive water velocity on or off site, and the flood plain may be altered only to the extent permitted by equal conveyance reduction on both sides of the channel. The proposed action will also be reviewed on the assumption that adjacent projects would have an equitable chance to be built, such that the cumulative impacts of both will not exceed the common criteria. In addition, since the proposed project includes levees that protect urban development, the minimum design criterion for the top of levee is the SPF plus 4.0, unless a relief system can be designed which would prevent catastrophic failure of the levee system. The ROD also provides criteria for mitigation of unavoidable losses to special aquatic sites including wetlands and guidelines for mitigation of other important resources.

The ROD also provided that variance from the criteria would be made only if public interest factors not accounted for in the Regional EIS overwhelmingly indicated that the "best overall public interest" is served by allowing such variance. During the review of this project proposal by the Corps, other agencies, communities and the public, it will be determined if it meets the ROD criteria or whether resolution of flooding problems of this frequency and magnitude should be deemed as an overriding concern, and if, a variance from the Record of Decision should be allowed as being in "the best overall public interest."

Environmental Justice

Executive Order 12898 provides for review of proposed activities to assess the effect on minority populations and low income populations. The area of potential project impact was screened and it has been determined that the area does contain minority and low income populations. A review of the effects of the proposed project alternatives indicate that all flood control plans, except the combination plan including a non-structural buyout of Cadillac Heights in lieu of a levee, provide significant flood protection for local residents and businesses. The economically feasible buyout of the 25-year flood zone would leave many minority and low income individuals subject to flooding. The proposed Cadillac Heights levee would provide protection from the Standard Project Flood and would reduce adverse economic impacts of repeated flooding in the area. This levee would impact an existing meat packing facility, but the plant could be relocated immediately adjacent to the existing location, thereby minimizing loss of employment opportunities to local residents.

Should the chain of wetlands be built alone, the majority of the economic benefits would accrue upstream within the Central Business District (CBD), with the negative impacts of forest loss occurring within the floodplain adjacent to Cadillac Heights and to the Lamar business area. There would be some flood damage reduction benefits within the immediate area, but not to the same level as provided to the CBD. Other economic benefits from the multi-purpose chain of wetlands project to the minority and low income populations would accrue due to the influx of recreation users of the trail system that would be constructed.

Building the river diversion at IH-45 to protect a major roadway bridge from catastrophic failure would benefit all people and would not be of detriment to any populations. The Tentative Federally Supportable Plan and the Locally Preferred Plan, including the environmental restoration of emergent wetlands, environmental mitigation, and a recreational trail would also provide benefits to the local area. Another benefit of the overall project is the clean-up of accumulations of trash and debris within the projected lands and some of the hazardous and toxic wastes in the project footprint. The proposed project would not result in disproportionate impacts to minority or low income populations. Recognizing the overall balance of benefits and impacts that would occur from the proposed project. It has been determined that implementation of either the TFSP or the LPP along with the river realignment would be in compliance with the intent and spirit of Executive Order 12898.

Table 2
Vegetation Species List

Trees — Common Name	Genus/species
Boxelder	*Acer negundo var. negundo*
Virginia redcedar	*Juniperus virginiana*
Persimmon	*Diospyros virginiana*
Eastern redbud	*Cercis canadensis var. candensis*
Honey locust	*Gleditsia triacanthos*
Eve's necklace	*Sophora affinis*
Bur oak	*Quercus macrocarpa var. macrocarpa*
Shumard red oak	*Quercus shumardii var. shumardii*
Texas buckeye	*Aesculus arguta*
Pecan	*Carya illionensis*
Osage orange	*Maclura pomifera*
White mulberry	*Morus alba*
Red mulberry	*Morus rubra*
American ash	*Fraxinus americana*
Pennsylvania ash	*Fraxinus pennsylvanica*
Texas ash	*Fraxinus texensis*
Green hawthorn	*Crataegus viridis*
Eastern cottonwood	*Populus deltoides ssp. deltoides*
Black willow	*Salix nigra*
Western soapberry	*Sapindus saponaria var. drummondii*
Wooly bumelia, Chittamwood	*Sideroxylon lanuginosa ssp. oblongfolia*
Sugar hackberry	*Celtis laevigata var. laevigata*
American elm	*Ulmus americana var. ameriacana*
Cedar elm	*Ulmus crassifolia*

Shrubs/Vines — Common Name	Genus/species
Oakleaf poison oak/Poison ivy	*Toxicodendron pubescens*
Possumhaw	*Ilex decidua*
Wooly dutchman's pipe	*Aristochia tomentosa*
Smooth swallow wort	*Cynanchum laeve*
Anglepod milkvine	*Gonolobus gonocarpus*
Japanese honeysuckle	*Lonicera japonica*
American elderberry	*Sambucus canadensis var. canadensis*
Coralberry	*Symphoricarpus orbicularis*
Burning bush	*Evonymus atropurpurea*
Sharppod morningglory	*Ipomoea codatotriloba var. codatotriloba*
Roughleaf dogwood	*Cornus drummondii*
Drooping melonette	*Melothria pendula var. pendula*
Swamp privet	*Forestiera acuminata*
Smooth elbowbush	*Forestiera pubescens var. glabrifolia*
Thinleaf privet	*Ligustrum quihoui*
Chinese privet	*Ligustrum sinense*
Maypop	*Passiflora incarnata*
Yellow passionflower	*Passiflora lutea*
Purple leatherflower	*Clematis pitcheri var. pitcheri*
Southern dewberry	*Rubus trivalis*
Balloonvine	*Cardiospermum halicacabum*
Greenbrier	*Smilax bona-nox*
Greenbrier	*Smilax tamnoides*
Common greenbrier	*Smilax rotundifolia*
Peppervine	*Ampelopsis arborea*
Heartleaf peppervine	*Ampelopsis cordata*
Virginia creeper	*Parthenocissus quinquefolia*
Summer grape	*Vitis aestivalis*
Mustang grape	*Vitis mustangensis*

Herbaceous Species — Common Name	Genus/species
Dicliptera	*Dicliptera brachiata*
Limestone ruellia	*Ruellia strepens*
Hairy tonguetube	*Siphonoglossa pilosella*
Alligator weed	*Alternanthera philoxeroides*
Palmer amaranth	*Amaranthus palmeri*
Berlandier amaranth	*Amaranthus polygonoides*
Tamarix amaranth	*Amaranthus rudis*
Canada sanicle	*Sanicula canadensis var. canadensis*
Cluster sanicle	*Sanicula odorata*
Hedge-parsley	*Torilus arvensis*
Golden alexander	*Zizia aurea*
Common ragweed	*Ambrosia artemiisifolia*
Western ragweed	*Ambrosia psilostachya*
Giant ragweed	*Ambrosia trifida var. texana*
Tall aster	*Aster prealtus var prealtus*
Hierba del Marrano	*Aster subulatus var. ligulatus*
Roosevelt weed	*Baccharis neglecta*
Devil's beggar ticks	*Bidens frondosa*
American basketflower	*Centaurea americana*
Texas thistle	*Cirsium texanum*
Prostrate lawnflower	*Calyptocarpus vialis*
Horsetail conyza	*Conyza canadensis var. canadensis*
Clasping coneflower	*Dracopis amplexicaulis*
Yerba de tago	*Eclipta prosrata*
Late eupatorium	*Eupatorium serotinum*
Broadleaf camphorweed	*Heterotheca subaxillaris var. latifolia*
Old plainsman	*Hymenopappus scabiosaeus var. corymbosus*
Marshelder	*Iva annua*
Louisiana lettuce	*Lactuca ludoviciana*
Prickly lettuce	*Lactuca serriola*

False ragweed	*Parthenium hysterophorus*
Sawleaf daisy	*Prionopsis ciliata*
Manystem false dandelion	*Pyrrhopappus pauciflorus*
Prairie coneflower	*Ratibida columnifera*
Brown-eyed Susan	*Rudbeckia hirta var. pulcherrima*
Scabrous goldenrod	*Solidago canadensis var. scabra*
Prickly sowthistle	*Sonchus asper*
Common sowthistle	*onchus oleraceus*
Yellow salsify	*Tragopogon dubius*
Baldwin ironweed	*Vernonia baldwinii ssp. baldwinii*
Cocklebur	*Xanthium strumarium var. canadense*
Shepard's purse	*Capsella bursa-pastoris*
Virginia peppergrass	*Lepidium virginicum var. virginicum*
Clasping Venus lookingglass	*Triodanis perfoliata var. perfoliata*
Sleepy catchfly	*Silene antirrhina*
Chickweed	*Stellaria media*
Lambsquarters	*Chenopodium album var. album*
Pitseed goosefoot	*Chenopodium berlandieri var. berlandieri*
Narrow dayflower	*Commelina erecta var. augustifolia*
Texas bindweed	*Convolvulus equitans*
Carolina ponyfoot	*Dichondra carolinensis*
Cherokee sedge	*Carex cherokeensis*
Emory sedge	*Carex emoryi*
Sawgrass	*Cladium jamaicense*
Taperleaf flatsedge	*Cyperus acuminatus*
Largespike spikerush	*Eleocharis palustris*
Western umbrellagrass	*Fuirena simplex*
Spotted spurge	*Chamaesyce maculata*
Prostrate spurge	*Chamaesyce prostrata*
Mat spurge	*Chamaesyce serpens*
Toothed spurge	*Euphorbia dentata*

Fern acacia	*Acacia angustissima var. Hirta*
Prairie senna	*Chamaecrista fasciculata*
Illinois bundleflower	*Desmanthus illinoensis*
Velvet bundleflower	*Desmanthus velutinus*
Western scarlet pea	*Indigofera miniata var. leptosepala*
Low peavine	*Lathyrus pusillus*
Black medic	*Medicago lupulina*
Buttonclover	*Medicago orbicularis*
White sweetclover	*Melilotus albus*
Sourclover	*Melilotus indicus*
Yellow sweetclover	*Melilotus officinalis*
Filaree	*Erodium cicutarium*
Carolina geranium	*Geranium carolinianum*
Swordleaf blue-eyed grass	*Sisyrinchium chilense*
Henbit	*Lamium amplexicaule*
Purple deadnettle	*Lamium purpureum*
Lemon beebalm	*Monarda citriodora var. citriodora*
Dotted beebalm	*Monarda punctata var. intermedia*
Wood sage	*Teucrium canadense var. canadense*
Wild onion	*Allium canadense var. caradense*
False garlic	*Nothoscordum bivalve*
Low winecup	*Callirhoe involucrata var. involucrata*
Carolina modiola	*Modiola caroliniana*
Spreading spiderling	*Boerhavia diffusa*
Lizardtail gaura	*Guara parviflora*
Roadside gaura	*Guara suffulta ssp. suffulta*
Common evening primrose	*Oenothera biennis ssp. centralis*
Cutleaf evening primrose	*Oenothera laciniata*
Roundleaf evening primrose	*Oenothera rhombipetala*
Showy primrose	*Oenothera speciosa*
Stemless primrose	*Oenothera triloba*

Dillen oxalis	*Oxalis dillenii ssp. dillenii*
White pricklypoppy	*Argemone albiflora ssp. texana*
Pokeberry	*Phytilacca americana var. americana*
Pigeonberry	*Rivina humilis*
Redseed plantain	*Plantago rhodosperma*
Purple threeawn	*Aristida purpurea var. purpurea*
King Ranch bluestem	*Bothriochloa ischaemum var. songarica*
Sideoats grama	*Bouteloua curtipendula var. curtipendula*
Japanese brome	*Bromus japonicus*
Common sandbur	*Cenchrus carolinianus*
Broadleaf woodoats	*Chasmanthuim latifolium*
Tumble windmillgrass	*Chloris vericillata*
Bermudagrass	*Cynodon dactylon*
Wooly rosettegrass	*Dichanthelium acuminatum var. acuminatum*
Jungle rice	*Echinichloa colona*
Barnyardgrass	*Echinichloa crus-galli var. crus-galli*
Barnyardgrass	*Echinichloa crus-pavonis var. macera*
Plains lovegrass	*Eragrostis intermedia*
Canadian wildrye	*Elymus canadensis*
Perennial ryegrass	*Lolium perenne ssp. perenne*
Texas wintergrass	*Nassella leucotricha*
Dallisgrass	*Paspalum dilatatum*
Annual bluegrass	*Poa annua*
Johnsongrass	*Sorghum halepense*
Prostrate knotweed	*Polygonum aviculare*
Swamp smartweed	*Polygonum hydropiperoides var. hydropiperoides*
Pensylvania smartweed	*Polygonum pensylvanicum*
Dotted smartweed	*Polygonum punctatum*
Curly dock	*Rumex crispus*
Fiddle dock	*Rumex pulcher*
Ten-petal anemone	*Anemone berlandieri*

White avens	*Geum canadense var. texanus*
Cleavers	*Galium aparine*
Beach groundcherry	*Physalis cinerascens var. cinerascens*
Clammy groundcherry	*Physalis heterophylla var. heterophylla*
Virginia groundcherry	*Physalis virginiana var. virginiana*
Black nightshade	*Solanum ptycanthum*
Southern cattail	*Typha domingensis*
Heartleaf nettle	*Urtica chamaedryoides var. chamaedryoides*
Prairie verbena	*Glandularia bipinnatifida var. bipinnatifida*
Sawtooth frogfruit	*Phyla incisa*
Slender verbena	*Verbena halei*
American germander	*Teucrium canadense*
Missouri violet	*Viola sororia var. missouriensis*

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EVALUATION OF THE CHAIN OF WETLANDS PLUS LEVEES PLAN OF THE DALLAS FLOODWAY EXTENSION IN ACCORDANCE WITH SECTION 404(b)(1) GUIDELINES

I. **PROJECT DESCRIPTION**. See basic report

A. **Location**. See basic report

B. **General Description**. See basic report

C. **Authority and Purpose**. This document fulfills the requirements of Section 404 (b)(1) of the Clean Water Act.

D. **General Description of Dredged or Fill Material**.

(1) **General Characteristics of Material**. The study area is in the Trinity-Urban land complex which consists of deep, nearly level, somewhat poorly drained soils and Urban land on flood plains. Urban land consists of fill material, and clayey material spread up to 3 feet deep on the flood plains. The Trinity soil is moderately alkaline, very dark, gray clay 30 inches thick. The clay becomes black to a depth of 48 inches and becomes a dark grayish brown clay to a depth of 80 inches. Urban land makes up approximately 20 % of the soil, the Trinity soil makes up approximately 60% and the remaining 20% is comprised of the Frio, Gowen and Ovan soils. (Maxim report of Sept. 1990). In 1995, Maxim Technologies, Inc. tested soil and sediment samples from the river and overbank in an area between the Corinth Street viaduct and the AT&SF railroad bridge. Five soil borings from the right descending bank were obtained by drilling to 20 feet below surface grade. Core lengths ranged from 1.8 to 3.4 feet. All samples contained tan and gray clayey sand(SC), sand (SP) and sand and gravel (SP) to the top of limestone at 7 to 8 feet; these samples also contained petroleum hydrocarbon odors. The odors appeared to decrease with increasing distance from upstream pump discharge points.

(2) **Quantity of Material**. About 3.2 million cu. yds. of material are proposed to be excavated at the site to create the swale, a series of wetlands, sumps on the protected side of the Lamar Street levee, and levee inspection trenches. The amount of fill which would be required to construct two levees and several wetland control structures is about 1.3 million cu. yds. The amount of material for disposal is, therefore, approximately 1.9 million cu. yds. The material excavated for the new channel is proposed to be used to fill the old channel portion. It is not expected that there would be any excess material from the realignment portion of the project. Approximately 479,000 cubic yards of this material will be disposed on in a class I non-hazardous landfill. In addition, approximately 11,722 cubic yards of concrete would be used to construct the hike and bike trail described in Appendix I, Recreation.

(3) **Source of material**. The overbank on the right descending side of the river would be the source of the excavated material for the swale and the realigned channel in the flood plain. This includes floodplain lands, two closed sludge landfills and a closed municipal landfill. Excavation would also take place on the protected side of the Lamar Street levee to create sumps.

E. **Description of the Proposed Discharge Site**. Much of the excavated material would go into the proposed levees. Contaminated soil and old landfill material would be disposed of in an appropriate landfill. Material excavated for the new channel would be used to fill in the old channel.

Disposal of clean fill would be within a 1000 +/- acre site in the City of Dallas bounded by Post Oak Road, Pleasant Run Road, East Wintergreen Street, and Cottonwood Creek. A portion of it is presently being mined for sand and gravel. It contains some moist sites but is out of the 100-year flood plain and is not jurisdictional.

F. **Description of Disposal Method.** Material would be transported by haul truck from point of excavation to the levee construction site or the old channel bed. Contaminated material would also be hauled by truck for disposal in appropriate landfills. The clean fill would be dumped at the proposed levee site and the excess would be placed at an approved disposal site located out of the flood plain in south Dallas County and graded.

II. FACTUAL DETERMINATIONS.

A. Physical Substrate Determinations.

(1) **Substrate Elevation and Slope.** The new channel would be at the same elevation as the bypassed segment (371' MSL) and, as is the case in the existing channel bed, it would be at zero slope.

(2) **Sediment Type.** The sediments in the study area of the Trinity River flood plain are described as alluvium floodplain deposits including indistinct low terrace deposits; gravel, sand, silt, silty clay and organic matter (Maxim, 1990). The new channel bed would be constructed by excavating 25 feet of overbank down to 371' MSL. Boring samples taken in 1980 by the Corps of Engineers show that at that level the soil consists of calcareous clay with sand.

(3) **Dredged/Fill Material Movement.** Much of the excavated material would be used in the construction of the levees. Some excess clean topsoil would be used as fill in one of the mitigation areas. Material from the new channel excavation would be used as fill for the old channel bed. Contaminated excavated material would be transported by haul truck to a suitable landfill. Minor amounts of fill may be required to stabilize the subgrade for the proposed recreation trails.

(4) **Physical Effects on Benthos.**

The benthic organisms in the present channel bed would be buried when the channel realignment takes place, but this is a relatively small area. The newly dug channel diversion would likely be repopulated, after a period of stabilization, with the same types of organisms as those which presently exist at the site.

(5) **Other Effects.** None.

(6) **Actions Taken to Minimize Impacts.**

(a) The swale alignment has been chosen to impact as little forested area as possible and still provide effective flood control.

(b) The two outflows from the wetlands to the creeks have been designed to prevent erosion at the discharge site. Water would flow from the wetlands through an underground 36" pipe, down a gradual slope and into the creeks below the water surface level.

(c) When the new channel portion is finished and ready to be flooded, it would be filled from the downstream end in order to avoid erosion from high flow rates and turbulence. This would also minimize the amount of sediment which would be carried downstream.

(d) It would be necessary to completely excavate the new channel before the old channel can be filled in. In order to have available the maximum land area for stockpiling the excavated material, the rechannelization construction would precede the construction of the wetlands. In this way, forested areas and grasslands would not be impacted unnecessarily.

(e) A portion of the Linfield Landfill would be excavated when the lower swale is constructed. The remainder would be sealed off with a slurry wall.

B. Water Circulation, Fluctuation and Salinity Determinations.

(1) Water.

(a) Salinity. Not applicable.

(b) Water Chemistry. The portion of the Trinity River in the study area is part of segment 805 as designated by the Texas Natural Resource Conservation Commission (TNRCC). It extends 100 miles "from a point immediately upstream of the confluence of the Cedar Creek reservoir discharge canal in Henderson/Navarro County to a point immediately upstream of the confluence of Elm Fork Trinity River in Dallas County". 1996 water quality information on segment 805 of the Trinity River is as follows (TNRCC, 1996):

- water temperature range: 7.90-33.50 C
- *DO: 4.70-11.60 mg/l
- pH: 6.80-8.20
- chloride: 10.00-201.00 mg/l
- sulfate: 24.00-126.00 mg/l
- specific conductance: 230.00-854.00 µmhos
- TDS: 207.35-555.10 mg/l
- ammonia: 0.02-0.76 mg/l
- *nitrates and nitrites: 0.60-11.83 mg/l
- *orthophosphorus: 0.10-3.69 mg/l
- *total phosphorus: 0.05-9.06 mg/l
- chlorophyll a: 1.00- 23.50 µg/l
- *fecal coliform: 10.00-8900.00 #/100 ml

* indicates areas of concern

These data have shown gradual improvement over time, and, in the last two years, particularly in dissolved oxygen. Passage of the CWWTP effluent through the chain of wetlands can improve the water quality by acting as a sink for the nutrients nitrogen and phosphorus. Tarrant County Water Control and Improvement District (TCWCID) evaluated water quality improvement in a small constructed wetland (4 acres) and reported removal of an average of 90% of nitrogen and 88% of phosphorus (Darryl Andrews TCWCID). Typically, fecal coliform values are reduced as well in water flowing through wetlands.

(c) Clarity. There would be a temporary increase in turbidity when the new channel portion is opened to flow from the river; however, it would be backfilled from the downstream end to minimize erosion and prevent adverse impacts from a high sediment load.

(d) Color. Not applicable.

(e) Odor. Not applicable to realignment project. In the wetlands, possible odor problems might develop.

(f) Taste. Not applicable.

(g) Dissolved Gas Levels. TNRCC (1996) Trinity River segment 805 data reports a dissolved oxygen range of 4.70-11.60 mg/l. USGS has a Continuous Automated Monitoring System (CAMS) in place on the West Fork, East Fork and mainstem Trinity River. The DO is expected to be the same in the river waters after the channel realignment. The DO of the water flowing into the river from the wetlands can be at kept at acceptable levels with constant flow (using the pumping system) if necessary.

(h) Nutrients. Not applicable to realignment project. The nitrates/nitrites water quality screening level used by TNRCC is 1.0 mg/L. In the 1996 TNRCC Water Quality Inventory report, this value was reported to have been exceeded 92.5% of the time for segment 0805. A similar situation exists for phosphorus.

The screening level for orthophosphorous is 0.10 mg/L and for total phosphorus is 0.20 mg/L. These values were exceeded 97.67% and 94.59% of the time respectively. High concentrations of these nutrients are one of several reasons this segment of the Trinity River is classified by the TNRCC as "water quality limited". Although the chain of wetlands has not been designed, nor would it function, as a water quality improvement site, wetland vegetation would become established in the wetland cells and nutrient removal would result as a passive feature of the wetlands complex. The removal of some of these nutrients by wetlands would have a positive effect on the overall water quality in this portion of the river.

(i) Eutrophication. Not applicable to channel realignment. Wetlands would be managed to minimize accumulation of organic materials that would affect water quality.

(j) Others as Appropriate.

(2) Current Patterns and Circulation.

(a) Current Patterns and Flow. The present flow pattern of the river would be changed in a portion of the channel bed. A 3400 linear foot segment of the present river channel under the IH-45 bridge is proposed to be relocated 150 feet to the west in order to reroute flow away from bridge piers in the channel bed. These piers trap debris and impede flow. Flow rates and current patterns would not be changed significantly; however, flow would no longer be impeded by debris accumulation at the bridge piers.

b) Velocity. Normal flows would not be affected by the discharge of dredged or fill material should this project be implemented. The new portion of the channel bed in the realignment project has been designed to be similar to the existing reach in order to maintain present water velocities.

(c) Stratification. Not applicable.

(d) Hydrologic Regime. The chain of wetlands proposed for construction on the west side of the river is a new feature for this area; however, the presence of these wetlands would not significantly change the hydrology of the river either at this location or downstream. Even though the channel would be realigned under the IH-45 bridge, the new channel segment was designed with physical features similar to the old portion so that the hydrology would not change.

(3) Normal Water Level Fluctuations. Nothing in this proposed action would affect normal water level fluctuations. Only extreme floodflows would be affected.

(4) Salinity Gradients. Not applicable.

(5) **Actions That Would be Taken to Minimize Impacts.** In order to prevent a high sediment load from the new channel bed, it would be allowed to backfill first, then the upstream plug would be removed to complete the rerouting of the water. The old channel bed segment would then be plugged and filled with material excavated from the new channel. In this way, there would be little additional turbidity carried downstream from the construction site.

C. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. There would be temporary increases in suspended particulates and turbidity levels when the new channel portion is constructed. These increases, however, would be of short duration and at levels tolerable to aquatic organisms downstream. Construction design and phasing have been planned to minimize turbulence and generation of suspended particulates.

Turbidity in the river waters is not expected to change as a result of the wetland construction. Wetlands are typically a sink for suspended particles, however, effluent from the CWWTP is already very clear (average 1.3 NTU) so the discharged water to the creek would not contribute to turbidity.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Realignment of the channel would produce temporarily turbid conditions in the new channel portion and downstream from it, but particulates should settle out again shortly after construction is completed. There would be a relatively short period of decreased light penetration but, because these waters are somewhat turbid under normal circumstances, no adverse effects are expected.

(b) Dissolved Oxygen. Insignificant from standpoint of turbidity in realigned channel and in wetlands. The increased turbidity would be of short duration and would not affect oxygen content.

(c) Toxic Metals and Organics. No release of toxic substances would occur from the realignment of the channel bed. Soil borings taken from this area show no contaminants. The soil to be excavated for the new channel would be used to fill in the old channel portion.
Much of the swale would be located where there are old capped landfills or other sites of contaminated material. (For example, Lagoon E, a closed and capped CWWTP sludge pit; Linfield landfill, closed and capped; Dallas Demolition open dump area; another open area reportedly containing old battery casings; and, the Southern Pacific property adjacent to the Linfield landfill). This material would be removed completely and disposed of at an-as-yet-to-be-designated landfill. Measures would also be taken to prevent leakage of contaminants from these areas into the swale/wetlands area. Such measures would involve, for example, construction of slurry walls to reseal the Linfield landfill.

(d) Pathogens. Not applicable to channel realignment. The Trinity River channel water exceeds the TNRCC standards criteria for fecal coliform bacteria (400 CFU/100 ml) 36% of the time. Wetlands remove coliform bacteria from wastewater through sedimentation and other mechanisms (D.A. Hammer, 1989 p. 332); therefore, water which passes through these constructed wetlands, whether from the wastewater treatment plant or from runoff, would undergo some improvement in coliform content. Neither the channel realignment nor the construction of the sumps would contribute to or create a problem with pathogens.

(e) Aesthetics. This segment of the Trinity River is normally turbid. The increase in turbidity due to the channel realignment would have a negligible and temporary impact on aesthetics. The planned wetlands and recreational areas would ultimately greatly improve the aesthetics of this region of the flood plain.

(f) Others as Appropriate. None.

(3) Effects on Biota

(a) Primary Production, Photosynthesis. There could be a temporary decrease in algal growth during the channel realignment. Construction would produce a short period of high turbidity which would result in reduced light penetration. This situation would be of short duration, however, and have no significant impact. The potential for high algal growth exists for the wetlands. If the high nutrient treatment plant effluent is used to fill them and is left standing (not flowing), conditions would be favorable for high rates of growth in warm temperatures. Water management features of the wetlands such as pumps and weirs, however, provide means for controlling water levels and flow and can be used to prevent buildups of algae.

(b) Suspension/Filter Feeders. Insignificant.

(c) Sight Feeders. Insignificant.

(4) Actions Taken to Minimize Impacts. Silt screens and silt curtains would be used to minimize suspended soil content in the river.

D. **Contaminant Determinations.** The channel realignment would not involve sediment removal, only sediment burial. The material to be excavated for the new channel has been determined to contain no contaminants. This material would be used to fill in the old channel bed; therefore, realignment construction would present no contaminant problems.

The swale construction for the upper and lower wetlands would intrude on several contaminated or landfill areas. These include a closed sludge lagoon at the CWWTP, a Southern Pacific RR dump, and the Linfield Landfill. Contaminated material would be completely removed and disposed of at an appropriate landfill. Where the swale would only slightly impinge on a contaminated area such as at the Linfield Landfill, the remaining contaminated material would be resealed.

Sumps would be constructed on the protected side of the Lamar Street levee. This area is and has been highly industrial. Any known contaminated areas would be avoided as sump sites. If any previously unknown contamination is encountered during construction of the sumps, measures would be taken to clean the area or seal off the contaminated volume.

E. **Aquatic Ecosystem and Organism Determinations.**

(1) Effects on Plankton. Insignificant in the channel realignment. The potential exists for high algal growth in standing water in the wetlands, however, with a rain event water would flow and flush out the algae. In addition, the wetlands would have a water level management system with water levels able to be controlled by concrete weirs at the outlets of each wetland cell. This feature, coupled with the pumping system proposed at the outflow of the CWWTP, would make possible flushing out of the wetland cells if necessary. There would be no overall effect on river plankton from the wetland discharge waters.

(2) Effects on Benthos. Not applicable to wetlands. The benthic organisms in the old channel bed would be buried during the realignment construction. Since this is a relatively short segment (3400 linear feet), it is expected that the same types of organisms would repopulate the new segment shortly after construction is completed. The overall impact would be insignificant.

(3) Effects on Nekton. Insignificant.

(4) Effects on Aquatic Food Web. Insignificant.

(5) Effects on Special Aquatic Sites. Special aquatic sites in the project area, in the form of forested wetlands, would be affected by construction. Other special aquatic site would be constructed, in the form of emergent wetlands. These sites are expected to provide 1) expanded fish and wildlife habitat, 2) natural area buffers and, 3) improved water quality through reduction of nutrients and sediments. The Chain of Wetlands swale would develop a mixture of emergent wetlands, permanent open water and grasslands. These wetlands, in conjunction with the adjacent bottomland hardwood forests and development of native grasslands, have been designed to provide resting and feeding habitat for migrating waterfowl and other waterbirds. Urban tolerant birds would also benefit from the restored wetlands.

(a) Sanctuaries and Refuges. No significant impact.

(b) Wetlands. Some forested wetlands would be removed by construction of the swale, levees and associated sumps, and channel realignment. This information is discussed in the main report text. All wetlands would be mitigated if the proposed project is implemented.

(c) Mudflats. Not significant.

(d) Vegetated Shallows. Not Applicable.

(e) Coral Reefs. Not Applicable.

(f) Riffle and Pool Complexes. Not Applicable.

(6) Threatened and Endangered Species. No threatened or endangered species would be impacted.

(7) Other Wildlife. No significant impacts to other wildlife are expected.

(8) Actions to Minimize Impacts.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Downstream of the new channel bed there is the possibility of a temporary increase in sediment load due to erosion. Boring samples in this area show that it would be primarily clay with some sand.

(2) Determination of Compliance with Applicable Water Quality Standards. Through telephone conversations with Jim Davenport in the Standards and Information Group of TNRCC, it has been determined that this project would not exceed applicable water quality standards of the State of Texas as they exist at the present time.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. The initial filling of the wetland cells would temporarily divert a large quantity of effluent from the river. This process could take 3-4 weeks. It might be most advantageous to fill the wetlands during the spring in order to take advantage of rain events. Rain water would also dilute the effluent resulting in the impoundment of water not as rich in nutrients. It is not anticipated that any part of this project would have any adverse effects on a water supply.

(b) Recreational and Commercial Fisheries. This portion of the mainstem of the Trinity has been under a Texas Department of Health aquatic life closure since January 1990 due to elevated levels of chlordane; therefore, fish consumption is prohibited. The affected reach extends 19 miles from the upper limit of the segment to IH 20 downstream from Dallas. This project would have no effect on consumable aquatic organisms.

(c) Water Related Recreation. According to the TNRCC, contact recreation use such as swimming is not supported at the present time in the vicinity of the project area. There is no other water related recreation at the present time.

(d) Aesthetics. The aesthetic aspects of this project are of primary concern. Project plans call for full mitigation of all forests, grasslands, wetlands etc. An extensive effort has been put into a plan to develop recreational facilities for a large portion of the study area. Included in this plan are nature trails, equestrian trails, canoe launch sites, etc. At present, there are no recreational facilities other than a small number of parks.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Not Applicable.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. None

h. Determination of Secondary Effects on the Aquatic Ecosystem. None

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge.

a. No adaptations of the Section 404(b)(1) guidelines were made relative to this evaluation.

b. The purpose of the Dallas Floodway Extension Project is to reduce flood damages to local residences and businesses. The Chain of Wetlands Plus Levees Plan has been proposed to provide greater flood protection to the current study area, immediately downstream of the existing Dallas Floodway. Other alternatives to this plan include the no-action, the non-structural plan, the NED Plan and the Chain of Wetlands Plan. The no-action is not practicable due to public pressure to provide greater flood protection to the current study area. The non-structural plan, which would involve buyouts of residences and businesses in the 10-year flood plain in the Cadillac Heights community does not meet project objectives. The NED Plan was controversial because of its adverse impacts on environmental resources within the area and did not have public support. The Chain of Wetlands Plan, without the levees, minimized the environmental impacts, addressed aesthetic concerns, but did not provide flood protection in the study area comparable to that of the Central Business District which is protected by the existing Dallas Floodway levees.

c. The proposed disposal of fill material at the Floodway Extension Project in Dallas, Texas would not violate any applicable State water quality standards. The proposed project would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The proposed project would not affect any federally listed threatened or endangered species or their critical habitat.

e. Neither the Locally Preferred Plan (LPP) nor the Tentative Federally Supportable Plan (TFSP) would result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish and wildlife. The life stages of aquatic life would not be adversely affected nor would life stages of other wildlife. For the LPP, a total of approximately 425 acres would be impacted by the project at the sites for the north and south swales, the 2 levees and the channel realignment. Included would be impacts to 20.62 acres of Pecan- Oak bottomland hardwood forested area, 141.06 acres of Ash-Elm bottomland hardwoods forest and 211.60 acres of mixed grasses and forbs, and 51.3 acres of open water. Mitigation plans would require approximately 1179 acres. This includes acquisition and management of 926 acres of existing forested area, and conversion of 223 acres of existing grassland to bottomland hardwood forest and, preservation of 30 acres of mixed grass forbland. See main appendix text for mitigation details. Mitigation for the TFSP would require approximately 1135 acres with proportional mitigation features to that of the LPP.

f. Appropriate steps to minimize potential adverse impacts of the project on aquatic ecosystems include: designing the new channel bed to the approximate dimensions of the old channel in order to maintain similar water velocities and flow; flooding the new channel from the downstream end in order to prevent a large sediment load from being carried downstream when the new channel is opened; and, developing a storm water pollution prevention plan to be implemented during the construction activities to minimize erosion and sedimentation.

g. On the basis of the guidelines, the proposed disposal site for the discharge of fill material is specified as complying with the requirement of these guidelines.

APPENDIX H

ARCHEOLOGICAL, ARCHITECTURAL, ARCHIVAL, AND GEOARCHEOLOGICAL INVESTIGATIONS OF THE PROPOSED DALLAS FLOODWAY EXTENSION PROJECT, DALLAS COUNTY, TEXAS

INTRODUCTION

The City of Dallas, in cooperation with the U.S. Army Corps of Engineers, Fort Worth District, is sponsoring a multi-year project to extend the Dallas Floodway to an area along the Trinity River flood plain between Corinth Street and Interstate 20/635 (Figures 1 and 2). The project will include the construction, renovation, and extension of levees, development of a chain of wetlands with central linear lakes, construction of a series of sumps to contain storm water runoff, and rechannelization of approximately 800 m (2,600 ft) of the Trinity River near its intersection with Interstate 45. Total flood control terrain is 1198 acres for the LPP, 547 of which will be subjected to direct impact. The calculations do not include the area of potential effect (APE). An aspect of the Environmental Impact Statement (EIS) for the project, as required under the National Environmental Policy Act of 1969, as amended (PL 91-190) , is coordination throughout the undertaking with interested parties, which includes the State Historic Preservation Officer. As a consequence, the action initiates a response through processes under the National Historic Preservation Act, as amended through 1992 (PL 102-575). Prior to producing the cultural resources appendix to the EIS, the Corps of Engineers conducted a Phase 1 survey through contractual means as an element of the planning process. The objectives of the project were to compile recorded data, field test (ground truth) and evaluate known and/or reported resources, as well as generate an initial predictive model for buried cultural deposits. The investigation was to report on four primary tasks, which included:

1. Following a literature review, all sites that would be impacted under the current design will be relocated and their condition assessed. The task will also include those sites in the area of potential effect (APE). The action at each site will be at a Phase 1 intensive survey level, although delineation of buried, submerged, or deep fill sites will not be possible. Acquisition of data necessary for preliminary evaluation of the resources would be ideal. Evaluation would be based on three classes: eligible, potentially eligible, and not eligible for inclusion in the *National Register of Historic Places (NRHP).* Due to project constraints, it is anticipated that most occurrences will fall into the potentially eligible class and additional investigations will be necessary for definitive evaluation.

2. A brief, intensive review and assessment of primary historic records and archives, as well as secondary documentary sources is necessary to identify potential historic site loci, as well as for the preliminary evaluation of standing structures. A chain of title will be undertaken on selected parcels to evaluate the completeness and character of available data. These will include such archival sources as conveyance records, probate court records, and birth and death records, among others. Efforts will also be made to contact local historical societies and interested parties to assess and evaluate private archival records.

3. Provide a four-tier assessment of all structures or complexes (may include more than one structural component) in the currently designed project footprint, as well as identified historic structures in the APE. All structures will be placed in four categories: 1 - potentially eligible historic; 2 - not eligible historic; 3 - not historic (<43 years old); and, 4 - not historic (>43 years old, <50 years old). In addition, all structural components considered potentially eligible will be prioritized based upon their historic contribution to the development of Dallas.

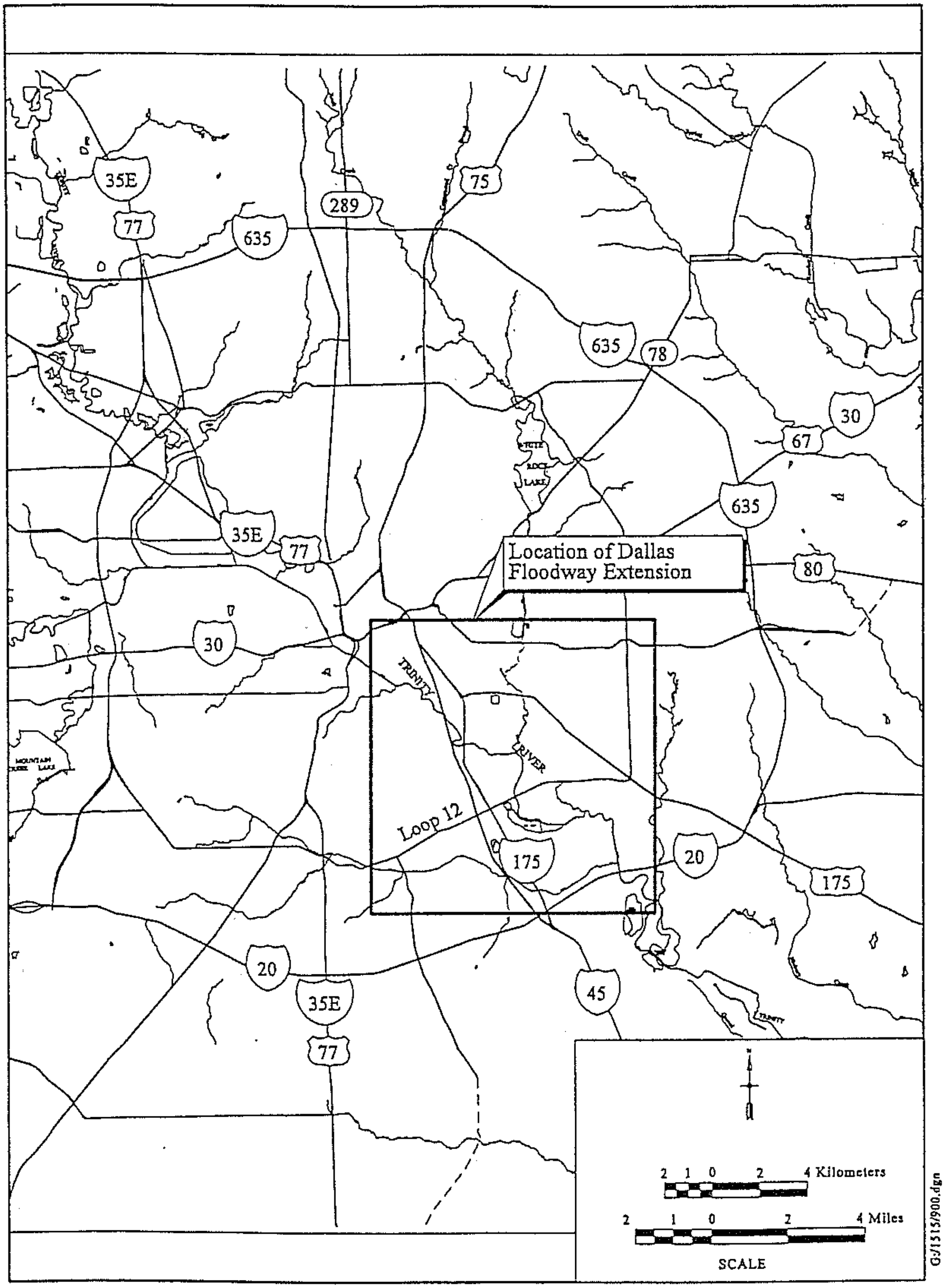

Figure 1. General location of the Dallas Floodway Extension project area within Dallas County.

4. Review all available geological and geomorphological data pertinent to the project area. Primary consideration should be given to core and boring data. A member of the team will be provided access to cores taken by the Corps of Engineers in other investigations. The objective of this task will be to gather enough data to generate a reliable model of buried topographic features or landforms and associated soil suites (paleosols). The surfaces and matrices of these relict and fossil deposits are believed to contain the remains of prehistoric occupations. Consideration should also be given to reconstructing the landscape prior to Euro-American modification, which will aid in the potential identification of buried features. An aspect of task 4 will be to take a series of cores in selected areas to aid in the reconstruction of paleolandscapes within the flood plain. Finally, a brief sampling program designed to evaluate the model will follow formulation. The results of the sampling program will be utilized to reformulate the model. An aspect of the final product will be a generalized estimate of the potential site density in the project terrain, which will include the environmental mitigation area between Loop 12 and Interstate 635.

The APE is defined as the area within the 100-year flood pool of the Trinity River between Corinth Street and Interstate 635, as noted. The Project Footprint area was defined as the area actually to be impacted by the current design, between the Martin Luther King Viaduct and Loop 12 (see Figure 2). This appendix is a synthesis of the technical report of finding and readers are encouraged to refer to the primary document, i.e., Cliff et.al 1997, for additional information.

This appendix is divided into eight sections. Section 2 presents the environmental setting of the project area, while Section 3 describes previous research in the project area and reviews the local prehistoric and historic chronology. Section 4 explains the research methods used during the investigation. Section 5 describes the reevaluation of the previously recorded archeological sites. Section 6 describes the archival research undertaken, while Section 7 presents the preliminary evaluations of the standing structures. Section 8 presents the results of the geoarcheological investigations and the model developed from this data. Finally, Section 9 presents the recommendations for the project. A list of references follows at the end.

ENVIRONMENTAL BACKGROUND

Dallas County is part of the Texan biotic province defined by Blair (1950) as an intermediate zone between the forests of the Austroriparian and Carolinian provinces and the grasslands of the Kansan, Balconian, and Tamaulipan provinces. Some species reach the limits of their range in the Texan province. Dallas County is part of the Blackland Prairie, one of several tall grass prairies present in this part of Texas. The vegetation in the Blackland Prairie is dominated by grasses, with woodlands being restricted to stream courses. Grasses expected to occur within this area include little bluestem, big bluestem, Indiangrass, hairgrama switchgrass, Florida paspalum, eastern gramagrass, sideoats grama, Texas needlegrass, Virginia wildrye, Torrey silver bluestem, meadow dropseed, vine-mesquite, and buffalograss (United States Department of Agriculture [USDA] 1980:88-90). The faunal community in this region has undergone changes due to the expansion of the Dallas-Fort Worth metroplex. However, the species of wildlife which previously inhabited the area include bobwhite, quail, pheasant, meadowlark, field sparrow, sage grouse, lark bunting, cottontail, red fox, antelope, and deer (USDA 1980:50).

The region has a warm, temperate, humid subtropical climate that is generally mild, with periods of extremely hot and cold weather being limited in duration. Yearly rainfall is fairly evenly distributed, with the maximum rainfall occurring in April and May and the minimum in August. Much of the rainfall occurs in the form of heavy thunderstorms, with the rapid runoff allowing only limited absorption of water by the soil. Snowfall is rare, with an average of less than 2.5 cm (1 in) falling per year. The snowfall is generally present for less than one week. The prevailing winds are southerly. Temperatures remain above 0° C (32° F) approximately 240 days each year (USDA 1964:72-73, 1969:51-52).

Dallas County is underlain by four geological formations—the Eagle Ford shale, the Austin chalk, the Taylor marl, and the Neylandville marl (Allen and Flanigan 1986). In addition, Pleistocene terrace deposits and Holocene alluvium are found along major streams and their tributaries. The APE is dominated by the Trinity River and two of its major tributaries—White Rock Creek to the northeast and Five Mile Creek to the west. Several smaller tributaries also join the Trinity River within the APE, including Kings Branch Creek, Little Cedar Creek, Cedar Creek, Honey Springs Branch, and Elam Creek.

Twenty-six soil map units are included within the APE, consisting of 16 upland map units, six flood plain map units, and four disturbed map units (USDA 1980). Given the rationale underlying the project, it is not surprising that the upland map units are limited to small areas within the APE and a small area along the edge of the APE, with the majority of the APE being composed of flood plain and disturbed soils. The upland map units and their role in archaeological research are discussed in detail elsewhere (Cliff et.al 1997).

CULTURAL SETTING

Previous Investigations

The history of archeological investigations within the Upper Trinity River drainage and the culture-historical framework for the area are aptly summarized in three, relatively recent, major reports concerning the archeology of the Upper Trinity River Basin (Peter and McGregor 1988; Prikryl 1990; and Yates and Ferring 1986). Although the combined efforts of professional and avocational archeologists have resulted in the recording of numerous sites, it is apparent that much research remains to be done. As noted by McGregor (1988:27-29), much of the excavation efforts within the Upper Trinity River Basin have focused on reservoir development, especially along the Elm Fork (Brown and Lebo 1991; Crook and Harris 1957, 1958, 1961; Lebo 1995a, 1995b; Lebo and Brown 1990; Skinner and Baird 1985; Skinner et al. 1982) and the East Fork (Dawson and Sullivan 1973; Lorrain and Hoffrichter 1968; Lynott 1975; Ross 1966). Field school excavations by the University of Texas at Arlington at the Northlake site on Grapevine Creek were also reported in the mid-1970s (Morgan 1975). Finally, investigations at Joe Pool Lake (Jurney, Lebo, and Green 1988; Peter and McGregor 1988) and test excavations at the River Bend site, 41TR68 (Peter et al. 1987), have provided the initial assemblage data necessary for an understanding of the adaptations along the West Fork of the Trinity River.

Reservoir studies along the East Fork have included work at Lake Ray Hubbard and Lake Lavon, east and northeast of Dallas, respectively. Lake Lavon was surveyed in 1949 with test excavations being conducted at the Campbell Hole (41COL10) and Hogge Bridge (41COL1) sites (Stephenson 1949). Additional excavations conducted at the Hogge Bridge site resulted in the formal definition of the Wylie focus—a Late Prehistoric manifestation believed to be characterized by arrow points, flexed burials, large pits, and trade pottery from cultures to both the east and west (Stephenson 1952). More recently, excavations were carried out by Southern Methodist University (SMU) as a result of the planned enlargement of Lake Lavon (Dawson and Sullivan 1973; Lynott 1975). Lake Ray Hubbard was surveyed with the help of members of the Dallas Archeological Society (DAS) in 1963 (Harris and Suhm 1963). Subsequently, excavations were carried out at the Glen Hill (41RW4) and Upper Rockwall (41RW2) sites (Ross 1966), and the Lower Rockwall site (41RW1; Lorrain and Hoffrichter 1968). Much of this work was concentrated on excavations at sites with "Wylie focus pits" in an effort to better understand the function of these large features.

More recently, two major reservoir studies have been undertaken a short distance south of the project area—Richland-Chambers Reservoir and Joe Pool Lake. Richland-Chambers Reservoir was originally included in the proposed Tennessee Colony Reservoir, to be constructed on the Trinity River below Dallas (Chamberlin 1972; Richner 1982; Richner and Bagot 1978; Richner and Lee 1976, 1977), but this development was later canceled. Subsequently, dams were planned on both Richland and Tehuacana creeks, and a preliminary overview of the cultural resources was prepared (Burton and Connors 1979). Finally, the project was reduced to the Richland Creek impoundment and became known as the Richland-

Chambers Reservoir. Fieldwork for the project was undertaken by SMU, beginning with a survey of the project area in 1980, during which 911 sites were discovered. This was followed by a testing phase, during which 270 sites were evaluated (Archaeology Research Program [ARP] 1982; Raab, Moir, and McGregor 1980, 1981). Finally, mitigation of 15 prehistoric and 38 historic sites was undertaken during four field seasons from June 1982 to December 1984 (Bruseth and Martin, eds. 1987; Bruseth and Moir 1987; Jurney and Moir, eds. 1987; McGregor and Bruseth 1987; Moir and Jurney, eds. 1987).

Located along Mountain Creek in southwest Dallas County, Joe Pool Lake was originally known as Lakeview Reservoir. Fieldwork began in 1977 with a survey which recorded 42 sites within the project area, including Archaic, Late Prehistoric, and Historic sites (Skinner and Connors 1979). Test excavations were then undertaken at 15 prehistoric and eight historic sites (Ferring and Reese 1980; Raab, Bruseth, and McIntyre 1980; Raab et al. 1982). Finally, mitigation was conducted from 1984 to 1986 at six prehistoric and 13 historic sites (Jurney, Lebo, and Green 1988; Peter and McGregor 1988).

Recent large cultural resources management projects in Dallas County include the excavation of the Freedman's Cemetery and research for the Dallas Area Rapid Transit (DART) rail lines, the latter of which has included both archeological and architectural investigations (Adovasio 1992; ARP 1989, 1991; Dorward and Weston 1990; Dorward et al. 1990; Jurney 1987a, 1987b, 1987c, 1987d, 1987e, 1987f, 1988a, 1988b; Jurney and Moir 1987a, 1987b, 1987c; Jurney, McElhaney, and Weston 1990; Jurney, Moir, Dorward, and Weston 1990, 1991; Jurney, Moir, and Peter 1987; Jurney, Peter, and McElhaney 1987, 1988; Jurney, Peter, McElhaney, Payton, and Girard 1987; Moir, Dorward, and Winchell 1991; Moir and Jurney 1987a, 1987b, 1988; Moir, Peter, and Jurney 1987a, 1987b; Moir and Peter 1987; Myra L. Franks & Associates 1987a, 1987b, 1987c, 1988a, 1988b, 1988c, 1988d, 1988e, 1990, 1993; Myra L. Franks & Associates and ArchiTexas 1987, 1988; Myra L. Franks & Associates and Burson & Cox Architects, Inc., 1987a, 1987b, 1987c, 1987d; Skinner and the Staff of the Archeology Research Program 1996; Skinner et al. 1994; Skinner, Whorton, Trask, Scott, Caran, and Dillon 1996; Weston and Dorward 1990; Winchell and Dorward 1991).

In addition to these large projects, Dallas County has seen many smaller cultural resources investigations within recent years and several projects have occurred in or near the project area. During 1974 and 1975, North Texas State University (NTSU; now known as the University of North Texas) conducted an archeological reconnaissance within the flood plain of Five Mile Creek (McCormick 1976), including the southern end of the APE. Six sites were investigated during this project, two of which, sites 41DL80 (designated 41-DA-5 NTSU) and 41DL102 (designated 41-DA-6 NTSU), are in the APE. In 1981, Environment Consultants, Inc., undertook a survey for the Dallas Floodway Extension (Bennett et al. 1981). Although the exact location is difficult to discern from the maps provided in the report, the project area appears to have been slightly larger than the current APE (Figure 3). Twenty-two sites were investigated during this project, of which 13 (sites 41DL69, 41DL70, 41DL73, 41DL80, 41DL84, 41DL91, 41DL99, 41DL104, 41DL204, 41DL205, 41DL206, 41DL208, and 41DL220) are located within the present APE.

In 1990, AR Consultants undertook an archeological survey for the Rochester Park Levee, immediately adjacent to the project area (Figure 3). Two previously recorded sites, 41DL69 and 41DL70, were investigated. In addition, archival research was conducted for the project area and an oral history of the nearby Metzger Dairy was recorded (Skinner et al. 1990). Also in 1990, AR Consultants began a cultural resources survey of a proposed new levee and associated borrow pits at the Central Waste Water Treatment Plant (Skinner et al. 1991). Following this field work, AR Consultants continued to monitor the sites found at the Central Waste Water Treatment Plant and recorded three new sites (Skinner and Whorton 1995). As a result of this project two prehistoric and two historic sites were recorded. AR Consultants again visited the project area in 1993 for an archeological survey around Little Lemmon Lake (Skinner and Whorton 1993). Two sites (41DL350 and 41DL351) were located, both of which are within the APE. Finally, in 1996, AR Consultants undertook construction monitoring within the Dallas Floodway immediately north of the Project Footprint (Skinner, Whorton, and Trask 1996). Two historic sites, 41DL370 and 41DL371, were recorded during this project.

Prehistoric Chronological Framework

Although the chronological framework for the Upper Trinity River Basin is not well developed, the available data allow the delineation of a generalized chronology (Table 1). Investigations at Joe Pool Lake (Peter and McGregor 1988) have provided evidence for a refinement of the chronology for the Late Prehistoric period, but the overall regional applicability of the phases recognized at Joe Pool Lake remains to be demonstrated. Prikryl (1990) has presented a chronological sequence of six periods. Unfortunately, his sequence relies almost entirely on diagnostic artifacts from surface contexts and comparisons to dated contexts distant from the Upper Trinity River Basin. The generalized chronology presented here reflects the present state of knowledge as interpreted from the Joe Pool Lake investigations. A brief summary of the adaptations associated with these periods is presented below.

Table 1
Chronological Framework for the Upper Trinity River Basin
(after Peter and McGregor 1988)

CULTURAL STAGE	TIME PERIOD
Paleo-Indian	ca. 11,000 - 6,000 B.C.
Archaic	6,000 B.C. - A.D. 700
Late Prehistoric	A.D. 700 - A.D. 1600
Protohistoric	A.D. 1600 - A.D. 1800

The Paleo-Indian occupation of the Upper Trinity River Basin is known primarily through diagnostic projectile points from surface collections or from stratigraphically mixed contexts. The Field Ranch site (X41CO10) (Jensen 1968) along the upper Elm Fork is a primary example of typical site contexts. Clovis and Plainview points are commonly found along both Denton and Clear creeks in the Cross Timbers. Until recently, the Lewisville Lake site (Crook and Harris 1957, 1958, 1961) was the best known Paleo-Indian site within the region. While the original radiocarbon dates (ca. 37,000 B.P.) contributed to the significance of the site, more recent work (Stanford 1981) has resolved the controversy concerning the date of the occupation. It appears that the presence of naturally-occurring lignite as either a fuel in these hearths or an inadvertent inclusion contaminated the radiocarbon samples. Consequently, the usually accepted date of 12,500-10,000 B.P. for Clovis-period occupations is probably a reasonable estimate for the first human occupation of Northcentral Texas. Our knowledge of the settlement-subsistence strategies used by these early occupants is extremely limited. However, recent important excavations at the Aubrey site (41DN479), a well-preserved Clovis-period occupation in Denton County, has indicated that subsistence efforts did not focus on big game animals alone. Rather, the entire range of prairie and forest species was used (Ferring 1989). Whether this pattern of a more generalized foraging subsistence system is characteristic of Clovis adaptations in the Eastern Woodlands and the focus on now extinct, big game species is more characteristic of a Plains adaptation remains to be documented. Furthermore, the situation of the Aubrey site, buried about 7-8 m below surface in the flood plain of the Elm Fork (Ferring 1990), suggests that well-preserved Paleo-Indian sites in this area will only be found by penetrating more recent Holocene alluvium in modern flood plain situations.

Our knowledge of the Archaic period in the Upper Trinity River drainage is limited by a lack of data from major excavations. This is particularly true for the Early and Middle Archaic periods. Recent investigations along the West Fork (Peter and McGregor 1988; Yates and Ferring 1986) indicate that primary contexts for Early and Middle Archaic sites will probably be found deeply buried within flood plain alluvium. Artifacts from these periods are present on terrace surfaces, but they are frequently mixed with later materials. In fact, the initial treatment of the Archaic period in Northcentral Texas (Crook and Harris 1952, 1954), which defined the Carrollton and Elam foci, was based upon materials from such mixed terrace contexts. Consequently, these time-space constructs are no longer recognized as being acceptable for this area of Texas (Peter and McGregor 1988; Prikryl 1990; Yates and Ferring 1986).

Recent investigations at Joe Pool Lake (Peter and McGregor 1988) and at Lake Ray Roberts indicate that remains of the Late Archaic period are characterized by assemblages apparently left by small bands of foraging hunters and gatherers who occupied a locality for a limited time period and then moved to another locality. These sites were apparently reoccupied numerous times on a seasonal basis. Deer and numerous small mammals were the primary food resources. The documentation of large pits associated with Late Archaic period sites in the Richland Creek and Chambers Creek drainages (Bruseth and Martin 1987) suggests that important sociopolitical changes may have been occurring during this time period. Unfortunately, the significance of these pits remains an enigma despite their excellent documentation.

The beginning of the Late Prehistoric period in the Upper Trinity River Basin is marked by the initial appearance of arrow points. A lower date of A.D. 700 for this period is based upon dated contexts for similar material in the Brazos River drainage to the west. Lynott (1977) suggests that the Late Prehistoric period may be divided into an early and a late phase. The early phase is characterized by sand- and grog-tempered ceramics, Scallorn and Alba arrow points, and a continuation of the foraging subsistence system of the preceding Late Archaic period. The late phase reflects Southern Plains influences, with the appearance of Nocona Plain ceramics of the Henrietta focus, various unstemmed triangular points (e.g., Fresno, Harrell, Washita), and the Perdiz point. Evidence of horticulture and the procurement of bison also appears in sites of this period (Harris and Harris 1970; Morris and Morris 1970). Prikryl's (1990) recent assessment of the Late Prehistoric period largely follows that of Lynott (1977).

Recent investigations at the Cobb-Pool site at Joe Pool Lake (Peter and McGregor 1988) have resulted in a reformulation of the Late Prehistoric period. The Cobb-Pool site has yielded house structures, roasting pits, Alba points, grog-tempered ceramics, and charred corn cupules. Radiocarbon dates from several features indicate the site was occupied during the late twelfth or early thirteenth century. Present evidence suggests that the site does not represent an intrusive Caddoan occupation; consequently, a significant adaptive change appears to have occurred during a middle phase of the Late Prehistoric period. It is also likely that ceramics were not introduced to the region before this time. Whether the Cobb-Pool site merely represents a local experiment or reflects a regional adaptive change remains to be fully documented, but a small grouping of disturbed human remains recovered from the Harbor Pointe site (41DL369) suggests that various prehistoric groups in the Dallas County area may have been pursuing radically different adaptive strategies at this time. This site, located on Rowlett Creek (a tributary of the East Fork of the Trinity River) yielded remains of at least four individuals dated by radiocarbon dating of bone collagen to cal A.D. 1010 (1035) 1165. No pottery was recovered with these remains, although shell beads and a shell gorget, were present; and a carbon isotope ratio of -21.6% suggests that the group's diet was not high in maize (Cliff et al. 1996).

Historical documentation and archeological evidence are very sparse for the Protohistoric period in the Upper Trinity River Basin. Numerous historic groups, including Tonkawa, Wichita, Caddo, and Comanche, all are likely to have traversed the area. However, exact locations of their sites and detailed ethnohistoric data are almost nonexistent. Although European trade items (Sollberger 1953) appear on a limited number of sites, no protohistoric site has been thoroughly investigated and characterizations of the Native American adaptations during this time period are conjectural at best. A lack of documentary evidence, together with a lack of interest among ethnologists and archeologists, has contributed to this situation.

Historic Background

The first documented presence of Europeans in Northcentral Texas may have occurred in 1542, when the remnants of the de Soto expedition, led by Luis de Moscoso de Alvorado, entered modern Texas in an effort to find a land route to New Spain. Some researchers believe that the expedition crossed Northcentral Texas (Lebo and Brown 1990:61), although others place the route much farther to the east and south (Bruseth and Kenmotsu 1991; Chipman 1992; Hudson 1986; Schambach 1989; Weber 1992). A consistent presence in the region did not occur until the early 1700s, when French traders from Louisiana began to move west along the Red River. The Spanish considered this French incursion to be a threat to the security of New Spain, and they responded by redoubling efforts to counterbalance the French influence with the Native Americans in East and Northcentral Texas. These efforts continued until 1763, when France ceded Louisiana to Spain under the Treaty of Paris. This reduced the perceived threat to the security of New Spain and resulted in a reduction in Spanish investment in eastern and northern Texas. More important from the Native American viewpoint, was the severe military defeat inflicted on the Spanish by Wichita and allied tribes at Spanish Fort on the Red River in 1758. It has been argued that this defeat put an end to Spanish military and missionary expansion to the north (Weddle 1964, 1965).

The first North Americans to settle in the region were primarily from Arkansas Territory. The first permanent settlement in the Dallas area was Bird's Fort in present-day Tarrant County, established in 1840. Also in 1840, John Neely Bryan reconnoitered the Dallas area to determine its suitability for a trading post. By the time Bryan returned in 1842, troops of the Republic of Texas had removed the Native American groups with whom he had intended trading. As a result, Bryan determined to found a settlement in the same area where downtown Dallas is today. To further this goal, Bryan invited the residents of Bird's Fort to join him in his new settlement. Five individuals—John and James Beeman, Captain Mabel Gilbert, Tom Keenan, and Isaac B. Webb—and their families decided to answer Bryan's call. Prior to this, in 1841, the Republic of Texas had contracted with the Texan Emigration Land Company to establish 600 families on a land grant encompassing portions of the modern Dallas, Denton, Cooke, Collin, Grayson, Ellis, and Wise counties. This land grant became known as the Peter's Colony. The majority of the Peter's Colony settlers held property north of Dallas. The Peter's Colony continued until 1852, when disputes about land title between the Texan Emigration Land Company and the settlers came to a head and some of the settlers rose up in arms to defend their title to the land they had settled. Dallas County was organized from Roberson County in 1846, with Dallas serving as the county seat (Works Progress Administration [WPA] 1992:38-50).

Texas was annexed by the United States in 1846 and some Dallas area residents joined the American army facing the Mexicans. The California gold rush in 1849 affected Dallas in two ways. First, it was near a major trail for the "49ers" that utilized a ford across the Trinity River about seven miles north of Dallas. Second, many Dallas area residents were struck with gold fever. Some, including John Neely, trekked to California, while others explored the nearby Wichita Mountains for gold (WPA 1992:46-47).

In 1855, another major colonizing venture was begun in the Dallas area when 200 French, Belgian, and Swiss immigrants arrived to found the utopian settlement of La Reunion, about three miles west of Dallas along the West Fork of the Trinity River. La Reunion was well funded, with an initial capital of $600,000, but the residents did not adapt well to frontier conditions and the colony never really prospered. Gradually the members of the colony drifted away, with many becoming residents of Dallas. The colony officially dissolved in 1867 (WPA 1992:286-290).

Although present, slavery did not loom as large in the economy of the Dallas area as it did farther to the east. In 1846, there were 45 slaves in Dallas County, a number that grew to 207 by 1850 (Prince 1993:10). In the 1860 census, Dallas County had a total population of 8,655 people, of whom 1,074 were slaves (Prince 1993:16). Most of the white residents of the county were southerners by birth and supported the pro-slavery side of the abolition question. As passions grew during the election of 1860, a fire swept through the Dallas business district, destroying all but one building. This was immediately assumed to be an abolitionist plot, resulting in the hanging of three African-Americans, the flogging of the remaining African-Americans in the county, and the whipping and banishment of two white preachers from Iowa (WPA 1992:53-54).

Following the presidential election of 1860, Texas, in common with the rest of the South, began to consider secession. In a February 23, 1861, referendum on the issue, Dallas County voted 741 to 237 in favor of secession. Many county residents joined Confederate military units and, after a 516 to 3 vote on the issue, Dallas County donated $5,000 in gold to the Confederate cause. The Dallas area provided foodstuffs to the Confederate army, and in 1862 a small arms and ammunition factory opened in Lancaster, south of Dallas. Although the fighting never reached Northcentral Texas, the region was gradually impoverished by the war. Many of the commodities that were imported to the region became difficult to obtain and expensive, while the price of food had risen between two and four times its 1861 levels by September 1863. The *Dallas Herald* was forced to cease publication between September 30, 1863, and July 2, 1864, due to a lack of newsprint. Following Lee's surrender, the Federal Army occupied Texas and announced the emancipation of Texas' slaves on June 19, 1865 (WPA 1992:55-58).

Although the Dallas area suffered economically in the aftermath of the Civil War, it was not as badly affected as other areas of the former Confederacy. This greater economic vitality was fueled in part by streams of immigrants from the rest of the country, who were hoping to make a fresh start in the as yet unsettled West. Other elements in the economy included Dallas' location near one of the cattle trails to Kansas and its role as a center of the buffalo hide market. In 1872, the Dallas economy received a major boost when the Houston & Texas Central Railroad reached the city from the south, while, in 1873, the Texas & Pacific Railway provided important access to points east. After the arrival of the railroads, Dallas began to acquire many of the trappings of a major city, including the beginning of a water distribution system (1873), gas lighting (1874), a private telegraph company (1875), the telephone (1880), and electricity (1882) (WPA 1992: 60-70).

An early dream of the Dallas business community was to gain water transport along the Trinity River. The problems associated with this effort included the seasonal fluctuations in the level of the Trinity River, as well as the many snags and rafts that had to be removed. The first effort in this respect occurred in 1866, when the state legislature chartered the Trinity Slack Water Navigation Company to provide the improvements required for navigation from Galveston to Dallas. Under the terms of the charter, the company was to receive 5,000 acres of public land for every lock and dam completed; unfortunately, the company never started work on the project. In 1867, Captain J.M. McGarvey agreed to bring his *Job Boat No. 1* from Galveston to Dallas. The journey required seven months, with much of the time being spent removing obstructions from the river channel. Although Captain McGarvey claimed that the Upper Trinity was superior to both the upper Red River and the upper Mississippi River, his proposal to provide regular service to Dallas did not prove practical. Following his arrival, construction began in Dallas on the steamer *Sallie Haynes*, which made three trips down river before being sunk; there are no records, however, of the *Sallie Haynes* making the voyage all the way to Galveston.

After the railroads arrived in Dallas, interest in river navigation began to wane, although several small steamers continued to ply the Trinity, some of which are thought to have made the trip from Galveston to Dallas. In 1881, the state government was asked for $75,000 to remove obstructions from the river. During the 1890s interest in Trinity River navigation revived, and the Trinity River Navigation Company was formed in 1891. The company built two steamers, *Dallas* and *The Dallas*, and purchased the *H.A. Harvey, Jr.*, in New Orleans. The *Harvey* made its way up the river in 1893, arriving in Dallas on May 13. A dam was built at McCommas Bluff to provide sufficient water for the steamer, and it spent the next few years carrying cargo between Dallas and the dam. In 1898, the *Harvey* and the remains of *Dallas* were sold to a Galveston firm, and the *Harvey* made a four-month voyage downriver to Galveston.

In 1899, the U.S. Army Corps of Engineers submitted a plan to construct 37 locks and dams between Dallas and the Gulf of Mexico, permitting navigation of the Trinity River for eight months of each year. The plan went on to suggest that if a series of artesian wells were to be dug along the river channel, adding to the water flow, year-round navigation would be possible. In 1902, Congress appropriated $750,000 to improve the Trinity River, with another $500,000 being appropriated in 1904-1905. In addition, the citizens of Dallas contributed $66,000 for the construction of a dam at Parson's Slough, 26 miles below the city. Nine locks were built before the beginning of Wold War I. In 1916 the project was reevaluated, with a new estimate of another $13 million and 15 years being required to complete the project. Finally, in 1921, the Corps of Engineers recommended that any efforts to make the Trinity navigable above Liberty were impractical and should be abandoned.

In 1930, renewed interest in river navigation led to the creation of the Trinity River Canal Association, which in turn sponsored the creation of the Trinity Watershed Soil Conservation and Flood Control Association in 1936. These two organizations later merged to become the Trinity Improvement Authority (TIA). In 1955, the State of Texas created the Trinity River Authority (TRA). Lobbying on the part of the TIA and TRA led to passage of the Trinity River Basin Bill in 1963; however, the bill merely authorized the project and contained no funding. Due to the huge backlog of river and harbor improvement projects approved by congress, no funding was ever appropriated for the project. The dream of a navigable Trinity River once again died in 1979, when the Corps of Engineers again determined that navigation of the Trinity River upstream of Liberty was not economically feasible (Jadrosich 1996; McElhaney 1995; Saunders 1991).

The history of Dallas is punctuated with several severe floods, with the floods of 1844, 1858, 1866, 1871, 1890, 1908, and 1913 being particularly memorable. Following the 1908 flood, the City of Dallas determined to try to reduce the impact of Trinity River flooding. This led to the construction of the Houston Street Viaduct, a 5,106-foot long concrete bridge constructed to ensure communication between Dallas and Oak Cliff even in the event of a major flood. A series of severe floods in the early 1920s led to renewed interest in flood control projects on the part of the local government. In 1926, the Dallas County Commissioners created the City and County of Dallas Levee Improvement District, which formulated the Ulrickson Plan for flood control. This plan called for the construction of levees, straightening and moving the river channel, additional viaducts, storm water drainage, and other improvements. Funds in excess of $15,000,000 dollars were provided for the project by the Levee Improvement District, The City and County of Dallas, and affected utilities and railroads. Among these improvements were the Cadiz Street Viaduct (completed in 1932), the Corinth Street Viaduct (completed in 1933), and the Lamar-McKinney Viaduct (completed in 1934) (Skinner, Whorton, and Trask 1996:18; WPA 1992:85, 94-96, 154-156).

By 1900, Dallas had become a major commercial and manufacturing center and, with a population of 42,638, was the third largest city in Texas. In 1908, a devastating flood occurred along the Trinity River, with the river cresting at 51.3 feet. The flood caused tremendous property loss, estimated at $2,500,000, and left 4,000 people homeless. The flood shut down the Dallas and Oak Cliff water systems and caused the collapse the Texas and Pacific Railroad trestle across the Trinity, as well as threatening several other bridges. During World War I, Dallas served as a training base for aviators, with Love Field and Camp Dick (at the State Fairground) being used for training. During the 1920s, the Ku Klux Klan became a factor in local politics, achieving particular importance between 1921 and 1924. Dallas' first radio station, WRR, was established in 1921, originally as a means of broadcasting emergency messages to the fire department. By 1927, WRR had become a commercial station. Beginning in 1930, Dallas began to be severely impacted by the Great Depression (WPA 1992:80-97, 266-267).

The economy of Dallas, and of the nation as a whole, did not begin to recover from the Depression until the mobilization for World War II began. After the war, the Dallas economy continued to grow along with the rest of the nation. Dallas' image was shattered by the Kennedy assassination on November 22, 1963, and it took many years to recover from this blow. A major economic downturn occurred in the late 1980s, when a drop in oil prices and the collapse of the real estate market dealt a severe blow to the Texas economy. This forced the Dallas region to diversify economically, investing heavily in the modern high-tech industries.

Project Specific Background

Although archeological surveys and archival research show that the Trinity River flood plain was occupied historically, little is known about settlement patterns, land use, social and economic development, historic structures, and the extent to which ethnic diversity may have existed in the area. Resources for historical data which pertain to Dallas County are widely available (see Graff et al. 1977), but data which pertain specifically to the APE are scarce and sometimes difficult to trace. Previous research and archeological surveys indicate that development in this area was limited, due in part to the frequent, unpredictable flooding of the river and its tributaries (Bennett et al. 1981:31, 38). Known historic structures and sites, however, suggest that the river played an important role in the activities which did occur.

Miller's Ferry, Cockrell's Bridge, and Lock and Dam No. 1 all indicate that fording and navigating the river were important considerations for earlier inhabitants (U.S. Army Corps of Engineers, Fort Worth District [USACE-FW] 1996; Yates and Ferring 1986:156). Ferries and bridges became venues for connecting settlements which developed on either side of the river—Dallas and Hord's Ridge (which later became known as Oak Cliff). As the town of Dallas grew to become a mercantile center with county farmers producing marketable crops, such as cotton and wheat, inhabitants dreamed of establishing shipping connections between Dallas and Galveston via the Trinity River. However, in spite of attempts to channel the river and to maintain a navigable level of water, an established water route between Dallas and Galveston never materialized (Bennett et al. 1981:41; McElhaney 1995; Saunders 1991; WPA 1992:150-153). Since the area was not highly developed, it did not receive the same attention from early chroniclers as did the more prominent areas. The early history of the downtown district, for example, is well documented as it was the center of social, economic, and political activities and was the site that John Neely Bryan chose for the original town (American Illustrating Company 1908; A.C. Greene 1973, 1984:59-61).

METHODS

Task 1 - Archeological Evaluation

The records of the U.S. Army Corps of Engineers, Fort Worth District; the Texas Archeology Research Laboratory (TARL), the University of Texas at Austin; and numerous cultural resources reports were consulted to determine what sites had been recorded within the APE. Due to limited right-of-access within the APE, it was not possible to revisit all of the recorded sites, while in other cases access was gained to the property only with significant limitations. For example, neither the Sleepy Hollow County Club nor the Dallas County Joppa Wildlife Preserve would allow shovel testing, greatly reducing the potential for relocating and reevaluating the sites in these areas. In addition, several sites had originally been discovered in cutbanks along the Trinity River, 1.5 to 3 m below present ground surface; and for these sites, shovel testing was futile, while safe examination of the bank was precluded by the high river levels during the period of investigation. A further complication arose in the case of the sites recorded by Forrest Kirkland in the 1940s, since careful reading of the site forms suggested that the TARL site plottings may not be accurate. For example, although the mapped position of site 41DL84 is within the Sleepy Hollow County Club, the latitude and longitude provided by Forrest Kirkland place the site adjacent to a gravel pit/strip mine about 500 m north-northeast of the plotted location, while the site map appears to place it adjacent to the Southern Pacific railroad tracks, over a kilometer away from the plotted location.

On May 14-15, 1997, an attempt was made to relocate all of the sites in the Project Footprint to which the Corps of Engineers had obtained right-of-access. The two-person field crew was able to actually revisit only two of the 13 previously recorded sites that fell into this category. Of the sites which were not revisited, one had been destroyed, two could not be relocated, and eight were inaccessible due to high flood waters. Those sites which could be relocated were shovel tested and recorded at a level equivalent to a Phase 1 survey. Shovel tests consisted of 30-x-30-cm units dug in 20-cm arbitrary levels to a minimum of 40 cm below surface or to subsoil. A Survey Unit Level Form was completed for each shovel test at each site, describing, at a minimum, the soil color and textures and artifacts (if any) recovered from the unit. A pace-and-compass map was drawn to show the locations of the shovel tests and pertinent landform features, and a site update form was completed. Within the Project Footprint, black-and-white and color photographs were taken of all sites that could be relocated, and of the reported location of those that could not. A record was maintained of all photographs taken during the project, and a daily record of the field work was maintained by the field supervisor, describing the survey conditions and the results of the investigations.

Subsequently, beginning on May 26, 1997, attempts were made to revisit sites in the APE outside of the Project Footprint, where the Corps of Engineers had not obtained any right-of-access. The goal of this second phase of fieldwork was twofold: (1) to discover which sites have public access, and (2) to revisit and reevaluate those sites the field crew could reach. Shovel testing could not be undertaken on any of these sites, in the absence of explicit right-of-access. Of the 27 previously recorded sites in this category, the four sites in the Joppa Wildlife Preserve were revisited but could not reevaluated due to the inability to shovel test, one appeared to be within the McCommas Bluff Sanitary Landfill and is probably destroyed, and the remainder could not be reached at all. An attempt was also made to reach the McCommas Bluff Lock and Dam No. 1, constructed in 1904-1905 as the first in a proposed series of 37 locks and dams to allow navigation of the Trinity River (USACE-FW 1992:28). Unfortunately, this site could also not be reached due to lack of access and high flood waters.

Task 2 - Archival Evaluation

The historical research conducted for this project focused on surveying sources for information that might shed light on the historical activities that occurred within the APE from the time that Dallas was settled in the 1840s. While some data were uncovered, the limited amount of available information demonstrates the need for more in-depth historical research on the Trinity River flood plain. Over 35 maps, located at the Dallas Public Library and at Fondren Science Library, Southern Methodist University, were consulted for data on settlement patterns, land use, land ownership, historic structures, and development (see Table 2: Cliff et. al 1997). Inquiries into record holdings were made at the Dallas County Historical Society, Preservation Dallas, and Black Dallas Remembered, Inc. Secondary (or published) material was consulted, as were earlier cultural resources survey reports and the 1903 and 1904 Dallas directories. Finally, deed research was conducted for several parcels of land.

Initial steps toward documenting the cultural and historical development in the APE focused primarily on a review of maps, which were consulted for information regarding historic structures, community development, land use, and land ownership. Unfortunately, the majority of the maps reviewed contained little or no information pertinent to the APE—exceptions included the 1900 *Sam Street's Map of Dallas County, Texas,* the 1920 Dallas County soil survey map, and a few others.

In conjunction with map research, the files at Preservation Dallas were consulted for information pertaining to neighborhood and community developments in or near the project area. Six developments which surround the APE were identified, including Cadillac Heights, Magna Vista (or Cedar View), South Central (or Joppa), Skyline Heights, Ervay Terrace Marlburg,and Colonial Hills (or Wendelkin/Driskell). Of these six districts, the first four (Cadillac Heights, Magna Vista/Cedar View, South Central/Joppa, and Skyline Heights) appear to be adjacent to or within the APE—located on the western side of the Trinity River.

The Colonial Hill Historic District is located adjacent to, but outside, the APE on the eastern side of the Trinity River, bound by Central Expressway and I-45/South Lamar on the east and west, and by Warren Avenue and Hatcher Street on the north and south, respectively. Data for each of these districts in the files at Preservation Dallas vary in detail. For example, no data pertinent to the project were found in the informational notebook for Cadillac Heights. For Magna Vista/Cedar View, Skyline, and South Central/Joppa, however, surveys completed by a neighborhood resident in 1994 at least provided a contact person from whom additional information could be obtained.

Secondary sources that were consulted provided general information for an historical overview of Dallas County and the role of the Trinity River in its development, but little data appeared to relate *directly* to the cultural and historic development of the APE, specifically. The final step in historical research for this project included deed/title and will/probate investigations for two properties, in order to evaluate the completeness and character of available records.

Task 3 - Architectural Evaluation

Addressing the architectural resources within the Dallas Floodway Extension Project Area involved two levels of identification and preliminary NRHP eligibility assessment. First, all architectural resources indicated by the COE Real Estate to be within the Project Footprint (the area that will be directly impacted by the construction of the levees or other components of the levee/flood control system) were assessed for their potential for being included in the NRHP. Second, all architectural resources within what has been defined by the Corps of Engineers as the APE—the 100-year flood pool—were identified. Any architectural resources in the APE that had been previously recommended as eligible for inclusion in the NRHP were assessed in the same manner as the architectural resources within the Project Footprint.

The assessment of the architectural resources included their categorization as:

1 — potentially eligible architectural resource or district (according to field evaluation, resource condition is at least fair, resource integrity is maintained to a reasonable degree, and the resource is likely to be more than 50 years old);
2 — architectural resource considered not eligible due to deteriorated condition or loss of integrity, or because it lacks sufficient significance;
3 — architectural resource that is not eligible because it is currently less than 50 years old, and will not be 50 years old at the time levee construction is scheduled to begin (estimated to be the year 2004);
4 — architectural resource or district that is not eligible because it is currently less than 50 years old, but one which will be 50 years old by the time levee construction is scheduled to begin and will thus need to be assessed when it becomes 50 years old.

The assessment of Category 1 buildings and structures was further refined by prioritizing these potentially eligible resources as:

1a — (highest priority) a resource or district that helps define the development of Dallas, including major municipal facilities, very important examples of local architectural or engineering design, and resources or districts associated with pivotal events or persons in Dallas history;
1b — a resource or district that is characteristic or typical of architectural or engineering styles important in the Dallas area and significant in the history of the city, or associated with important events or persons in the history of Dallas;
1c — a resource or district that is of minor architectural or engineering importance in the Dallas area, of minor significance to the history of the city, or associated with less important events or persons in the history of Dallas (but that will likely be considered eligible because of significance related to broader architectural or engineering styles, historical events, or persons); or
1d — (lowest priority) a resource or district considered to be significant primarily for its associations with architecture and engineering design, events, or persons of importance within broader historical themes (i.e., not Dallas-specific themes).

All buildings and structures within the Dallas Floodway Extension Project Area were given identification numbers. Those shown to lie within the Project Footprint (specifically in areas that will be directly impacted by the construction of the levee system or other flood control components) were assigned identification numbers prefixed with "A" (herein referred to as A-series resources). Those located within the APE but not to be directly impacted by levee construction were assigned identification numbers prefixed with "B" (herein referred to as B-series resources). The number of A-series resources thus identified was 49, and the number of B-series resources was 699 (one of which is a potential historic district that includes other B-series resources).

U.S. Geological Survey (USGS) 7.5-minute quadrangle sheets for the area, in conjunction with historic maps, archives and historic quadrangles, were examined to determine which resources had been constructed subsequent to the original date of the sheets (1958), indicating that the resources were less than approximately 40 years old. In general, assessment for NRHP eligibility should take place at least 50 years after a potential historic property has achieved significance in order to allow proper historical perspective for an accurate assessment. Thus, sufficient time has not yet passed—nor will it have passed by the time the Dallas Floodway Extension Project construction is scheduled to begin (estimated to be the year 2004)—for resources constructed after 1958 to be considered for inclusion in the NRHP. Only resources of exceptional significance should be considered prior to reaching 50 years of age, and there are no known resources of exceptional significance within either the Project Footprint or the APE.

It should be noted that most of the areas identified as ruins on Corps of Engineers map were not assigned identification numbers, since they do not include standing structures and are more appropriately considered as archeological rather than architectural resources. It should also be noted that no architectural resources between Loop 12 and Highway 635 were assigned identification numbers since no construction efforts are planned in that area which would potentially impact architectural resources. In the event actions are planned or undertaken that may impact architectural resources in the area between Loop 12 and Highway 635, inventory and assessment of the resources within the area should be undertaken.

The areas with A-series resources were first visited on May 12, 1997 to ascertain the variety of resource types, general conditions, accessibility, and to assess the resources. A large majority of these buildings and structures were in industrial areas and appeared to serve as storage and industrial activity facilities. Some were retail outlets. Buildings and structures that were estimated to be 50 years old or older were photographed. Unfortunately, several of the buildings and structures could not be observed because they were behind fenced areas, obscured by other buildings, or hidden by trees. A second trip to the area was made on June 9, 1997, to ensure that every effort to locate and assess all architectural resources was made, but this second visit contributed little to the previous resources assessment. Although additional efforts to see buildings and structures on private lands were made (by searching for higher ground, looking for open lines-of-sight around obstructions, and by driving or walking along public transportation routes), only in a few cases could the locations be seen clearly enough to make accurate assessment of the resources thereon.

Preliminary age determinations were made for each of the 699 B-series resources in the APE, based on information contained on the USGS quad sheets of the area. This data allowed a preliminary assessment (using the same five categories employed for the A-series resources) of many of these resources to be made. Several of the B-series resources were visited during field assessment of the A-series resources, but most will need additional assessment should the design or layout of the levee system or other flood control components be altered such that it would impact B-series resources. Field observations were concentrated in locations that contained resources previously recommended as eligible for inclusion in the NRHP and residential areas. While assessing the A-series resources, any nearby B-series resources that appeared to be more than 50 years of age were also assessed.

Task 4 - Geoarcheological Investigation

Field geological investigations in the Dallas Floodway Extension were confined to the Project Footprint and were conducted in May and June 1997. The purpose of the field investigation was to establish a geomorphic model that would compliment a predictive model for buried prehistoric resources in the APE. Prior to the field investigation, geological and geomorphological data pertinent to the APE were collected and reviewed. An initial field reconnaissance of the area was conducted to view geomorphic characteristics of the landscape, identify areas significantly altered by modern land use development, and assess the logistics of implementing the field plan. Access to the areas of impact were limited by logistics of right-of-entry in this mostly urbanized area. Also many areas are already significantly impacted by landfilling, dumps, industrial/commercial activity, and other development.

Primary consideration was given to core and boring data, especially newly acquired data collected with the Geoprobe. A Geoprobe is a hydraulically powered, percussion/probing machine designed specifically for use in environmental soil investigations. Soil probing techniques can be thought of as a direct push technique, where sampling tools and/or sensors are pushed into the ground without the use of drilling to remove soil or to make a path for the tool. The Geoprobe relies on a relatively small amount of static (vehicle) weight combined with percussion as the energy for advancement of a tool string.

Electrical conductivity (EC) logs were run to define zones of varying conductivity in the soil profile. Soil conductivity and earth resistivity (the inverse of conductivity) have long been used to classify soils. Higher EC values are representative of finer-grained sediments, such as silts or clays, while sands and gravels are characterized by distinctly lower electrical conductivities. Site specific core samples, either from discrete depths or a continuous core, were also collected to verify the lithology represented by EC values at a site. The electrical logs are correlated through the Project Footprint to show changes in thickness or elevation of soil units of interest. Seventeen EC traces were collected from the project area during the field investigation. The patterns of the EC curves were compared to discrete soil samples collected and described in the field for verification of soil properties.

The geomorphological map of the Dallas Floodway Extension APE and surrounding area was compiled from existing published geologic reports (Allen and Flannigan 1986; Ferring 1990), the published Soil Survey of Dallas County (USDA 1980), and data collected in this investigation. Stratigraphic contacts were drawn on overlays using parts of the Dallas, Hutchins, and Oak Cliff, TX USGS 7.5-minute topographic quadrangles as a base. The map units and their descriptions are modified from these sources to provide appropriate detail to assess the likelihood of encountering cultural deposits within the delineated APE.

Discrete sediment samples were inspected and described using a modified USDA approach (Soil Survey Staff 1975, 1981). Sediment samples were described as to their position in a vertical profile, color, texture, soil structure, consistence, and other notable sedimentologic and pedologic properties. Descriptions were correlated with corresponding alluvial stratigraphic units in Ferring's (1990) model.

RESULTS

TASK 1 - ARCHEOLOGICAL EVALUATION

A total of 41 archaeological sites were previously recorded within or immediately adjacent to the APE (Tables 2 and 3, Figure 4). Fourteen of these fall within the Project Footprint, another 13 fall within the APE but are outside the Project Footprint, and the remaining seven are on the edge of, or only partially within, the APE. Another seven sites are recorded as being adjacent to, but outside of, the APE. On May 14-15, 1997, an attempt was made to revisit the 13 sites in the Project Footprint to which right-of-access had been obtained. Subsequently, attempts were made to revisit sites in the APE outside of the Project Footprint, although right-of-access had not been obtained and investigation was subsequently limited to surface inspection. However, a crew did return in August and inspected visit all previously identified archaeological sites in the Project Footprint.

Table 2
Location of Archeological Sites Within or Adjacent to the Dallas Floodway Extension APE

SITES WITHIN PROJECT FOOTPRINT	SITES WITHIN APE (100-YEAR FLOOD POOL)	SITES ON EDGE OF, OR PARTIALLY WITHIN, APE [1]	SITES ADJACENT TO, BUT OUTSIDE, APE
41DL69	41DL67	41DL71	41DL68
41DL70	41DL78	41DL72	41DL77
41DL84	41DL79	41DL73	41DL92
41DL104	41DL99	41DL76	41DL105
41DL220	41DL102	41DL80	41DL207
41DL317	41DL204	41DL91	*X41DL39*
41DL318	41DL205	41DL223	*X41DL40*
41DL319	41DL206		
41DL320	41DL208		
41DL337	41DL350		
41DL338	41DL351		
41DL355	*X41DL36* [2]		
41DL356	*X41DL38*		
41DL357			

Footnotes to Table 2
[1] APE = Area of Potential Effect.
[2] *X41DLxx* = Site number assigned by the Archeology Research Program of Southern Methodist University.

Table 3
Summary of Previously Recorded Archeological Sites within the Dallas Floodway Extension APE

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL67	APE[1]	Late Prehistoric; scraper, flakes, "arrow-heads and bird points," no potsherds; found on "deep sand bed in the river bottom"; 150-x-150 yds; Dec. 1940.	Yes	Not investigated; will not be impacted as it is within Central Waste Water Treatment Plant; actually outside 100-year flood pool.	Not evaluated
41DL68	Adjacent to APE[1]	ALate Prehistoric; polished stone axe, two celts, two discoidals, large muller, many "arrowheads and bird points," no potsherds; sand-covered clay hills reaching down to edge of Trinity River bottoms; 500-x-300 yds; reported in Hanna (1940); site form dated Nov. 1940. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined Late Prehistoric period; 460-x-460 m; on terrace along Honey Grove Spring; built over, poor potential for further work.	No	Not relocated.	Not evaluated
41DL69	Project Footprint	Late Prehistoric; many "arrowheads and more than one-hundred bird points," one steatite pipe, potsherds, scrapers, and flakes; on slight ridge at edge of Trinity River bottoms; 200-x-400 yds; Dec. 1940. Not relocated by ECI (Bennett et al. 1981:Appendix B); summarized in Table 2. The result of years of collection at the site were summarized by Bill Young (1988); burials reported.	Yes	Six ST's excavated; some prehistoric material remaining; area badly impacted by excavation of gravel pits.	Ineligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL70	Project Footprint	Late Prehistoric; flakes, two potsherds, some shell; found in deep sand on flat land just above the overflow level; 100-x-400 yds; Dec. 1940. Not relocated by ECI (Bennett et al. 1981:Appendix B); summarized in Table 2.	Yes	Destroyed by construction of Rochester Park Levee.	Ineligible
41DL71	APE[1]	Late Prehistoric; arrowheads, blade cache, six almost complete pots, fragments of three effigy pots, flakes, burial, European battle axe?; sandy ridge at edge of river bottom; 200-x-400 yds; Dec. 23, 1940	No	Some areas of site may retain integrity; need Corps of Engineers to determine landowner and gain right-of-access.	Not evaluated
41DL72	APE[1]	Late Prehistoric, historic; arrowheads, "bird points," blades, flakes, one potsherd, one burial with no grave goods reported by farmer; historic farmstead for over 50 years; extensively collected by 1940; on hill, large spring in center of site; 300-x-400 yds; Dec. 29, 1940.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to find landowner and gain right-of-access.	Not evaluated
41DL73	APE[1]	Late Prehistoric; "many arrowheads and bird points," blades, scrapers, metates, one notched axe, no potsherds; poor condition, artifacts found only in eroded areas; on extended sand bar in river bottom; 200-x-3,000 yds; Dec. 1940 Not relocated by ECI (Bennet et al. 1981:Appendix B); summarized in Table 2.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and gain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL76	APE[1]	Late Prehistoric; arrowheads, "bird points," mano, metate, broken bone gorget, flakes, potsherds, mussel shell; reported burial removed prior to 1940, associated potsherds, gorget; on two knolls at edge of river bottom; 400-x-800 yds; Dec. 1940. Reported destroyed by SMU field crew, 1978. Summarized by Skinner et al. (1978:Table 2); lithic scatter of an undetermined Late Prehistoric period; 360-x-740 m; on a terrace along Elam Creek; altered by quarrying with poor potential for further work.	No	Possible City of Dallas property; need Corps of Engineers to determine landowner and gain right-of-access.	Not evaluated
41DL77	Adjacent to APE[1]	Wood site; Late Prehistoric; arrowheads, scrapers, metate, flakes, potsherds; low, sand-covered hills at edge of river bottoms; on both sides of small drainage near mouth of Elam Creek; badly cut up by two gravel pits; 250-x-400 yds; Dec. 1940. Revisited by SMU field crew in 1978; site listed as "destroyed: borrowing in gravel pits." Summarized in Skinner et al. (1978:Table 2); lithic and ceramic scatter; undetermined Late Prehistoric period; 230-x-360 m; on terrace along Elam Creek; altered by quarrying, poor potential for further work.	No	In McCommas Bluff Park; not relocated, no shovel testing undertaken; site area heavily overgrown, no evidence of recent disturbances	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL78	APE[1]	Late Prehistoric; mussel shells, arrowheads, scraper, blades, flakes, few potsherds; found on deep, flat sand beds near the river bottoms; no disturbance noted; Dec. 1940. Summarized in Skinner et al. (1978:Table 2); lithic and ceramic scatter of an undetermined Late Prehistoric period; 140-x-140 m; found on a terrace of the Trinity River; reported as inundated with no potential for further work.	No	In Joppa Wildlife Preserve; not relocated; heavily overgrown, water in bottom of pit; 2-2.5 m high berm on north side.	Not evaluated
41DL79	APE[1]	Late Prehistoric; bird points, flakes; found on deep, flat sand beds at edge of river bottoms; no disturbance noted; Dec. 1940. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined Late Prehistoric period; 140-x-180 m; found on a terrace of the Trinity River; reported as inundated with no potential for further work.	No	In Joppa Wildlife Preserve; area heavily overgrown, shovel testing not permitted; no significant ground-altering disturbances noted in site area; may be misplotted, site map shows it much closer to RR tracks.	Not evaluated
41DL80	APE[1]	Late Prehistoric; arrowheads, "bird points," scrapers, manos, flakes, potsherds; found on low, sandy loam ridges at edge of river and creek bottoms; 150-x-350 yds; no disturbance noted; Dec. 1940. Reported in McCormick (1976:14-15, Figures 4, 5, and 6); occupied in Archaic, Late Prehistoric, and Early Historic aboriginal periods based on artifacts from R.K. Harris collection; southern half of site severely damaged by I-635 construction.	No	Behind chainlink fence; need to have Corps of Engineers determine landowner, gain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
		Summarized in Skinner et al. (1978:Table 2); lithic and ceramic scatter of Early Archaic to Late Prehistoric II periods; found on a terrace of Five Mile Creek; disturbances include alteration by construction and quarrying; considered to have excellent potential for future work. Relocated by ECI (Bennet et al. 1981:Appendix B); flakes and a biface were collected; site disturbed by I-635, dirt roads, and an animal pen; site measured 60-x-120 m; summarized in Table 2. Visited by NTSU field crew, Sept. 1985; site form largely illegible, but multiple occupations present; considered of unknown eligibility for the NRHP; site has shrunk to 35-x-20 m.			
41DL84	Project Footprint	Late prehistoric; arrowheads, flakes; found on sand ridges at edge of river bottom; reported "most of site area has been dug over for sand and gravel"; 400-x-500 yds; Feb. 1941. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined prehistoric period; 360-x-460 m; found on terrace of the Trinity River; altered by quarrying, fair potential for further work. Not relocated by ECI (Bennet et al. 1981:Appendix B); summarized in Table 2.	Yes	No prehistoric remains located; site may be misplotted or destroyed	Ineligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL91	APE[1]	Late Prehistoric; blades, hand ax, flakes; located on sandy hills at edge of bottoms; site was "badly dug into by a gravel pit and part of it evidently extends into a heavy woods"; 100-x-100 yds; April 1941. Summarized in Skinner et al. (1978:Table 2); lithic and ceramic scatter of an undetermined Late Prehistoric period; 90-x-90 m; found on terrace of Trinity River; altered by quarrying, fair potential for further work. Not relocated by ECI (Bennet et al. 1981:Appendix B); summarized in Table 2.	No	Not relocated; need to have Corps of Engineers determine landowner and obtain right-of-access.	Not evaluated
41DL92	Adjacent to APE[1]	No site form. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined prehistoric period; 90-x-550 m; on terrace along Trinity River; altered by quarrying, fair potential for further work. Reported on in Bennet et al. (1981); site not relocated.	No	In McCommas Bluff Park; site not relocated, no shovel testing undertaken; site area heavily overgrown, no evidence of recent disturbance.	Not evaluated
41DL99	APE[1]	Only summary index card available, no site form; small Archaic lithic scatter, few artifacts. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined prehistoric period; no site size; found on a terrace of the Trinity River; altered by construction, poor potential for further work.	No	Not relocated; need to have Corps of Engineers determine landowner and gain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
		Not relocated by ECI (Bennet et al. 1981:Appendix B); summarized in Table 2.			
41DL102	APE[1]	Only summary index card available; fairly large site with some indication of depth; lithic scatter, dating Early Archaic to Late Prehistoric I. Reported in McCormick (1976:17, Figure 7); northern part of site destroyed by gravel mining; buried 3-4 ft below surface; predominantly Archaic, with some evidence of a Late Prehistoric occupation. Summarized in Skinner et al. (1978:Table 2); lithic scatter dating from Early Archaic to Late Prehistoric periods; found on a terrace of Five Mile Creek; altered by quarrying, good potential for further work.	No	Inside McCommas Bluff Sanitary Landfill; not revisited; probably destroyed.	Not evaluated
41DL104	Project Footprint	No site form available but summary index card is available; recorded by R.K. Harris, probably 1940s or 1950s; small, Archaic lithic scatter; reported destroyed by gravel operation. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined Archaic period; no site size; found on terrace of Trinity River; altered by construction, fair potential for further work. Not relocated by ECI (Bennet et al. 1981:Appendix B); summarized in Table 2.	Yes	No prehistoric remains located; site may be misplotted or destroyed.	Ineligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL105	Adjacent to APE[1]	No site form, summary information from TARL states just south of Elam Creek; very small camp, Archaic as far as can be determined; probably destroyed; TARL information is that this is Old Trinity City. Summarized in Skinner et al. (1978:Table 2); lithic scatter of an undetermined Archaic period; size unknown; on terrace of Trinity River; listed as totally destroyed, but fair potential for further work.	No	Not relocated; need to have Corps of Engineers determine landowner and obtain right-of-access.	Not evaluated
41DL204	APE[1]	Archaic; four points reported (Pedernales, Ellis, two Trinity), cobbles, flakes, possible end scraper; on gently sloping terrace; eroded; sandy red soil with small patches of gray sand; eroded; 150-x-150 m; May 1981. Located by ECI (Bennet et al. 1981:Appendix B); three complete points and two point fragments collected, all dart points; cobbles, flakes, and cores also present; site 150 m in diameter; disturbed by erosion; summarized in Table 1.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated
41DL205	APE[1]	Unknown prehistoric; flakes, cobbles; gently sloping terrace; red/orange sandy loam; heavily eroded; 120-x-60 m; May 1981. Located by ECI (Bennet et al. 1981:Appendix B); flakes and cobble were observed; 120-x-60 m; summarized in Table 1.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL206	APE[1]	Historic; ceramics, glass, cans, coal burner; on terrace at edge of gravel pit; light brown sandy loam; poor condition/eroded; 60-x-60 m; May 1981. Located by ECI (Bennet et al. 1981:Appendix B); late nineteenth-century historic; refined earthenware, bottle glass, milk glass, tin cans, scrap metal, and an oil stove burner observed; 45-x-30 m; summarized in Table 1.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated
41DL207	Adjacent to APE[1]	Unknown prehistoric, historic; scrapers, cobbles, stoneware, earthenware, bottle glass, cartridge case; first terrace above Trinity River; 45-x-30 m; red/orange sandy loam; eroded; May 1981. Site reported in Bennet et al. (1981); chert and quartzite flakes, chert scraper, Alibates cobble, brown transfer-printed whiteware, stoneware, bottle glass observed at site.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated
41DL208	APE[1]	Historic structure; board-and-batten house converted into a barn; first upland terrace above the Trinity River; red/orange sandy loam; clear glass also found; 42-x-24 m; May 1981. Located by ECI (Bennet et al. 1981:Appendix B); board-and-batten house converted to barn; log sills, 4-x-4" posts, metal slanted roof, small asphalt shingles (siding?); summarized in Table 1.	No	Elam Road blocked at Pemberton Hill Road; other access appears to be driveway; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL220	Project Footprint	Historic; apparent well, possible packed clay floor, no artifacts; river edge-flood plain; white clay; 2-x-2 m; May 1981. Located by ECI (Bennet et al. 1981:Appendix B); collapsed limestone well approx. 1 m in diameter; hackberry tree growing out of well; summarized in Table 1.	Yes	No historic remains located; site destroyed.	Ineligible
41DL223	APE[1]	Historic double pen house; moved to this location; in gravel pit; possibly associated with abandoned meat packing plant; no cultural material present; March 1982.	No	In McCommas Bluff Park; no evidence of structure observed, possibly removed.	Ineligible
41DL317	Project Footprint	Historic; Millers Crossing Bridge; consists of two concrete-filled, steel pillars; one pillar 45 ft tall, other 4 ft tall; remnants of second pillar along south bank of Trinity; Dec. 1990.	Yes	Only one column remains, protruding about one meter above water.	Ineligible
41DL318	Project Footprint	Unknown prehistoric; 10-m-long exposure in south bank of Trinity River; five bone fragments, mussel shell, burned rock; occupation thin, begins 1.5 m below surface; possibly associated with buried soil; erosion major threat to site; June 1991.	Yes	Three shell loci observed, one containing *in situ* materials; probably associated with nearby sites 41DL319 and 41DL357.	Eligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL319	Project Footprint	Late Archaic (?); 12-m-long exposure in south bank of Trinity River; 1.5 m below surface, lens not more than 20 cm thick; one large bone fragment (possibly bison), mussel shell, burned rock, one biface fragment (possible Gary preform); possibly associated with buried soil; erosion major threat to site; June 1991.	Yes	New shell locus farther west; shell fragments at both loci in eroded context; no source for fragments observed; may be buried behind slumped soil; probably associated with nearby sites 41DL318 and 41DL357.	Eligible
41DL320	Project Footprint	Historic; old City of Dallas dump; three areas of site, two date ca. 1930s, other 1900s; being looted by bottle collectors; site impacted by road construction, erosion, excavation of storm drain outflow; Dec. 1990.	Yes	Condition apparently unchanged since 1990..	Eligible
41DL337	Project Footprint	Unknown prehistoric; exposed in Central Waste Water Treatment Plant effluent outflow channel; thin (10 cm or less) cultural deposit 3 m below surface; bison bone, mussel shell, one flake; impacted by construction of outflow channel; found at the contact between a black (10YR 2/1) clay and dark brown (10YR 3/3) clay; Sept. 1992.	Yes	No prehistoric remains located; apparently permanently submerged by outflow channel; probably associated with nearby sites 41DL338, 41DL355 and 41DL356.	Eligible
41DL338	Project Footprint	Unknown prehistoric; 3-m-long exposure in Central Waste Water Treatment Plant effluent outflow channel; approximately 3 m below surface; only mussel shell present; materials seem to be on soil contact; impacted by excavation of outflow channel; Sept. 1992.	Yes	No prehisatoric remains located; apparently permanently submerged by outflow channel; probably associated with nearby sites 41DL337, 41DL355 and 41DL356.	Eligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL350	APE[1]	Unknown prehistoric; 50-m exposure along south bank of Trinity River; cultural deposits 2 m deep, 30-60 cm thick; bone fragments (including large mammal, possibly bison), mussel shell; bison bone found above buried A-horizon, other bone, shell found 30 cm below buried A-horizon; impacted by continued erosion of the Trinity River; Jan. 1993. Reported on in Skinner and Whorton 1993.	No	At time of visit, cutbanks too steep to examine safely with high water levels in the Trinity River.	Not evaluated
41DL351	APE[1]	Historic; Wulschlager Farm site; old truck farm; identified by fences, two standing residences, pump house, boat house, sheds; probably post-WW II; surrounded by recent trash; abandoned; Dec. 1993. Reported on in Skinner and Whorton 1993.	No	In Joppa Wildlife Preserve; some structures appear demolished since recorded; site crossed by pedestrian trail, no motor vehicles allowed; no sign of significant ground-altering activities.	Not evaluated
41DL355	Project Footprint	Unknown prehistoric; 11-m exposure in Central Waste Water Treatment Plant effluent outflow channel; thin (less than 25 cm) shell lens found 3 m below surface; mussel shell, bone fragments, burned rock; impacted by erosion, excavation of channel; Sept. 1993.	Yes	No prehistoric remains located; apparently permanently submerged by outflow channel; forms part of site complex with sites 41DL337, 41DL338 and 41DL356.	Eligible
41DL356	Project Footprint	Unknown prehistoric; 20-m long exposure in Central Waste Water Treatment Plant effluent outflow channel; two thin lenses separated by 50 cm, begin 3 m below surface; impacted by channel construction, erosion; Sept. 1993.	Yes	*In situ* shell deposits found ca. 160cmbs; additional shell observed underwater; probably associated with sites 41DL337, 41DL338 and 41DL355.	Eligible

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
41DL357	Project Footprint	Unknown prehistoric; 35-m exposure in bank of Trinity River; cultural deposits begin 1.5 to 2 m below surface; burned and unburned mussel shell, burned rock, biface; major impact erosion; Sept. 1993.	Yes	No *in situ* prehistoric remains located, although redeposited material is present below cutbank; probably associated with nearby sites 41DL318 and 41DL319, and may actually be 41DL319.	Eligible
X[2]*41DL36*	APE[1]	Unknown prehistoric; SMU site number, no site form available; summarized in Skinner et al. (1978:Table2); lithic scatter; no site size; located on a terrace along an abandoned channel of Trinity River; site was totally destroyed and has no remaining research potential.	No	Behind chainlink fence; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated
X[2]*41DL38*	APE[1]	Unknown prehistoric; SMU site number, no site form available; summarized in Skinner et al. (1978:Table 2); lithic scatter; no site size; located on a terrace along an abandoned channel of the Trinity River; site was totally destroyed and has no remaining research potential.	No	Behind chainlink fence; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated
X[2]*41DL39*	Adjacent to APE[1]	Unknown prehistoric; SMU site number, no site form available; summarized in Skinner et al. (1978:Table 2); lithic scatter; unknown size; found on terrace along abandoned channel of Trinity River; major disturbance by natural causes, fair potential for further work.	No	Behind chainlink fence; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated

SITE NUMBER	LOCATION WITHIN PROJECT AREA	SITE DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
X41DL40[2]	Adjacent to APE[1]	Unknown prehistoric; SMU site number, no site form available; summarized in Skinner et al. (1978:Table 2); lithic scatter; unknown size; found on terrace along abandoned channel of Trinity River; major disturbance by natural causes, fair potential for further work.	No	Behind chainlink fence; need Corps of Engineers to determine landowner and obtain right-of-access.	Not evaluated

Footnotes to Table 3
1 APE = Area of Potential Effect.
2 *X41DLxx* = Site number assigned by the Archeology Research Program of Southern Methodist University.

Although the intent of the current study was to provide a Phase 1 evaluation of all known sites, several problems prevented that level of effort. First, neither the River View Country Club nor the Dallas County Parks and Recreation Department would allow shovel testing on their respective properties, negating the efforts to relocate sites 41DL78, 41DL79, 41DL104, 41DL350, and 41DL351. In addition, at the sites in the APE to which the Corps of Engineers did not yet obtain right-of-access, shovel testing was not undertaken without permission. Second, the high water level of the Trinity River during the period of the fieldwork made access to a number of the sites impossible, especially those deeply buried sites originally exposed in cutbanks. During the May 14-15 period of fieldwork, the Trinity had drowned all the deeply buried sites and, although water levels had fallen by May 27, they were still too high to allow safe examination of the steeper cutbanks, where artifact exposure is most likely to occur. The result was that shovel testing during the initial field phase could only be undertaken at two sites within the Project Footprint—41DL69 and 41DL70. The team returned and inspected all known site loci in the Project Footprint during a second phase in August. Descriptions of all of the recorded sites within the Project Footprint are presented in a separate technical report of findings (GMI 1997).

Unrecorded and Potential Archeological Sites

Ninety-five unrecorded and potential historic sites were identified by archival research within the Project Footprint and the APE. Six of these sites were discussed in the *Dallas Floodway Extension Study Area - Feasibility Draft: Cultural Resources Background* (USACE-FW 1992). These six sites include the wreck of the steamboat *Nellie*, Lock and Dam No. 1, the Corinth Street Bridge, the Joppa Slave Settlement, Millermore, and Trinity City (Table 4). Three of these sites (Millermore, Trinity City, and the Joppa Slave Settlement) appear to be located outside of the APE, while the Corinth Street Bridge is more properly recorded as an architectural, rather than an archeological, property. The remaining two sites are located within the Trinity River channel. The location of Lock and Dam No. 1 is shown on both the 1920 soil map and a 1941 county road map. Bennett et al. (1981:45-46) records information about the site received from Peggy Riddle (or Ribble—both spellings are used). At that time only about 40 percent of the structure remained and it was under water most of the time. The steamboat *Nellie* was wrecked during the 1908 Dallas flood. Richner and Bagot (1978:111) state that the *Nellie* was docked at the Commerce Street wharf when the flood waters swept it away. It stopped at the "Dallas-Oak Cliff Street trestle" and sank during salvage operations. The feasibility study (USACE-FW 1992:30) states that it may be located at the Forest Avenue (now Martin Luther King) Bridge. A potentially more likely location is near the modern Houston Street Viaduct, as this appears to be near the first obstruction shown on *Sam Street's Map of Dallas County* (1900).

Only two of the maps consulted during the archival portion of this project showed the location of individual homesteads—*Sam Street's Map of Dallas County* (1900) and the 1920 soils map for Dallas County. These two maps were the source of an additional 89 potential historic sites—66 from the soils map and 23 from Sam Street's map. The locations were then replotted onto the modern USGS 7.5' quad maps. The locations derived from the soils map are probably more accurate than those from Sam Street's map, as the soils map had more identifiable landmarks in common with modern maps and was drawn to a defined scale. With Sam Street's map, the accuracy with which landmarks such as roads and streams are drawn is questionable, while a scale had to be estimated from the presumed correspondence of these landmarks with those shown on the modern quadrangles.

TASK 2 - ARCHIVAL EVALUATIONS

A review of numerous maps suggests that, relative to the downtown area of Dallas, growth and development within the APE was slow. One of the earliest maps to depict the flood plain area is *Sam Street's Map of Dallas*, dated 1900. Structures and communities are plotted along with the names of landowners and homeowners. According to Street's map at least 10 rental houses, 10 owner-occupied houses, a store, a dairy, and a clubhouse (associated with the Rod and Gun Club Lake which is now Lemon Lake) existed in the project area. The map also plots an early African-

American freedmen's town known as Joppa (frequently pronounced "Joppy") of which little is known. According to information on file at Preservation Dallas and communication with Dr. Mamie McKnight, the founding director of Black Dallas Remembered, Inc., Joppa developed near Honey Springs sometime in the 1800s. Now bound by Linfield to the north, Loop 12 to the south, the Sleepy Hollow County Club to the east, and Carbondale Street to the west, some of the structures along the far east side of Joppa (near the streets of Yancy, Luzon, and the east side of Yukon Circle) fall within the APE (M. Greene 1996; Joppa/South Central n.d.; McKnight, personal communication, 1997). Sam Street's map notes that at least two of the houses in Joppa were owned and occupied by African-Americans. Though the names on the map are difficult to decipher, it appears that the last name of one owner is "West" and the other is "Norrel." An attempt was made to locate these names (and variations) in the 1903 and 1904 Dallas directories which were available at Dalla

names. Documents on file at Preservation Dallas indicate that in 1994, eight shotgun-style houses were still standing in Joppa. File information also noted that Lemon Lake was used by community residents for fishing purposes—a use which may have an historical precedent (M. Greene 1996; South Central [Joppa] n.d.).

The examination of historic maps also indicated that the downtown area of Dallas had begun to spread in a southeasterly direction by 1912. Streets, such as Edgar, Oplar, Pine, and Marburg appear east of Lamar Street on *Worley's Street Map of Dallas, Texas*, and on a 1915 city map by Koch and Fowler. By 1927, Forest Avenue is shown crossing the Trinity River in a map of Dallas by Ulrickson, and by 1933, the area of Cadillac Heights and street development along White Rock Creek (within the APE) appear in *H.A. Spencer's Street Guide and Index* (Koch and Fowler 1915; Spencer 1933; Ulrickson 1927; U.S. Geological Survey [USGS] 1920; Worley 1912).

Research at Preservation Dallas provided a limited amount of information on the development of communities within or near the APE. Six communities which surround or cover part of the APE were identified, including Cadillac Heights, Magna Vista (or Cedar View), South Central (or Joppa), Skyline Heights, Ervay Terrace/Marburg, and Colonial Hills (or Wendelkin/Driskell). Of these six, Cadillac Heights, Magna Vista/Cedar View, South Central/Joppa, and Skyline Heights all developed along the western side of the Trinity River and appear to include property that is within the boundaries of the APE. Ervay Terrace/Marburg and Colonial Hills (Wendelkin/Driskell) developed along the eastern side of Lamar Street, and do not appear to extend into the boundaries of the APE. The Colonial Hill Historic District is located adjacent to, but outside, the APE on the eastern side of the Trinity River, bounded by Central Expressway and I-45/South Lamar on the east and west, and by Warren Avenue and Hatcher Street on the north and south, respectively (map supplied by the U.S. Army Corps of Engineers).

Data for each of these communities, on file at Preservation Dallas, vary in detail. For example, no data pertinent to the project was found in the informational notebook for Cadillac Heights or for Colonial Hills (Wendelkin/Driskell). For Magna Vista/Cedar View, Skyline, South Central/Joppa, and Ervay Terrace/Marburg, surveys, completed by a neighborhood resident in 1994, provided a contact person from whom additional information could be solicited. The file on South Central/Joppa contained the most information (which was presented above). Data for Ervay Terrace/Marburg indicate that the neighborhood is transitional and comprised of an older population. The homes in the area are "ready for demolition" and are owned by absentee landlords (Cadillac Heights n.d.; Colonial Hills [Wendelkin/Driskell] n.d.; Ervay Terrace/Marburg n.d.; Magna Vista Cedar View n.d.; Skyline Heights n.d.; South Central [Joppa] n.d.).

Research into deed records and plat maps, located at the Dallas County Records Building, was conducted in an effort to establish the chain of property ownership for several tracts of land within the APE. Dallas County deed records extend back to 1846, however establishing a chain of title is made difficult by incomplete records and indexes, name changes, subdivisions of property, consolidations of property, and time limitations. Several parcels were initially chosen for deed research, but as the chain was interrupted by missing records, or as it became time consuming to try

Table 4
Summary of Unrecorded Archeological Sites within the Dallas Floodway Extension APE

SITE	LOCATION WITHIN PROJECT AREA	DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
Steamboat *Nellie*	Project Footprint	Richner and Bagot (1978:111) state the *Nellie* was docked at the Commerce Street wharf when the 1908 flood swept it away. It wedged against the "Dallas-Oak Cliff Street Trestle" and sank during salvage operations. It was never raised. A subsequent study (USACE-FW 1992:30) states that it may be located south of the Forest Avenue Bridge, now known as the Martin Luther King Blvd. Bridge. A more likely location may be near the modern Houston Street Viaduct, which appears to contain the first potential obstruction downstream of Commerce Street on Sam Street's 1900 map. Other possibilities are the Cadiz Street Viaduct and the Atchison, Topeka & Santa Fe Railroad bridge between the Corinth Street Viaduct and the Martin Luther King Blvd. Bridge—both of which were present in 1900.	Yes	Under water if present; will need a major effort to locate; may not be in Project Area.	Not evaluated
Lock and Dam No. 1	APE[1]	Shown on both the 1920 soil survey map and the 1941 Dallas county road map; Bennett (1981:45-46) states that Lock and Dam No. 1 was destroyed in the 1908 flood; approximately 40 percent of the structure remained in 1981, but this was under water most of the time.	No	Need the Corps of Engineers to determine landowner and obtain right-of-access; high water levels suggest that site is underwater.	Not evaluated

SITE	LOCATION WITHIN PROJECT AREA	DESCRIPTION	RIGHT-OF-ACCESS	RESULTS OF CURRENT INVESTIGATION	NRHP STATUS
Corinth Street Bridge	APE[1]	A prior feasibility study (USACE-FW 1992:30) describes this as a "unique concrete structure built during WPA days (early 1930s)"; structure was actually built with local funds for flood improvement and was completed in 1933 (WPA 1992:155).	Yes	Not an archeological site; will need recording as an architectural property if structure will be impacted.	Potentially Eligible
Joppa Slave Settlement	Adjacent to APE[1]	Described by Corps of Engineers feasibility study (USACE-FW 1992:29) as lying east of U.S. 75, south of Loop 12, and bordered on the east by Little Lemmon Lake; present archival research indicates that Joppa is actually located north of Loop 12 between the Sleepy Hollow Country Club and Carbondale Road, largely outside of the APE.	No	Not investigated, outside APE.	Not evaluated
Millermore	Adjacent to APE[1]	Site of early settler's home at 3110 Bonnie View Road; structure moved to Old City Park (USACE-FW 1992:29).	No	Location not investigated, outside APE.	Not evaluated
Trinity City	Adjacent to APE[1]	1849 settlement north of and including McCommas Bluff (USACE-FW 1992:28-29).	No	Location not investigated, outside APE.	Not evaluated

Footnotes to Table 5
1 APE = Area of Potential Effect.

to pursue an indirect chain, another tract was chosen for deed research. Plat maps and deed records were examined for a parcel of land in the area south of Loop 12 and another parcel near the northern portion of the APE in the Cadillac Heights area. The results of the deed research are presented below.

Chain of Title—South of Loop 12

This property was chosen for investigation to provide information on activities in the southernmost portion of the APE. However, the deed chain was difficult to establish and time permitted the investigation of only a few transactions. This parcel is bound by the Trinity River to the east, Simpson Stuart to the south, and Lemmon Lake to the north. The legal description for this tract is Lot 2; Block 8002 (*Dallas County Tax Assessor* 1995b). Plat records indicate that the area was a part of the John B. Richards Survey and was assigned to Abstract No. 1192. The earliest transaction discovered for this property (for this particular research survey) dates only to January 17, 1964, when W.C. Jack Miller sold 1,322.161 acres of land for $1,554,000.00 to Trinity Industrial Properties (*Dallas County Deed Records* 64233:1285-1294). Earlier transactions associated with the John B. Richards Survey were lost at this point when the deed chain shows W.C. Jack Miller acquiring property that belonged to W. Jenkins on August 6, 1963 (*Dallas County Deed Records* 128:1580-1586). The property acquired by Miller from Jenkins included much of the land in the 1964 transaction, but the property associated with the John B. Richards Survey was not mentioned in the transaction between Miller and Jenkins (*Dallas County Deed Records* 128:1580-1586 and 5688:317-328). Thus, to determine ownership of this parcel prior to 1964 would have required that the property be traced from the original owner, a process that is often very time-consuming. Since properties generally subdivide over the course of time, going from original owner to current owner often requires that numerous deed transactions be examined in order to follow the trail of the correct parcel of land.

On February 2, 1965, the 1,322.161 acreage was transferred to Central States, Southeast and Southwest Areas Pension Fund (*Dallas County Deed Records* 65495:0722-0731). Central States, Southeast and Southwest Areas Pension Fund sold the property to Metropolitan Sand and Gravel Company for $1,400,000.00 on July 6, 1965 (*Dallas County Deed Records* 65613:2233-2242). Nearly four years later, on June 20, 1969, ownership was transferred from Metropolitan Sand and Gravel Company to Farrell Kahn, Joe Simpkins (President of Metropolitan Sand and Gravel Company), Morris A. Shenker and Morris A. Shenker, Jr. (*Dallas County Deed Records* 69126:1014-1022). On August 22, 1979, ownership was transferred to "Citizens Bk. University C" (*Dallas County Deed Records* 7914:0881). The property is now owned by the city of Dallas (*Dallas County Tax Assessor* 1995b).

Adjacent to, and west of this property is Tract 11, Lot 1, Block 8002, which is an eight-acre parcel currently owned by Fritz Wullschleger (*Dallas County Tax Assessor* 1995c). This property is associated with site 41DL351—a truck-farming operation reported on by Skinner and Whorton (1993:19-24). The tax assessment records spell the owner's last name as "Wullschleger," but Skinner and Whorton spell it as "Wulschleger."

Chain of Title—Lot 85

This parcel of land is associated with the house at 2838 Alex Street in Cadillac Heights. It was assigned Lot No. 85 and is a part of the Robert Sloan Survey, Abstract 1449, Block 6642 in an area known as McNabb's Meadow Garden of the R.C. Day Addition. The earliest known owner of this property was M. Hines who more than likely obtained it from one of the following three landowners—G.W. Givens in December of 1883 (*Dallas County Deed Records* 64:176); D.K. and A.C. King in January of 1885 (*Dallas County Deed Records* 82:52); or from the M.J. Dart trust in September of 1889 (*Dallas County Deed Records* 139:624). Unfortunately, there was insufficient time to review these three documents to determine previous ownership.

On December 4, 1894, Conrad Gansevoart et al. acquired the property from the trust of M. Hines (*Dallas County Deed Records* 187:257-258). Robert C. Day acquired the property on

November 11, 1895, when he purchased a portion of the Robert Sloan Survey for $1,000 (*Dallas County Deed Records* 197:433-434). Robert C. Day died in June of 1933. Since his wife, Susanah, had preceded him in death, his property was subdivided among his children and grandchildren (*Dallas County Deed Records* 1872:203-207). Two daughters, Rachel Childers and Frances M. Day, sold their parcels to Alexander McNabb on April 17, 1942 (*Dallas County Deed Records* 2354:115-116). At some point after this date, this parcel was acquired by the Department of Housing and Urban Development (HUD). To determine who sold this property to HUD would have required an examination of numerous deeds. *Dallas County Deed Indexes* list hundreds of HUD transactions. Even though the number of deeds to examine could have been narrowed down to some extent using property descriptions, there would still have been a large number to inspect. On September 4, 1973, U.C. Ford and his wife Lillian Ford acquired ownership of Lot 85 (*Dallas County Deed Records* 73219:0549).

The data from these two examples, though limited, suggests that by the 1960s, large parcels of land were being purchased for commercial enterprises (such as sand and gravel operations), and for government housing developments. The research for Lot 85 on Alex Street also serves as an example of earlier land inheritance patterns whereby large tracts of family land are quickly subdivided within one generation when children and grandchildren inherit from a parent or grandparent. This record also suggests that the Cadillac Heights area was being developed in the early 1940s when Alexander McNabb purchased the property which became known as McNabb's Meadow Garden. Property records for Dallas County indicate that the structure located on this property is a duplex built in 1949. The property address is listed as 2836 and includes 2838 (*Dallas County Tax Assessor* 1995a).

TASK 3 - ARCHITECTURAL EVALUATIONS

As noted previously, all buildings and structures within the Project Footprint, specifically in areas that will be directly impacted by the Dallas Floodway Extension, were assigned identification numbers prefixed with "A" (A-series resources); and those within the APE but not to be directly impacted by the project were assigned identification numbers prefixed with "B" (B-series resources). Forty-nine A-series resources were identified, and 699 B-series resources (one of which is a potential historic district that includes other B-series resources) were identified.

Three Category 1 (potentially eligible for inclusion in the NRHP) A-series resources were identified (Figure 5 and Table 5). Each of these buildings should be assessed by an architectural historian for their integrity, condition, and architectural/engineering significance. Each structure considered to be NRHP-eligible by the architectural historian will require further archival research to document its history and better determine its significance. The historic context of each resource will need to be established so that the significance of the resource can be effectively conveyed. Each NRHP-eligible resource will also need to be preserved or appropriately documented according to Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) standards (the level of documentation required should be determined through consultation with the Texas State Historic Preservation Officer).

In addition, there are 27 Category 2 A-series resources (see Table 6). These structures are either no longer standing or have been determined to lack enough significance to be considered eligible for inclusion in the NRHP. Sixteen structures were assessed as Category 3 (see Table 6). These resources have been determined (by field observation, by information on the USGS quadrangle sheet, or both) to be of insufficient age to be considered eligible for inclusion in the NRHP. Three building (Resource A-6, A-7 and A-12) have been assessed as a Category 4 A-series resource. They were built in 1949, 1950 and 1954, respectively (*Dallas County Tax Assessor* 1995a), and will require further assessment when it becomes 50 years old. The assessment of this resource should include research into its role in the development and history of the Cadillac Heights community, in which they are located. Further research and assessment of Category 4 resources will be a necessary goal.

Table 5
Assessment of Architectural Resources Within the Dallas Floodway Extension Project Footprint

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-1	2	Oak Cliff (1958, photorevised 1981)	3	structure no longer standing, not an architectural resource
A-2	2	Oak Cliff (1958, photorevised 1981)	3	structure no longer standing, not an architectural resource
A-3	2	Oak Cliff (1958, photorevised 1981)	3	structure no longer standing, not an architectural resource
A-4	2	Oak Cliff (1958, photorevised 1981)	3	structure no longer standing, not an architectural resource
A-5	2	Oak Cliff (1958, photorevised 1981)	3	structure no longer standing, not an architectural resource
A-6	4	Oak Cliff (1958, photorevised 1981)	1, 2	residence; not shown on quad sheet; visited on May 12, 1997, and photographed; the several structures along Alex Street are small vernacular-style residences, frame construction; building A-6 is in good condition; Dallas County tax records indicate A-6 built in 1949
A-7	4	Oak Cliff (1958, photorevised 1981)	1, 2	industrial building; shown on quad sheet as pre-1958 structure; visited on May 12, 1997, photographed; part of Dallas City Packing complex
A-8	3	Oak Cliff (1958, photorevised 1981)	1, 2	industrial building; shown on quad sheet as pre-1958 structure; visited nearby structures on May 12, 1997, but could not see this one; probably part of Dallas City Packing complex
A-9	1c	Oak Cliff (1958, photorevised 1981)	1, 2	industrial building; shown on quad sheet as pre-1958 structure; visited on May 12, 1997, photographed; part of Dallas City Packing complex

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-10	2	Oak Cliff (1958, photorevised 1981)	3	noted to be a ruin on the Corps of Engineers project map; not an architectural resource
A-11	2	Oak Cliff (1958, photorevised 1981)	3	shown on the quad sheet as post-1958 structure
A-12	4	Oak Cliff (1958, photorevised 1981)	3	shown on the quad sheet as post-1958 structure
A-13	3	Oak Cliff (1958, photorevised 1981)	3	shown on the quad sheet; post-1958 structure
A-14	3	Oak Cliff (1958, photorevised 1981)	3	structure not shown on the quad sheet, but area is shaded as post-1958 development; visited on June 9, 1997, resource is a recent metal-sided industrial building
A-15				number not assigned
A-16	1d	Oak Cliff (1958, photorevised 1981)	1, 2	a pre-1958 structure is shown on the quad in this general area, but it is not clearly A-16; visited on May 12, 1997, building appears to be a barn but could not get very close; photographed
A-17	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; visited June 9, 1997 structure is a simple, covered storage area
A-18	2	Dallas (1958, photorevised 1981)	3	very small structure, not shown on quad sheet; no access to structure (which is on private property, on land probably owned by Faubion Associates, Inc.) so assessment could not be made; could not see structure because of vegetation and boundary wall
A-19	2	Dallas (1958, photorevised 1981)	3	very small structure, not shown on quad sheet; no access to structure (which is on private property, on land probably owned by Faubion Associates, Inc.) so assessment could not be made; could not see structure because of vegetation and boundary wall

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-20	3	Dallas (1958, photorevised 1981)	3	shown on quad sheet as post-1958 structure
A-21	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-22	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-23	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-24	2	Dallas (1958, photorevised 1981)	3	noted on Corps of Engineers project map to be a ruin; no longer an architectural resource
A-25	2	Dallas (1958, photorevised 1981)	3	noted on Corps of Engineers project map to be a ruin; no longer an architectural resource
A-26	3	Dallas (1958, photorevised 1981)	3	structure is in an area of post-1958 development
A-27	3	Dallas (1958, photorevised 1981)	3	structure is in an area of post-1958 development; probably part of the old Metzger diary
A-28	2	Dallas (1958, photorevised 1981)	3	structure no longer standing, may have been demolished or removed

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-29	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property; probably owned by P&H Transportation, Inc.) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-30	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property; probably owned by P&H Transportation, Inc.) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-31	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property; probably owned by P&H Transportation, Inc.) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-32	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property; probably owned by P&H Transportation, Inc.) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-33	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property; probably owned by P&H Transportation, Inc.) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-34	2	Dallas (1958, photorevised 1981)	3	structure shown on the quad sheet as pre-1958; visited on May 12, 1997; building is large undistinguished metal sided storage/industrial building
A-35	3	Dallas (1958, photorevised 1981)	3	structure shown on the quad sheet as post-1958
A-36	1c	Dallas (1958, photorevised 1981)	1, 2	probably one of two structures shown on the quad sheet in this area; this building appears to be more than 50 years old; photographed on May 12, 1997; clock on front of building exterior has "White Bottom Socks" in an arch above the face
A-37	2	Dallas (1958, photorevised 1981)	3	structure probably one of two pre-1958 structures shown on the quad sheet in this area; visited on May 12, 1997—retail store, not significant
A-38	2	Dallas (1958, photorevised 1981)	3	structure probably not one of the two pre-1958 structures shown on the quad sheet in this area (see A-36 and A-37); visited on May 12, 1997—vacant retail store, not significant
A-39	2	Dallas (1958, photorevised 1981)	3	structure not shown on the quad sheet; no access to structure (which is on private property) so assessment could not be made; visited area on June 9, 1997, could see only roof jacks (probably large industrial-use vents) and the ridge of a hip or gable roof of a one-story structure; building nearly obscured by heavy vegetation and automobile bodies
A-40	2	Hutchins (1958, photorevised 1968 and 1973)	3	not shown on the quad sheet; no structure currently exists at this location

IDENTIFICATION NUMBER	CATEGORY	MAP REFERENCE (USGS QUAD SHEET)	RECOMMENDATIONS FOR FURTHER WORK[2]	COMMENTS
A-41	2	Hutchins (1958, photorevised 1968 and 1973)	3	not shown on the quad sheet; no structure currently exists at this location
A-42	2	Hutchins (1958, photorevised 1968 and 1973)	3	not shown on the quad sheet; no structure currently exists at this location
A-43	2	Hutchins (1958, photorevised 1968 and 1973)	3	not shown on the quad sheet; no structure currently exists at this location
A-44	2	Hutchins (1958, photorevised 1968 and 1973)	3	not shown on the quad sheet; no structure currently exists at this location
A-45	3	Hutchins (1958, photorevised 1968 and 1973)	3	metal garage for golf cart storage for the country club
A-46	2	Dallas (1958, photorevised 1981)	3	labeled as a tank on the Corps of Engineers project map; does not appear on the quad sheet; in Sump Lamar 2
A-47	2	Oak Cliff (1958, photorevised 1981)	3	structure not shown on the quad sheet; in Sump Lamar 4; no access to structure (which is on private property) so assessment could not be made; could not see structure because of sheet-metal fences, buildings, and vegetation
A-48	3	Dallas (1958, photorevised 1981)	3	shown on the quad sheet as post-1958 structure
A-49	2	Dallas (1958, photorevised 1981)	3	structure is roof for covered parking or storage area
A-50	3	Oak Cliff (1958, photorevised 1981)	3	shown on the quad sheet as post-1958 structure

Footnotes to Table 6

[1] 1 — potentially eligible
    1a — resource of great importance in Dallas history;
    1b — resource of moderate importance in Dallas history;
    1c — resource of minor importance in Dallas history;
    1d — resource whose significance is not based on its role in Dallas history;
2 — not considered eligible;
3 — currently not 50 years old and will not be 50 years old at the time the project is expected to begin (estimated at 2004);
4 — currently less than 50 years old, but is potentially eligible and will be at least 50 years old before the project is expected to begin (estimated at 2004);

[2] 1 — archival research needed for age determination;
2 — needs assessment by architectural historian for NRHP eligibility;
3 — no further work considered necessary at this time;
4 — gain access to property for preliminary assessment.

As mentioned above, there were 699 B-series resources identified on the Dallas Floodway Extension Project Area maps. A preliminary age determination and assessment (using the same five categories employed for the A-series resources) was made based on information contained on USGS quad sheets of the area (Table 6). Although several of the B-series resources were visited, most were not and will require additional assessment should the design or layout of the project be altered such that it would impact the B-series resources (Table 7). Any resources determined to be Category 1 will need to be assessed by an architectural historian. If the architectural historian determines that the resource is NRHP-eligible, an historic context for the resource will need to be established so that the significance of the resource can be effectively conveyed. Each NRHP-eligible resource will also need to be preserved or appropriately documented according to HABS/HAER standards.

Two resources in the APE that have previously been noted to warrant consideration for inclusion in the NRHP are included in the list of B-series resources. These are the Corinth Street Viaduct and the community of Joppa (also called the Joppa Slave Settlement). The Corinth Street Viaduct, or Bridge (Resource B-268), is located at the far northwestern extent of the Dallas Floodway Extension Project Area. The structure was completed in 1933 at a cost of $745,500 (WPA 1992:155). It has previously been recommended for inclusion on the NRHP by the Corps of Engineers (USACE-FW 1992:30). The community of Joppa (Resource B-727) is one of three freedmen's communities still extant in the Dallas area. African-Americans began settling there as early as the mid-1800s, and a few of the early shotgun-style houses are still standing, although the majority of the more than 250 residences now in the community were constructed during the 1940s (M. Greene 1996:n.p.; South Central/Joppa n.d.). One of the early shotgun houses is only about 60 m outside the APE, on the corner of Luzon and Dutch Harbor.

Joppa is bound by Linfield Road on the north, Loop 12 on the south, Carbondale Street on the west, and the Sleepy Hollow Country Club on the east. The area defined by these boundaries is considered potentially eligible for inclusion on the NRHP as a National Historic District. Few of the architectural resources therein would be considered eligible for inclusion in the NRHP as individual historic properties, but many would be eligible as contributing elements to an historic district. Twenty-seven buildings and structures within the Dallas Floodway Extension Project APE (Resources B-681 through B-691 and B-708 through B-723) are in the community of Joppa as defined above. Should it be determined that the construction of the Dallas Floodway Extension will directly or indirectly impact the Corinth Street Viaduct or elements of the Joppa community, measures will have to be taken to protect these potential historic properties (as well as vacant lots in Joppa, which may contain historic-era archeological sites) from those impacts, and research efforts should be undertaken so that the historical value of the bridge and/or the little-known community may be adequately documented.

These research and documentation efforts are likely to include, but should not be limited to, assessment by an architectural historian; research into the various municipal, county, and state records to determine the history of the resource (and individual resources within a district); the collection of oral history interviews; the development of an historic context so that the significance of the resource can be effectively conveyed; preservation of the resource (and individual resources within a district) that may be impacted by the construction of levees or other components of the flood control system; and/or appropriate HABS/HAER documentation (to be determined in consultation with the Texas State Historic Preservation Officer) of any resources that will be impacted or destroyed by the construction project.

In addition to the above two important B-series resources elsewhere recommended as eligible for inclusion in the NRHP, three buildings (Resources B-121, B-122, and B-123) were identified during the current research as potentially eligible for listing in the NRHP. Resource B-121 is a distinctive industrial/institutional building (functional design with minimal decorative elements, dark red/brown brick construction, limestone accents, original six-over-six light wood-sash windows) that appears to be in good condition. The building was probably built in the 1920s or 1930s. Resources B-122 and B-123 are also constructed of dark red/brown brick with minimal decorative elements, but have accents of white brick rather than limestone, and have single-pane sashes.

Table 6
Assessment of Architectural Resources Within the Dallas Floodway Extension Project APE

CATEGORY 1[1]	CATEGORY 2[2]	CATEGORY 3[3]		CATEGORY 4[4]	CATEGORY 5[5]	
B-121 (1c)	B-13	B-6 - B-9	B-198		B-1 - B-5	B-213
B-122 (1c)	B-91	B-30	B-199		B-10 - B-12	B-215
B-123 (1c)	B-94	B-31	B-206		B-14 - B-17	B-217 - B-227
B-268 (1c)	B-96	B-33	B-216		B-28	B-229
B-727 (1b)	B-99	B-44	B-257		B-29	B-230
	B-102	B-72	B-258		B-32	B-241 - B-256
	B-115	B-73	B-287 - B-294		B-34 - B-43	B-259 - B-267
	B-196	B-85 - B-87	B-296 - B-302		B-45 - B-71	B-269 - B-286
	B-197	B-103	B-304 - B-322		B-74 - B-84	B-295
	B-200	B-107	B-345 - B-347		B-88 - B-90	B-303
	B-201	B-116	B-377		B-92	B-323 - B-344
	B-212	B-119	B-380		B-93	B-348 - B-376
	B-214	B-124 - B-126	B-382		B-95	B-378
	B-228	B-129	B-401		B-97	B-379
	B-231 - B-240	B-142	B-411		B-98	B-381
	B-713	B-173 - B-177	B-537		B-100	B-383 - B-400
	B-724	B-182 - B-185	B-580 - B-582		B-101	B-402 - B-410
	B-725	B-187	B-584		B-104 - B-106	B-412
		B-188	B-586		B-108 - B-114	B-413
		B-190	B-591		B-117	B-419 - B-469

CATEGORY 1[1]	CATEGORY 2[2]	CATEGORY 3[3]		CATEGORY 4[4]	CATEGORY 5[5]	
		B-191	B-677		B-118	B-478 - B-536
		B-195	B-703		B-120	B-539 - B-579
					B-127	B-583
					B-128	B-585
					B-130 - B-141	B-587 - B-590
					B-143 - B-172	B-592 - B-654
					B-178 - B-181	B-656 - B-673
					B-186	B-678 - B-702
					B-189	B-704 - B-712
					B-192 - B-194	B-714 - B-723
					B-202 - B-205	B-726
					B-207 - B-211	

Footnotes to Table 6

[1] Category 1 — potentially eligible
- 1a — resource of great importance in Dallas history;
- 1b — resource of moderate importance in Dallas history;
- 1c — resource of minor importance in Dallas history;
- 1d — resource whose significance is not based on its role in Dallas history.

[2] Category 2 — not considered eligible.

[3] Category 3 — currently not 50 years old and will not be 50 years old at the time the project is expected to begin (estimated at 2004).

[4] Category 4 — currently less than 50 years old, but is potentially eligible and will be at least 50 years old before the project is expected to begin (estimated at 2004).

[5] Category 5 — data insufficient to determine classification.

Table 7
Additional Research Needs for Architectural Resources Within the Dallas Floodway Extension APE[1]

FURTHER RESEARCH NEEDED			NO FURTHER RESEARCH NEEDED	
B-1 - B-5	B-120 - B-123	B-348 - B-376	B-6 - B-9	B-195 - B-201
B-10 - B-12	B-127	B-378	B-13	B-206
B-14 - B-17	B-128	B-379	B-30	B-212
B-28	B-130 - B-141	B-381	B-31	B-214
B-29	B-143 - B-172	B-383 - B-400	B-33	B-216
B-32	B-178 - B-181	B-402 - B-410	B-44	B-228
B-34 - B-43	B-186	B-412	B-72	B-231 - B-240
B-45 - B-71	B-189	B-413	B-73	B-257
B-74 - B-84	B-192 - B-194	B-419 - B-469	B-85 - B-87	B-258
B-88 -- B-90	B-202 - B-205	B-478 - B-536	B-91	B-287 - B-294
B-92	B-207 - B-211	B-539 - B-579	B-94	B-296 - B-302
B-93	B-213	B-583	B-96	B-304 - B-322
B-95	B-215	B-585	B-99	B-345 - B-347
B-97	B-217 - B-227	B-587 - B-590	B-102	B-377
B-98	B-229	B-592 - B-654	B-103	B-380
B-100	B-230	B-656 - B-673	B-107	B-382
B-101	B-241 - B-256	B-678 - B-702	B-115	B-401
B-104 - B-106	B-259 - B-286	B-704 - B-712	B-116	B-411
B-108 - B-114	B-295	B-714 - B-723	B-119	B-537
B-117	B-303	B-726	B-124 - B-126	B-580 - B-582
B-118	B-323 - B-344	B-727	B-129	B-584
			B-142	B-586
			B-173 - B-177	B-591
			B-182 - B-185	B-677
			B-187	B-703
			B-188	B-713
			B-190	B-724
			B-191	B-725

Footnotes to Table 7

[1] Research recommended if the design or layout of the Dallas Floodway Extension Project levee system and flood control components is altered such that it would impact one or more of these resources.

These latter two buildings were probably constructed somewhat later than Resource B-121, their architectural design intended to complement that of the former structure. These three buildings, as well as any other buildings in the complex in which they are located, will need to be assessed by an architectural historian should construction of the levees or other flood control system components directly or indirectly impact these buildings in any way.

TASK 4 - GEOARCHEOLOGICAL INVESTIGATIONS

General Landscape Geomorphology and Geological Setting

Dallas County, Texas, is situated predominantly in the Blackland Prairie Physiographic province, at the up dip edge of the Gulf Coastal Plain and the northwest limit of the East Texas Embayment (Allen and Flannigan 1986). The city of Dallas sits in an hourglass-shaped valley formed by differential erosion of three exposed marine bedrock units of Cretaceous age: Eagle Ford Shale, Austin Chalk, and Taylor Marl. Surficial deposits of clayey upland residuum, terraced alluvial deposits of Pleistocene age, and late Pleistocene to Holocene flood plain alluvium cover bedrock units to various depths. Elevations of upland landscapes in metropolitan Dallas range from about 120 to 150 meters amsl.

The Trinity River drains Dallas County and surroundings. Three branches join west of the city, then the main stem flows through downtown Dallas and through the APE in the southern part of the city. The West Fork, the Elm Fork, and White Rock Creek are the principal tributaries near the Dallas Floodway Extension APE. The main stem of the Trinity River has a distinct Holocene flood plain. Multiple Pleistocene terraces have been recognized on the valley flanks (Ferring 1990).

Surface weathering of the Cretaceous upland bedrock exposures has left most of the uplands covered with residual clay soils. Weathering profiles can be up to 7 m in thickness. Soils developed in chiefly loamy to sandy Pleistocene alluvium form on fluvial terraces. Flood plain soils form at the tops of the alluvial units found beneath flood plain geomorphic surfaces.

The alluvial stratigraphy, soils stratigraphy, and geomorphology of the Upper Trinity River have been investigated in a variety of studies. Ferring (1990) summarizes the history of geomorphic investigations and provides a working stratigraphic framework that can be applied to the Dallas Floodway Extension APE. Details of alluvial stratigraphic units and paleosol stratigraphy can vary within the Trinity River valley; however, lithostratigraphic properties, cross cutting relationships, and superposition of stratigraphic units allow for a general correlation to the stratigraphy of Ferring (1990). General elements of the Ferring (1990) Trinity River model are summarized below for comparison to the newly acquired data from the Dallas Floodway Extension APE.

Ferring (1990) recognized three terraced Pleistocene stratigraphic units and five flood plain stratigraphic units of Late Pleistocene to modern age in the Upper Trinity River. Terraced units are, in decreasing age, Irving, Coppell, and Tioga alluvium. Geomorphic position, areal distribution, lithologic properties, and upper bounding paleosols are included as criteria for unit differentiation. Units beneath the flood plain include, in decreasing age, Carrollton, Aubrey, Sanger, Pilot Point and Recent alluvia. General stratigraphic properties of these units in their type areas are summarized in Table 8. A conceptual cross section (Figure 6) illustrates geologic relationships between alluvial units in the Dallas Floodway area.

In comparing the Ferring (1990) model to the data from the Dallas Floodway Extension APE, technical and logistical considerations must first be addressed. The correlation of the alluvial stratigraphic units by lithostratigraphic properties and relative stratigraphic positions allows for the development of a general correlation scheme. The paleosols at the top of each alluvial unit are implicit in Ferring's (1990) model; however, that does not require that paleosols will exist at all localities nor will they possess all properties described in their type areas. First, there are inherent variabilities in an individual paleosol, and second, there are possible upstream to downstream variations in properties over the distances involved from the type areas to the Dallas Floodway Extension APE.

Table 8
Lithologic Properties, Depositional Environments, and Inferred Ages of Alluvial Stratigraphic Units in the Upper Trinity River
(adapted from Ferring 1990)

ALLUVIUM	LITHOLOGY	DEPOSITIONAL ENVIRONMENTS	INFERRED AGE
Recent	silt and clay grading to sand and gravel	meander belt alluvium, abandoned channel fill	alluviation <200 years
Pilot Point	silt and clay grading to sand and gravel	meander belt alluvium, overbank veneer over older alluvium	alluviation and soil formation from 4,500 years to present
Sanger	calcareous silt and clay; grades to sand and gravel	meander belt alluvium	alluviation from 11,000 to 7,500 yrs, soil formation from 7,500 to 4,500 years
Aubrey	bedded sand and gravel, finer-grained alluvial marls and lacustrine sediment	channel, abandoned channel fill, lake plain	alluviation from 14,000 to 11,000 years
Carrollton	loamy sediment grading to sand and gravel	meander belt alluvium	alluviation from 30,000 to 14,000 years
Coppell, Tioga, Irving	loamy sediment to sand and gravel	channel belt alluvium	> 30,000 years

A geomorphological map of the Dallas Floodway Extension APE and surrounding area was compiled from existing published geologic reports (Allen and Flannigan 1986; Ferring 1990), the published Soil Survey of Dallas County (USDA 1980), and data collected in this investigation (Table 9 and Figure 7). Stratigraphic data collected within the Dallas Floodway Extension Project Footprint (Table 10; and, see Appendix B: Cliff et.al 1997) provide information on the lithologic, pedologic, and geometric properties of surficial sediments associated with the geologic map units. A total of 17 vertical profiles was inspected and logged, from continuous EC traces and core samples collected with the Geoprobe (see Figure 7). Sediments associated with the various flood plain depositional environments recognized within the Dallas Floodway Extension Project Footprint have distinctive lithologic and pedologic properties that allow for their differentiation (see Table 11 and Appendix B: Cliff et.al 1997).

Pilot Point alluvium is typically the first mappable unit encountered below the flood plain surface. Recent alluvium locally covers this unit near the present Trinity River channel, and recent overbank deposits may be locally included in Pilot Point overbank veneer deposits. Pilot Point alluvium is characterized as a black to dark gray (10YR 4/1 to 5/2) silty clay loam to silt loam. In channel belt areas it grades downward to loamy or sandy textures, whereas outside of channel belts it veneers older alluvial units. The unit commonly has either an A-Bt-C or A-Bw-C horizon sequence. Plant rooting and bioturbation are the most common pedogenic processes. Pedogenic properties and stratigraphic position correlate to the West Fork paleosol of Ferring (1990). In channel belt areas the soil profile grades to stratified alluvium, but outside channel areas the base of the soil can be mixed with underlying alluvium.

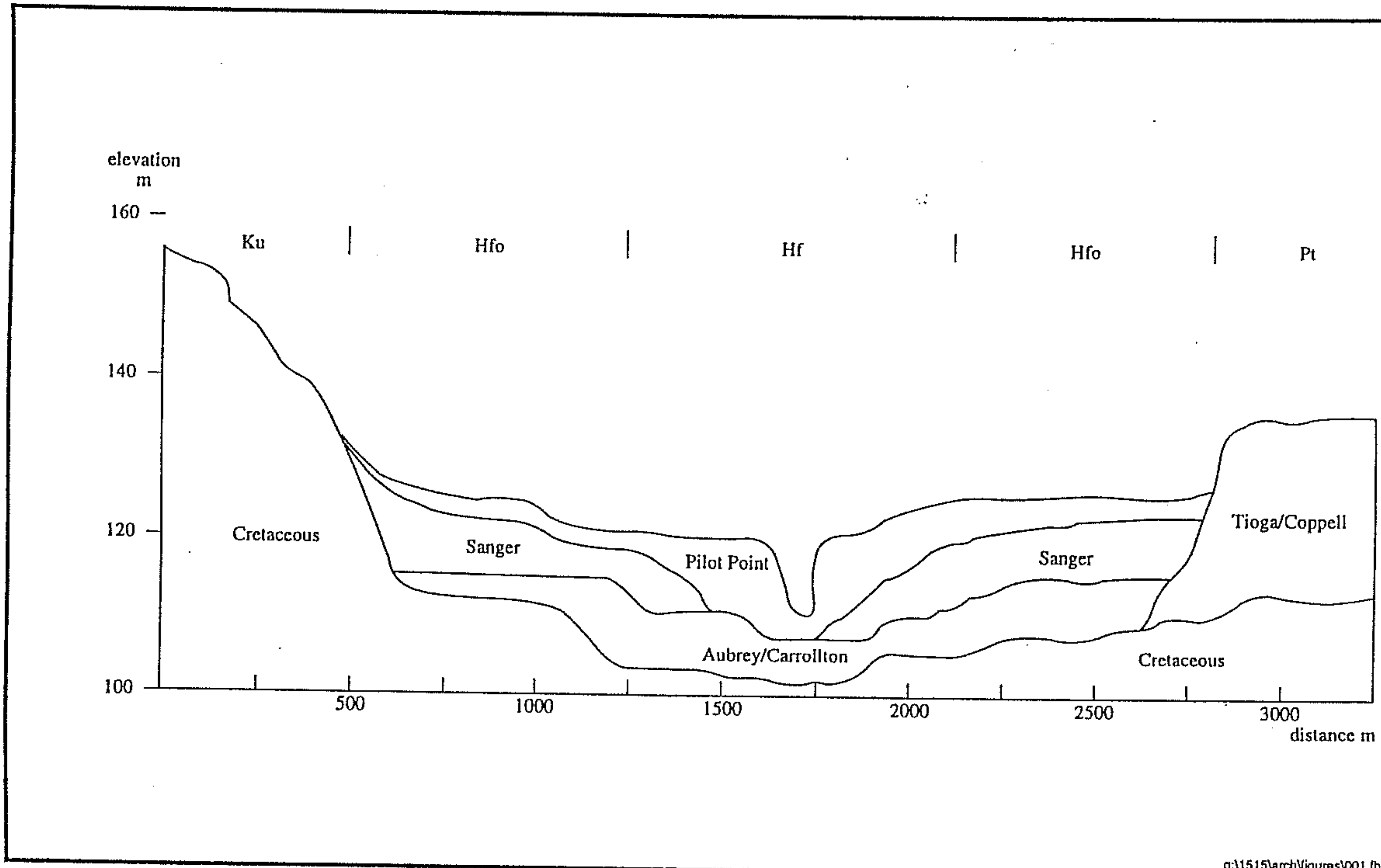

Figure 6. Conceptual geological cross section of the Trinity River valley in the Dallas Floodway. Alluvial deposits are inset into Cretaceous bedrock and terrace Pleistocene Tioga/Campbell alluvium. Pilot Point, Sanger, and Aubrey/Carrollton alluvium are the units beneath the present flood plain. Stratigraphic units are adapted from Ferring (1990).

Sanger alluvium occurs beneath the Pilot Point alluvium in most locations, except where it has been eroded by Pilot Point alluvium. This unit is characterized as a brownish (10YR 6/4) calcareous silt loam with yellowish (10YR 6/6) mottles that commonly grades downward to channel belt sand or sand and gravel. The base of the Sanger alluvium rests either on older Aubrey/Carrollton alluvium or Cretaceous rock. The unit commonly has a buried Btk-Ck or Bwk-Ck horizon sequence. Carbonate accumulations on ped surfaces, in root channels, and as concretions along with dark iron-manganese concretions are the most common pedogenic processes. Pedogenic properties and stratigraphic position correlate to the Arlington paleosol of Ferring (1990).

Table 9
Key to Geomorphological Map of the Dallas Floodway Extension APE

MAP UNIT		DESCRIPTION
Hf	Holocene flood plain	Youngest meander belt alluvium of the Trinity River; primarily Late Holocene in age. Areas of Pilot Point alluvium overlying older flood plain units. Deposits vary from silty clay loam overbank deposits to sandy channel and point bar deposits.
Hfo	Holocene flood plain, older surfaces	Flood plain deposits of the Trinity River primarily of Late Wisconsinan to Middle Holocene in age. Meander belt deposits of Sanger alluvium and lacustrine deposits of Aubrey/Carrollton alluvium underlie a veneer of Pilot Point overbank alluvium. Sanger alluvium generally has silt loam overbank deposits and sandy channel and point bar deposits. Aubrey/Carrollton alluvium are clayey to silty deposits of primarily overbank swamps, marshes, and lakes with interspersed channel deposits.
Ht	Holocene tributary alluvium	Sediments of primarily Holocene age deposited in small tributaries of the Trinity River.
Pt	Pleistocene terraces	Loamy to sandy flood plain alluvium of primarily Middle Wisconsinan age; terraced above flood plain levels. Coppell/Tioga alluvium identified along the terrace edge.
Ku	Cretaceous bedrock	Undifferentiated limestones; surface deposits can be covered with clayey residuum.

Aubrey/Carrollton alluvium occurs beneath younger Pilot Point and/or Sanger alluvium. This unit is characterized as a dark grayish (10YR 5/1) to yellowish brown (10YR 7/6) silty clay loam to clay loam that is interbedded with sandy loam to sand. Plant roots, root traces filled with carbonate and/or iron oxide, carbonate concretions, and gastropod shells characterize the unit. Soil development at the top of the unit is commonly weak, and C or Cg horizons were noted in most samples.

Coppell/Tioga alluvium was identified at a single location beneath the Pleistocene terraces in the Dallas Floodway Extension Project Footprint. At this location a reddish (5YR 6/8) sandy clay loam Bt horizon with grayish (10YR 7/2) mottles was identified. Paleosol characteristics include moderate development of soil structure, clay accumulations on peds and in root traces, and manganese stains and concretions. The paleosol grades downward into bedded sand and gravel.

The traces of EC versus depth are used to identify significant paleosurfaces in the Project Footprint. Buried paleosurfaces are typically represented by a distinct increase in EC, followed by decreases in EC with depth as the probe moves from clay rich, weathered sediments to zones of less weathered soil. Textural variation associated with processes of flood plain sedimentary deposition produce erratic or sawtooth-shaped traces. Zones of high EC values that grade downward to zones of low EC values reflect fining upward sequences in the Trinity River flood plain alluvium.

For example Probe DF8, taken from Sargent Park, clearly shows three alluvial fill sequences above Cretaceous rock (Figure 8;see Figure 10:Cliff et.al 1997). The sharp increase in EC at the top of unit 2 and unit 3 reflect the buried Sanger and Aubrey/Carrollton paleosurfaces respectively. Similar patterns have been identified in EC traces collected elsewhere in the Project Footprint. The typical pattern of EC as a function of sediment texture and soil weathering is affected by the position of the water table. For example, the transition from moist to water-saturated Sanger alluvium at Probe DF14, taken from Moore Park, shows a distinct increase in EC as the water table is encountered (see Figure 11: Cliff et.al 1997).

Pilot Point alluvium is typified by relatively low EC values that often grade into sawtoothed patterns when stratified sediments are present. Sanger alluvium commonly has a sharp upper bulge in conductivity that typically decreases as the trace becomes sawtoothed as it penetrates coarser interbedded sediments below. The Aubrey/Carrollton alluvium often has an erratic sawtoothed trace along with highly variable penetration rates, due to the consolidated nature of the deposit and its high degree of textural variability. Weathered bedrock was recognized by sharp decreases in EC values, followed by a refusal to penetrate the indurated Cretaceous limestone.

Based on the initial characterization of EC traces in the Dallas Floodway Extension Project Footprint, a correlation of EC traces to alluvial units has been accomplished. It is important to note that the relative pattern of EC as a function of depth is the primary correlation criteria, not the quantitative EC values of individual units. Interpretations of alluvial units from the EC traces are labeled on the individual logs (see Appendix B: Cliff et.al 1997). These logs were prepared by importing the EC data into a spreadsheet, converting the depth curve to meters, and plotting the resulting data transforms. Interpreted stratigraphy of individual traces is included on the EC traces (see Appendix B: Cliff et.al 1997).

Landscape Evolution Summary

The data collected in the Dallas Floodway Extension Project Footprint and the implications of the geomorphological mapping can be compared to previous investigations in the Trinity River to provide a general landscape evolution summary applicable to the APE. This landscape evolution summary can be used to infer general paleoenvironmental evolution, assess archeological site distribution data, and provide cultural resources management recommendations for areas impacted by the project. Geomorphological map units and alluvial deposits within the APE are correlated to the model of Ferring (1990) for the purpose of inferring regional events in the Trinity River basin (Table 10).

The oldest Trinity River deposits in the area are the Coppell/Tioga alluvium. This unit reflects a period of slow valley alluviation at a base level higher than present. Stream channels were relatively shallow, bedload dominated meander belts and climatic conditions were probably comparable to the modern. The unit formed in mid- Wisconsinan time, probably before 30,000 years ago (Ferring 1990).

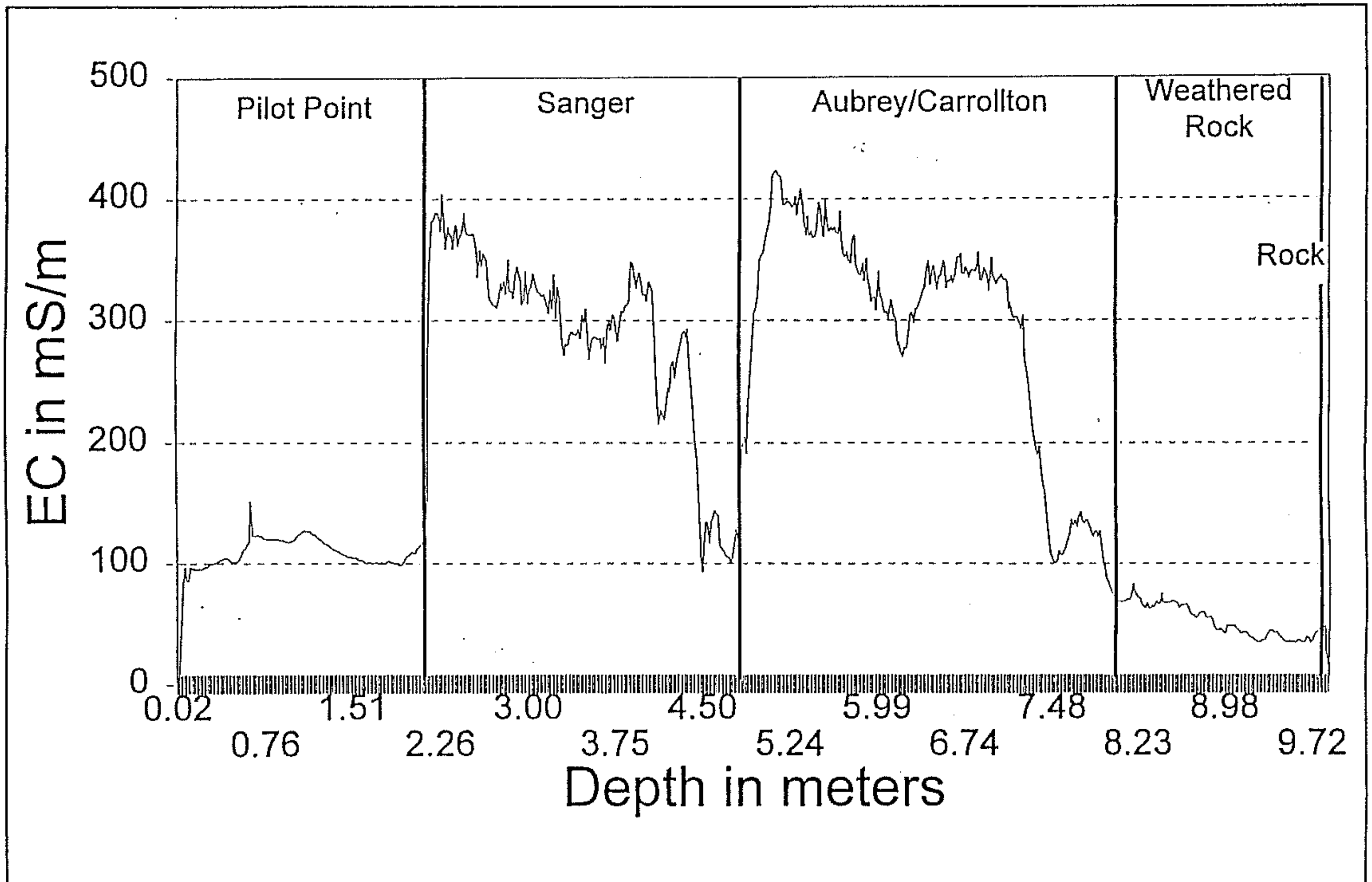

Figure 8. An example of an EC trace, Probe DF8 at Sargent Park, showing interpretations of alluvial units.

Table 10
Comparison of Upper Trinity River Stratigraphy to Units in the Dallas Floodway Extension Project Footprint

UPPER TRINITY RIVER (FERRING 1990)			DALLAS FLOODWAY EXTENSION	
ALLUVIUM	TERRACE SURFACE	AGE	ALLUVIUM	SURFACE(S)
Pilot Point	Denton Creek	< 4,500 years	Pilot Point	Holocene flood plain (Hf)
Sanger	Denton Creek	4,500 to 11,000 years	Sanger	Holocene flood plain, older surfaces (Hfo)
Aubrey	Denton Creek	11,000 to 14,000 years	Aubrey/ Carrollton	Holocene flood plain, older surfaces (Hfo)
Carrollton	Hickory Creek	14,000 to 30,000 years		
Coppell/Tioga	Stewart Creek	> 30,000 years	Coppell/Tioga	Pleistocene terraces (Pt)
Irving	Stewart Creek	> 30,000 years	not identified	

Onset of continental glaciation produced widespread and rapid valley incision throughout much of Central Texas (Blum et al. 1994; Ferring 1990). Climatic instability and associated increases in effective precipitation not only induced incision of Trinity River into its present flood plain, but also resulted in alluviation of the Carrollton/Aubrey sequence in a low relief, wetland dominated flood plain. The lithologic and stratigraphic attributes of this unit suggest that the Trinity River flood plain was a mosaic of swamp, marsh, and lakes with interspersed scattered stream channels. Sediment delivered to the flood plain was derived from erosion of the upland residuum, triggered by vegetational instability associated with full glacial climate changes (Blum et al. 1994).

Rapid alluviation in the Trinity River ensued with early Holocene meander belt development and deposition of the Sanger alluvium (Ferring 1990). A return to increased climatic stability and seasonality occurred (Blum et al. 1994) at this time. The lithology of the Sanger alluvium may in part be a result of the widespread exposure of Cretaceous rock in the Trinity River basin after Late Pleistocene stripping of residuum. The middle Holocene is characterized by a transition toward modern climatic conditions. The Trinity River flood plain exhibited a slowing of the rate of alluviation and concurrent increase in the rate of alluvial pedogenesis (Ferring 1990).

The Late Holocene is typified by varying rates of alluviation and pedogenesis and deposition of channel belt alluvium and overbank veneers draping older flood plain surfaces. Soil formation was concurrent with sedimentation to produce the thick, cumulative West Fork paleosol at the top of Pilot Point alluvium (Ferring 1990). The most significant disruption in the cumulative aggradation of the Pilot Point sequence is an inferred period of drier climate about 1,000 years ago (Hall 1990). Hall cites widespread occurrence of an alluvial discontinuity in the southern Great Plains; however no data to either support or refute this idea was generated in this investigation.

Recent alluviation occurs near the modern channel of the Trinity River. Recent overbank veneers probably drape the entire Trinity River flood plain, but recent mud drapes cannot be confidently separated from upper Pilot Point alluvium based on available data. Ferring (1990) indicates that the Recent alluvium is young, but he does not specifically correlate this unit to the onset of European settlement in the region. Similar alluviation associated with Euro-American land use alteration has been suggested throughout the Mississippi River drainage basin (Autin 1992; Bettis and Autin 1997; Grissinger et al. 1982; Knox 1972).

Results of Model Testing

The preliminary results of the geological investigation of the Dallas Floodway Extension APE suggests the presence of significant buried paleosurfaces in areas of project impact. Geological testing with Geoprobe proved to be useful for recognizing buried paleosurfaces, however documentation of significant cultural deposits cannot be accomplished without further field testing. Trenching at high likelihood locations did not yield significant new sites (see Figure 6), but this does not preclude the possibility of impacting sites during project implementation.

The following areas were field tested to look for buried prehistoric cultural deposits. Moore Park shows stratigraphic continuity between probes DF13 and DF14. The upper dark unit is about 1.8 m thick at DF13, but thins to about 0.9 m on the valley edge at DF14. The upper unit is Pilot Point alluvium and the underlying early to middle Holocene paleosurface is Sanger alluvium containing the Arlington paleosol. The area at Sargent Park (probe DF8) has the most representative of all EC traces. The Sanger paleosurface identified at Moore Park is at about 2.1 m below the land surface. A trench into the Arlington paleosol at the top of the Sanger paleosurface was placed here for comparison to the Moore Park locality. The data collected at Moore Park identify a paleosurface that traces from the valley edge onto the flood plain of the Trinity River. The lithology beneath this surface has been identified at other locations, but the geomorphic development of a terrace edge escarpment is a likely setting for prehistoric cultural deposits.

Two trenches were placed in Moore Park—the first was at the break in slope adjacent to the flood plain east of probe DF14, and the second was upslope and to the south. The first trench revealed about 2 m of colluvial loam with abundant limestone fragments overlying the Sanger paleosurface. The contact between the paleosurface and the colluvium was diffuse, and the surface horizons of the Arlington paleosol were not present. The paleosurface appears to be an eroded B-horizon and yielded no cultural deposits. The second trench was placed about a meter higher in elevation, and the profile was the same, about 2 m of loamy colluvium over the clay loam Sanger paleosurface.

The EC and core data at Sargent Park identified three surfaces above Cretaceous rock, including the present land surface. Multiple episodes of alluviation and landscape stability are conducive to finding possibly significant buried prehistoric cultural deposits. Backhoe trenches were unable to reach the lower Aubrey/Carrollton paleosurface, but did reach the upper Sanger paleosurface. The Sanger appeared to be a truncated or eroded B horizon with surficial paleosol horizons absent. The overlying Pilot Point alluvium is a dark alluvial clay with occasional bits of broken limestone, presumably from the nearby uplands. No cultural deposits were present on the truncated paleosurface. Water-saturated sandy deposits were encountered beneath the truncated Arlington paleosol before reaching the full limit of the backhoe.

The truncated nature of the Sanger paleosurface and its burial by overbank deposits of Pilot Point alluvium, as well as its colluvial equivalent, exemplifies the nature of the alluvial transition between these units. Surface A and E horizons probably developed, but have been reworked into the overlying deposit.

The Diversion Channel is likely to impact flood plain deposits to the greatest depths in sequences that also contain evidence of buried paleosurfaces. Trenching in this area was conducted to provide insight into the potential for buried prehistoric impact prior to channelization during project implementation. The EC traces at DF16 and DF17 show what appear to be a buried paleosurface at about 1.5 m, whereas this surface appears to be at about 3.4 m at DF15. Trenches were aligned to look at the edge of what appeared to be a topographic feature, possibly the edge of a cut-and-fill feature.

The first trench was placed in the vicinity of DF15. It proved to be disturbed sequence with a high water table between 2 and 3 m below land surface. The trench revealed recent sandy loam over a dark clayey sediment with historic material and logs that appears to be artificial fill. The second trench was placed between DF15 and 16 and showed between 1 and 2 m of recent sandy loam over alluvial clayey deposits. At the top of the clayey sediment was the buried West Fork paleosol. Below this buried surface the clay continued to deeper than 4 m, and no cultural deposits were found in the trench.

The third trench was placed almost due east of the second, in a modern natural levee ridge. A 1- to 2-m-thick recent sandy loam levee deposit buried the dark clayey alluvium that contains the West Fork paleosol. The Pilot Point alluvium continued down to deeper than 4 m, and no cultural deposits were found in the trench. The fourth trench was placed east of DF16. Here a dark clay was present from the land surface down, but the upper part appeared to be disturbed, containing an anomalous mottled brown clay. Based on the trench results, the paleosurface defined by the EC traces is the West Fork paleosol covered by recent (European historic?) flood deposits. The depth of the paleosurface in DF15 may be due to disturbance, not to a change in the paleotopography.

RECOMMENDATIONS

Task 1 and Task 4 - Archeological and Geoarchaeological Evaluations

A total of 41 previously recorded archeological sites are located either within or adjacent to the APE, with 14 of these sites in the vicinity of the Project Footprint (see Figure 4). Evaluation of many of these sites proved difficult due to problems of high water conditions and the suspected misplotting of the sites recorded in the 1940s and 1950s. Of the 14 sites in the Project Footprint, it is recommended that six sites be considered not neligible for inclusion in the NRHP (41DL69, 41DL70, 41DL84, 41DL104, 41DL220 and 41DL317) due to heavy disturbance by construction, gravel mining, and erosion. It is further recommended that eight sites (41DL318, 41DL319, 41DL320, 41DL337, 41DL338, 41DL355, 41DL356 and 41DL357) be considered eligible for inclusion in the NRHP based on good research potential. It is believed that the seven prehistoric sites may yield data relevant to research problems like paleoenvironmental reconstruction, culture history, settlement-subsistence systems, lithic raw material use patterns, and prehistoric technology. Sites 41DL318, 41DL319 and 41DL357 are all located 1.5 to 2 m below surface, adjacent to the current channel of the river, within 100-120 m horizontal distance of each other, and may represent a single site composed of multiple artifact concentrations. Likewise, sites 41DL337, 41DL338, 41DL355 and 41DL356 are also arguably a single site. They are all located between the current channel and the Central Waste Water Treatment Plant, approximately 3 m below surface and within 100-120 m horizontal distance of each other. Apart from these two prehistoric site clusters, only the old City of Dallas dump, Site 41DL320, appears to retain substantial research potential..

Of the remaining 27 sites in the APE, it is recommended that one (site 41DL223) be considered not eligible for inclusion in the NRHP, while the other 26 be considered potentially eligible for inclusion in the NRHP (sites 41DL67, 41DL68, 41DL71, 41DL72, 41DL73, 41DL76, 41DL77, 41DL78, 41DL79, 41DL80, 41DL91, 41DL92, 41DL99, 41DL102, 41DL105, 41DL204, 41DL205, 41DL206, 41DL207, 41DL208, 41DL350, 41DL351, X41DL36, X41DL38, X41DL39, and X41DL40). The high proportion of potentially eligible sites is due to the lack of right-of-access to these properties resulting in an inability to evaluate their current condition. Only the sites in the Joppa Wildlife Preserve and the McCommas Bluff Park had clear public access, but the field crew was unable to shovel test these sites.

When the final Project Footprint is identified, it is recommended that a 100 percent pedestrian survey be undertaken during a period of low water to identify the specific cultural resources that will be effected by the project. Prior to the surface survey, a chain of title and archives study should be undertaken to identify historic land use and potential historic site loci for concentrated and intensive search activity. The effort should concentrate on the profiles of minor drainages and borrow cuts for prehistoric resources.

Given the known presence of buried cultural resources sites within the Trinity River flood plain, a multistage Phase 1 subsurface survey must be employed to identify high and moderate site potential loci followed by a program of selective coring and exploratory trenching to locate and define the character and research potential of the resources. It is recommended that the initial survey strategy use a combination of Geoprobe readings at 20 m intervals to generate a topographic map of the buried surfaces that will be effected, followed by a coring program to acquire soil samples of the fossil deposits for sedimentary, pollen and radiometric dating purposes, as well as the identification of fossil sedimentary environments. An alternative to the Geoprobe-coring program may be the use of a Geddings Probe at intervals of 20 meters, although the data from all probes will have to be extensively analyzed to identify the various fossil deposits. Once these data have been analyzed, it will be possible to identify settings and deposits most likely to be associated with human occupation. The subsequent stage of the survey will entail the excavation of trenches using appropriate machinery (backhoe, trackhoe, dredge) dependant on terminal depth. One primary focus of intensive work should be given to those areas identified as containing *Holocene flood plain older surface* deposits. Resources determined to be potentially eligible must then be tested for eligibility through a Phase 2 program. Should any resources prove to be eligible and avoidance is not possible, a Phase 3 data recovery program may be necessary to minimize the loss of the resource. All phases of the investigation would be developed through a Programmatic Agreement or Memorandum of Agreement with interested parties, such as the Texas Historic Preservation Officer.

The APE encompasses an area south of the current Dallas Floodway, from Corinth Street on the northwest to I-635 on the southeast. The APE can be systematically divided into four types of impact areas based on the activities planned for the Dallas Floodway Extension. Each of the impact areas are assessed for the purpose of planning archeological surveys and managing cultural resources (Table 11). The following summary is designed as a general set of recommendations, and inferences should be verified as necessary prior to implementation into management initiatives or policies relative to Floodway construction, operation or maintenance.

Area 1 is an area of *new levee construction*. A total of 123 acres are scheduled for direct impact, which includes 75 acres on the Lamar Street side and 48 acres at Cadillac Heights. These areas include the northeastern edge of the Dallas Floodway Extension from the edge of the existing levee to a point east of I-45 in Rochester Park, the southwestern edge of the Dallas Floodway Extension from the Dallas Waste Water Treatment Plant to I-45, and a ring levee primarily surrounding part of the Cadillac Heights residential area. The new levee construction along the northeastern edge of the Dallas Floodway Extension is along the fringe of an area that is already heavily industrialized and disturbed. Areas previously impacted by industrial development are not likely to contain significant in situ prehistoric deposits. Areas southwest of the railroad track in the Rochester Park area mapped as Holocene, older flood plain may contain locations with possible buried cultural remains. Areas mapped as Pleistocene terraces may contain surficial cultural deposits.

The new levee construction along the southwestern edge of the Dallas Floodway Extension passes along the edge of the Dallas Waste Water Treatment Plant and I-45 right-of-way. Based on a consideration of present land use alterations, the chances of finding significant *in situ* prehistoric deposits are considered low. The new levee construction surrounding part of the Cadillac Heights area passes through areas of disturbed and undisturbed landscape. Much of the undisturbed landscape is mapped as Holocene, older flood plain, as characterized at Sargent Park, where multiple paleosurfaces were identified. Site potential in this area is considered moderate to high.

Area 2 is a *diversion channel* to be developed in an area that parallels the present Trinity River both upstream and downstream of I-45. A total of 23 acres will be affected by the project, although direct massive impact will be essentially restricted to a 14-acre area. In this area, the diversion channel is likely to disturb flood plain alluvium to bedrock or nearly to bedrock.

Table 11
Matrix of Cultural Resources Potential, Dallas Floodway Extension APE

IMPACT AREA	EXISTING SURFACE MODIFICATION	SUBSURFACE POTENTIAL	POTENTIAL PROJECT IMPACTS
New levee construction, northwest area	intensive	moderate to high with depth	moderate to high below 1 meter
New levee construction, Cadillac Heights	low	high	high
Diversion channel	very low	high	high
Sump, northwest area	moderate	moderate to high with depth	moderate to high below 1 meter
Chain of Wetlands	limited	moderate to high	low to nil in upper 1 meter of deposit; moderate to high below 1 meter

Buried paleosurfaces were identified near the impact area. The survey program should be initiated in the area of the diversion channel, where the proposed undertaken will reach greatest depth. Previous survey in the flood plain, especially within the Project Footprint, has shown that sites may occur from 1.5 to 2 m below surface (sites 41DL102, 41DL318, 41DL319, 41DL350, and 41DL357) and as deep as 3 m below surface (41DL337, 41DL338, 41DL355, and 41DL356) in association with the Pilot Point and Sanger alluvia. The downstream portion of the proposed diversion channel will likely include excavation into the deeply buried Arbury Aluvium associated with Paleo-Indian occupation in the watershed.

Area 3 includes the *sump areas* to be created behind the new levees along the northeastern edge of the Dallas Floodway Extension. A total of 139 acres are scheduled for direct impact through sump construction. The areas along the northwest boundary of the Dallas Floodway Extension are mostly disturbed by prior industrial development and are not likely to contain significant *in situ* undisturbed prehistoric cultural deposits in the upper meter of deposits. However, prehistoric and early historic culture-bearing deposits may have been buried by leveling activity and the filling of headward eroding drainages prior to industrial development. The area is in close proximity to the Pleistocene valley wall and may have contained numerous specialized settings, e.g., seeps, drainage heads, that were often exploited by prehistoric inhabitants of the region. Many of these loci would have been covered by fill prior to construction and while they may have suffered compaction, their essential distribution could remain intact. The potential for these deposits should be investigated prior to and during construction.

Area 4 includes proposed *wetlands* that will be created along the southwestern edge of the Dallas Floodway Extension for purposes of environmental mitigation. A total of 271 acres will be impacted through varying amounts of excavation and/or terrain modification. Developing wetlands should produce minimal disturbances to buried cultural deposits, especially if wetland creation is simply the development of bottomland hardwood forest areas in the flood plain. However, using data from the lower West Fork for comparative purposes, the potential for impact to buried deposits increases substantially with excavation. At a minimum, careful monitoring by a professional archaeological team would subsequently be necessary should excavations be included in the undertaking.

Task 2 - Archival Evaluations

The review of historical resources suggests that information for the Project Footprint and APE is available. However, based on the *type* of resources that can be secured, the extraction of data will require a concerted amount of effort and time. Little information associated with the APE is compiled, thus, an in-depth examination of records, collections, and documents will be necessary in order to provide an accurate historical context. Since secondary sources of information on this area are limited, future research should also include interviews with long-term community residents, or other persons with specific knowledge about the area.

Inquiries into archival material at the Dallas Historical Society reveal two collections of papers that may contain valuable data—the Overton Family papers and the Sara Cockrell papers. The archivist was not able to confirm if these collections contained information pertinent to the APE, but given the proximity of the Overton property to the APE and since Cockrell's Bridge traversed the Trinity River, these collections are worth reviewing. It would also be worth investigating other files and collections at this repository. Other resources such as early newspapers, city directories, and historic photographs may also yield pertinent data.

Another potential source of information, especially for little-known African-American communities such as Joppa, is Black Dallas Remembered, Inc., which shares space with Preservation Dallas on Swiss Avenue. Dr. Mamie McKnight, founding director of Black Dallas Remembered, Inc., is currently updating file information on Joppa which should be available in July of 1997. In addition to this information, community residents should be interviewed for information on family and community history. Files at Preservation Dallas indicate that Joppa residents are likely to have historical knowledge, as many have lived in the area throughout their lives and are descendants of original inhabitants. One Joppa resident, in particular, appears to be quite interested in preserving the community's history (M. Greene 1996). Contact persons for all of the communities associated with the APE are available at Preservation Dallas; interviews with these persons could yield valuable information for each particular community.

The data contained in deed records can vary tremendously from one transaction to the next, and, as indicated in the examples for this survey, chain of ownership is not always straightforward, hence, it requires a considerable amount of time to track deed/title chains. Tracking the chain of title for a single property can take up to one day. Though it may take time to establish the chain of ownership, deed records do provide information that is useful for further investigations. Provided it can be established that the landowners lived on or made use of the property, then census records, tax records, wills, and directories may provide data that is useful for understanding land use, migration trends, urban growth, zoning changes, occupational trends, the material culture, and the built environment. Landowner's names are also useful for tracing descendants who might share their family's history, or for inquiring about documents and records left at archival repositories.

Future archival research for this area should include an examination of as many primary sources of information as is possible. Since published sources for this area are limited, data from a wide range of sources should be reviewed in order to develop a more comprehensive historical context that reveals the social and economic trends associated with this area.

Task 3 - Architectural Evaluation

Investigation of the architectural resources within the Project Footprint of the Dallas Floodway Extension revealed that there are 49 architectural resources that will be directly affected by the construction of the levee system or other flood control components, as presently proposed (see Table 6). These resources are composed of:

- Category 1 resources, three that should be assessed by an architectural historian and will require further archival research for any that the architectural historian recommends as NRHP-eligible;
- Category 2 and 3 resources, 43 that require no further work;
- Category 4 resources, three that will need to be assessed by an architectural historian or that requires further archival research when they become 50 years old (1999).

In addition, there are 699 B-series architectural resources. Of these, assessments have been made as follows:

- Category 1 resources, five that will need additional assessment and research should the layout or design of the levee system or other flood control components be altered such that these resources would be impacted;
- Category 2 and 3 resources, 120 that will require no further work should the layout or design of the levee system or other flood control components be altered such that these resources would be impacted;
- Category 4 resources, none have been assessed as such; and
- 574 will need additional research in order for an accurate assessment to be made should the layout or design of the levee system or other flood control components be altered such that these resources would be impacted.

The B-series resources that have been assessed as Category 1 resources (potentially eligible for inclusion in the NRHP) are:

- B-121, B-122, and B-123, all industrial/institutional buildings of distinctive architectural style that appear to be in good condition and to retain a reasonable degree of integrity;
- the Corinth Street Viaduct (B-268), which has previously been recommended eligible for inclusion in the NRHP by the Corps of Engineers (USACE-FW 1992:30); and
- the community of Joppa (B-727), a potential NRHP Historic District (only a portion of which is located within the APE).

All Category 1 resources are potentially eligible for inclusion on the NRHP. Each Category 1 A-series resource will need to be assessed by an architectural historian for their integrity, condition, and architectural/engineering significance. Each of those that is considered to be NRHP-eligible by the architectural historian will require further archival research to document its history and better determine its significance. The historic context of each resource will need to be established so that the significance of the resource can be effectively conveyed. Each NRHP-eligible resource will also need to be preserved or appropriately documented according to HABS/HAER standards (the level of documentation required should be determined through consultation with the Texas State Historic Preservation Officer). Any Category 4 A-series resource that is upgraded to a Category 1 resource will require the same documentation efforts.

At this time, a Category 1 assessment of a B-series resource does not necessitate further research, documentation, or evaluation. However, should the layout or design of the levee system or other flood control components be altered such that these resources would be impacted, each will need to be treated in the same manner as the Category 1 A-series resources, as described in the preceding paragraph. Any Category 4 or 5 B-series resource that is upgraded to a Category 1 resource in future assessments will require the same documentation efforts if subject to impacts because of changes made to the layout or design of the levee system or other components of the flood control system.

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APPENDIX I

RECREATION AND OPEN SPACE

EXISTING RECREATIONAL RESOURCES

Regional Recreation Resources

The 1990 Texas Outdoor Recreation Plan (TORP) prepared by the Texas Parks and Wildlife Department (TPWD) identifies existing recreational facilities, usage trends, and projected recreational needs for 23 regions within the state. The Dallas Floodway Extension is located within a 16 county area designated in the TORP as Region 4 (see Figure 1).

Region 4 has experienced several years of rapid population growth. With 336.6 people per square mile, the density of Region 4 is surpassed only by the Houston region. Many of the small towns and rural areas within Region 4 have become part of the rapidly expanding metropolitan area as people have moved from the heavily populated cities to the suburbs. People in these urbanizing areas are finding open space increasingly scarce. The region now ranks 21st out of 23 regions in recreation land per thousand population.

Residents of Region 4 are generally worse off than the state as a whole in recreational facility supply. Of 19 commonly used facilities or designated resources, 13.have a below average supply. The supply of baseball fields, swimming pools, and campsites is among the lowest in the state in facilities per thousand population. Table 1 shows the supply of recreational land, water, and facilities managed by various providers. The administrative category with the highest proportion of park land acres (39 percent) is the aggregate of municipalities. The Corps of Engineers follows closely with 38 percent of the regional total. Much of the 48,737 acres of recreational land in this region operated by the Corps of Engineers can be found in close proximity to the urban areas. Only 9.6 percent of the park land acres found within the region is provided by the Texas Parks and Wildlife Department. State parks located within a one hour drive of the study area include Ray Roberts Lake State Park and Cedar Hill State Park at Joe Pool Lake. There are several other state parks within a two hour drive of the Metroplex. The Texas Legislature has authorized the acquisition of approximately 1500 acres along the Trinity River within the study area for a future low density recreational area to be named Trinity River State Park. Funding sources for acquisition of all of these lands, however, have not been identified.

Residents in the metroplex need not drive far to find recreational waters because many of the state's major reservoirs are located in the metropolitan area. A total of 232,581 surface acres gives the region more lake acres than all regions except Deep East Texas; however, the large numbers of people residing in the region make the suitable surface acres per thousand population still fall below the state average.

With so many reservoirs in the area, the value of the free-flowing sections of the region's rivers increases as they become more rare. Public agencies within Region 4 are taking a fresh look at the valuable natural resources along these long neglected streams. Many cities have identified linear corridor resources within their jurisdictions which are highly desirable for recreation, and sites within the Trinity River floodplain are among those most actively studied. Nine cities and three counties within the region are participating with the (NCTCOG) in the development of a *Common Vision* to protect the resources within this corridor.

TABLE 1
Supply of Recreational Land, Water, and Facilities Within the Upper Trinity Study Area

Facility / Resource	Forest Service	Corps of Engineers	TPWD State Park System	TPWD Wildlife Mgmt. Areas	Other State	River Authorities	Counties	Cities	Other Local	Commercial	TOTAL
Number of Parks/ Rec. Areas	1	58	10	2	3	7	11	1,218	24	120	1,454
Total Park Land (ac.)	15	48,737	12,192	6,570	190	394	560	50,160	667	8,081	127,567
Developed (ac.)	4	8,588	1,944	0	190	331	61	21,302	413	4,370	37,203
Developable (ac.)	11	6,818	6,335	0	0	63	374	19,862	211	3,352	37,026
Preserved or Unsuitable (ac.)	0	33,331	3,913	6,570	0	0	125	8,996	44	359	53,338
Baseball Fields	0	0	0	0	0	0	0	305	4	1	310
Basketball Goals	0	0	0	0	0	2	0	438	21	8	469
Boat Ramp Lanes	1	195	9	0	7	13	3	92	0	103	423
Campsites	0	1,011	405	0	0	299	62	313	0	3,303	5,393
Fishing Bank Access (yd.)	0	60,850	7,040	0	0	18,000	0	11,162	0	30,310	127,362
Fishing Structures (yd.)	0	550	212	0	0	650	0	2,703	0	4,052	8,167
Golf Holes	0	0	0	0	18	0	0	486	0	162	666
Hiking Trails (mi.)	0	0	12	0	0	0	0	11	0	0	23
Horseback Riding Trails (mi.)	0	15	9	0	0	0	0	7	0	0	31
Lake Acres (BFS Suitable)											165,749
Off-road Vehicle Area (ac.)	0	0	0	0	0	0	0	94	0	2,805	2,899
Picnic Tables	8	730	248	0	0	23	18	5,877	0	2,044	8,947
Playground Areas, Equipped	0	0	11	0	0	2	0	863	11	28	915
Soccer/Football Fields	0	0	0	0	0	0	0	553	12	0	564
Softball Fields	0	0	1	0	0	0	0	469	6	2	478
Swimming, Designated Lake (yd2)	0	142,400	3,900	0	0	150	3,000	39,500	0	200,698	389,648
Swimming, Pool (yd2)	0	0	0	0	0	0	0	78,361	0	11,775	90,136
Tennis Courts	0	0	0	0	0	1	0	826	40	10	877
Trails, Walk, Bike, Jog (mi.)	0	2	0	0	0	0	0	116	0	0	118

Source: Parks Division, TPWD, 1988. Figures are based on 1986 inventories.

Goals include the development of a regional construction permit system and cooperation in the creation of a linear greenbelt of parks and trails along and adjacent to the river and its tributaries.

Local Recreational Resources

Over 6000 acres of existing parks, open spaces, natural areas, and cemeteries are available for present or future public use within an 80 square mile section of the county that includes the study area (Figure 2). These public and private lands and facilities provide recreational opportunities for residents of the Metroplex, especially those who are unable to travel to recreational sites outside the metropolitan area.

Most of the recreational resources within the study area are owned and managed by the City of Dallas, the Dallas Independent School District, and the Dallas County Open Space Board. A list of these resources and their approximate acreages are included in Table 2.

Recreational lands and open space areas proposed for future use are also shown on Figure 2. These areas have been identified and recommended for acquisition by the City of Dallas, and the Dallas County Open Space Board in support of the comprehensive Trinity River Greenbelt concept.

TABLE 2
Trinity River Floodway Extension Landuse Acreage

Landuse Type	Number of Facilities	Approximate Acreage
Lakes	1	149
Landfills	1	2,009
Private Parks/Recreational Facilities	1	4
Golf Courses	4	627
Cemeteries	5	340
Public Parks	81	5617
Natural Parks	2	243
City Open Space	4	765
Large Outdoor Stadiums	2	33
Proposed City Parks/Open Space	16	824
Proposed State Parks/Open Space	5	1245

Regional Recreational Activities

The projected per capita outdoor recreation participation generated by Region 4 residents in each of the 26 activities shown in Table 3 closely matches the statewide figures. The exceptions are the saltwater activities, in which Region 4 residents are less likely to participate as a whole.

Table 3 also shows the activities garnering the most participation per capita. The top five activities which people do most frequently are walking, bicycling, pool swimming, playground use, and jogging. The state averages show the same top activities. Compared to the state rates per capita for the 26 activities, Region 4 residents participate at higher rates for 7 activities, at the same rate for 5 activities, and at lower rates for 14 activities. Soccer and tennis participation in Region 4 is higher than almost all other regions.

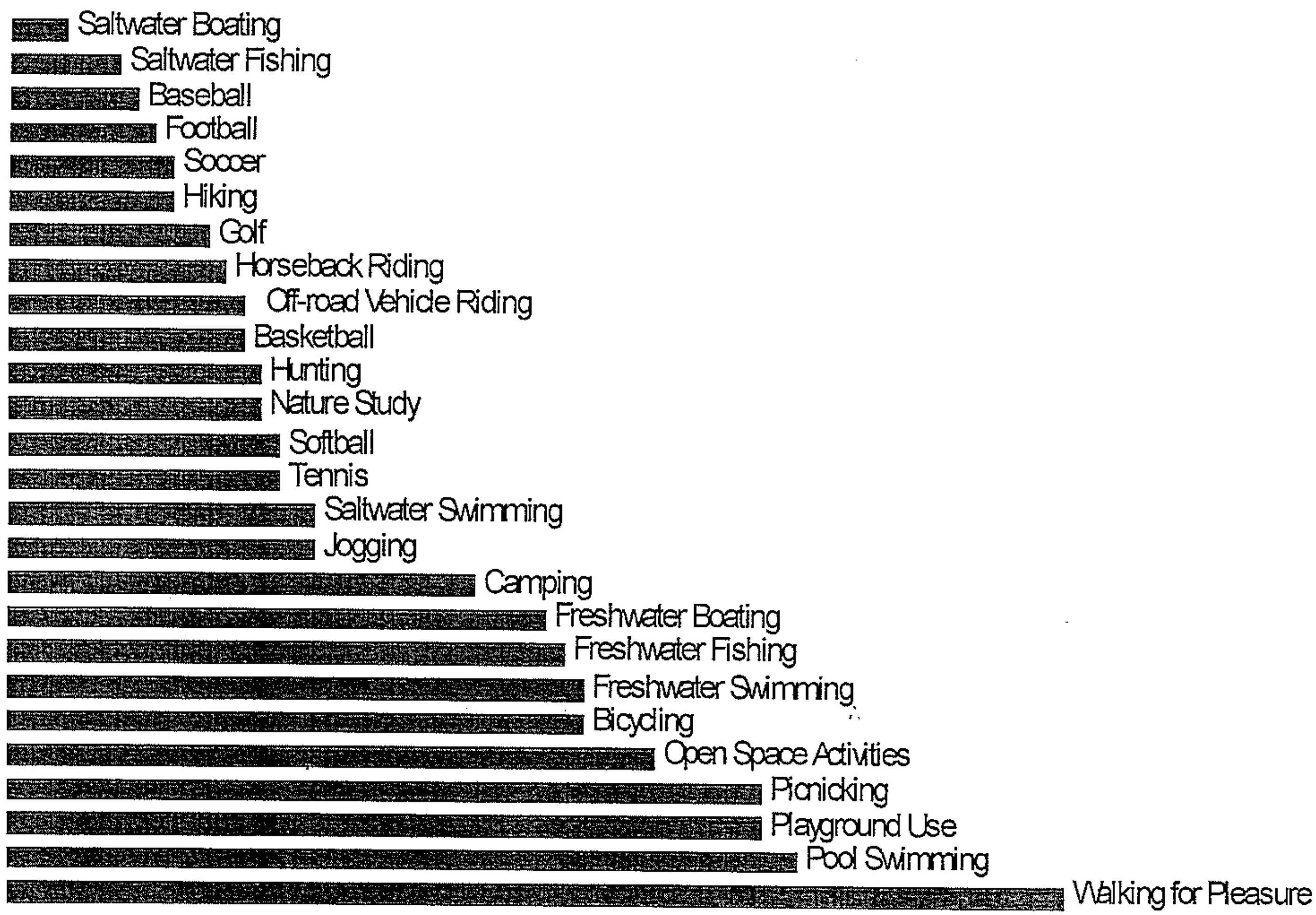
TABLE 3
Projected 1995 per Capita Outdoor Recreation Participation
Generated by Residents of Region 4 and Texans
(in Annual User Occasions)

Activity/Facility Use	Projected Per Capita Particiipation Generated By Residents of Region 4		
	in Region 4 Only	Occurring in All Regions	All Texans Statewide
Boat Ramp Lanes, FW	0.8	1.3	1.3
Boat Ramp Lanes, SW		*	0.3
Boating (Pleasure), FW	0.4	1.7	1.7
Boating (Pleasure), SW		*	0.1
Camping	0.4	1.7	1.7
Fishing, FW	1.6	2.4	2.4
Fishing from Banks	0.5	0.8	0.8
Fishing from Boats	0.7	1.1	1.1
Fishing from Structures	0.4	0.5	0.5
Fishing, SW	*	0.2	0.7
Fishing from Banks	*	*	0.3
Fishing from Boats	*	*	0.1
Fishing from Structures	*	*	0.3
Hiking	0.2	0.3	0.4
Hunting	0.4	1.1	1.3
Lake Use (BFS Suitable), FW	1.0	1.4	1.5
Nature Study	0.6	0.9	0.9
Picnicking	1.4	1.8	1.9
Swimming, FW	1.3	2.1	2.1
Swimming, SW	*	0.5	1.2
Baseball	1.2		1.5
Basketball	1.4		1.6
Bicycling	10.5		10.7
Bicycling on Trails	0.6		0.7
Football	0.7		0.8
Golf	1.4		1.3
Horseback Riding	0.8		0.8
Horseback Riding on Trails	0.2		0.2
Jogging/Running	4.8		5.4
Jogging/Running on Trails	1.5		1.7
Off-road Vehicle Riding	1.4		1.4
Off-road Vehicle Riding/Trails	0.3		0.3
Open Space Activities	3.4		3.2
Playground Use	4.9		4.8
Soccer	1.4		1.2
Softball	1.6		1.8
Swimming, Pool	6.3		6.4
Tennis	1.5		1.3
Walking (Pleasure/Exercise		15.1	14.8
Walking on Trails	3.5		3.5

Source: 1986 Participation Survey, Parks Division, TPWD, 1987.
Notes: Asterisk (*) indicates value is less than 0.1 occasion per capita.

FIGURE 3

Region 4 Projected Percentage of Population Participating



as projected in the 1990 Texas Outdoor Recreation Plan (TORP). Participation will increase for each projection year. Fresh water fishing, swimming, and picnicking will attract the most participation in the region for resource based activities. Participation in urban oriented activities projected for 1995 were over eight times as high as the participation in resource based activities in the region. This ratio is one of the highest in Texas. Texans from outside Region 4 will have little impact on the region's resources.

Table 6 shows regional facility needs for 13 of the 18 commonly used facilities/resources by 1995. Increases of more than 100 percent over existing supply are needed for five facilities (hiking, horseback, and multi-use trails, playgrounds, and freshwater swimming areas). Table 7 ranks the outdoor recreation needs within the region. Multi-use trails are the highest need followed by freshwater swimming, playgrounds, and hiking trails.

Public recreation providers in the region have repeatedly expressed a need for more parks and passive open space. In recent years, park land and open space have become increasingly scarce as available sites have been reduced. Rapid development has replaced many natural areas with buildings and pavement. Needed lands shown in Table 6 represent only the acres required to develop recreational facilities. Most park providers have identified undeveloped land as their highest priority need (park sites, open space, and greenbelt acquisition). The next greatest need expressed is for upgrading and renovating existing facilities.

The City of Dallas and the Dallas County Open Space Board have specific plans to acquire additional lands to meet future public recreational demands. Proposed acquisitions are often dependent on the availability of public funds and are influenced by private development pressures and development permit approvals. Both the City and the County have bond funded open space acquisition programs. The recent slump in the Texas economy has temporarily suppressed rising land costs, making the present a very good time to pursue needed acquisitions.

Public Use of Rivers, Tributaries, and Corridors

As would be expected, river and creek segments which have had trees and shrubs removed, have been channelized, lined with levees, or heavily developed are less desirable and the least utilized by area canoeists, bicyclists, hikers, and bird watchers. Many of these channelized and leveed river segments offer recreation potential but will need to be enhanced with river access points, trails, play areas, sports fields, tree and shrub plantings and wildlife habitat improvements in order to attract recreational users to the floodway.

Recreational Fishing

The Texas Department of Health issued an aquatic life closure for a stretch of the Trinity River in January 1990 due to elevated levels of chlordane in fish tissue. This 66-mile stretch of the Trinity River, denoted as Segment 806, extends from Fort Worth to IH-20 in southern Dallas County, which includes the DFE project area. Fishing can be conducted, but no taking of fish is currently allowed. In addition, the TNRCC does not support contact recreation within the waters of Segment 806 due to continued water quality violations.

Trinity Corridor and Greenbelt

Without exception, the recreational master plans and sector plans of the cities and counties with jurisdiction along the Trinity River call for utilization of the flood plain for open space, linear parks, access areas, active and passive use areas, interpretive areas, natural areas, "urban wilderness" areas, and a system of linked hiking, biking and equestrian trails. A regional goal is to tie public lands and open space within the Trinity Corridor and its tributaries from Lewisville Lake, Lewisville, Coppell, Carrollton, Irving, White Rock Lake, Dallas, Grand Prairie, Mountain Creek Lake, Joe Pool Lake, Arlington, Fort Worth, Lake Worth, Benbrook Lake and other publicly owned areas.

The North Central Texas Council of Governments (NCTCOG) is pursuing a Trinity Greenbelt of major parks linked by a regional trail system. According to NCTCOG, "Tens of thousands of acres of open space are being preserved within the river corridor with outstanding potential for active and passive recreation. Using the Trinity River Information Network, local park departments and recreational professionals will prepare a realistic Trinity Greenbelt strategy of major parks linked by a regional trails system." It is the intent of NCTCOG to implement a "world class" Trinity Greenbelt strategy.

Local bicycle, equestrian, and conservation groups have shown a keen interest in the development of trails as part of a recreation plan for the project area. The following planning/design recommendations have been offered for consideration.

Bicycles

- Create an extended linear spine trail, at least 5-10 miles long, with shorter loops coming off of it.

- Keep the trail elevations as high as possible in the flood plain. Consider using the top and/or sides of levee for portions of the trail.

- Use American Association of State Highway and Transportation Officials (AASHTO) standards for main trail construction to minimize maintenance requirements. Consider alternative materials for loops.

- Include signage which conveys the rules of the trail system, warns of potential danger spots, and provides trail information such as mile markers, location of streets and facilities, special features, etc. Signs which display location maps would also be helpful.

- Trails should take a meandering path, rather than straight. The layout should seek to avoid blind corners and 90 degree turns.

- Parallel trails should not encourage users to cross over in front of each other. Try to avoid at-grade crossings on the main spine trail.

- Parking areas should be in secure areas, visible from the road and tied into the existing city street network. Good lighting and visibility are also necessary. Informational signage at these and other entry points are a must. Take advantage of existing parking lots in contiguous parks and commercial areas.

- The transportation value of trails should be given a high profile. Make useful connections to downtown Dallas and to residential and commercial areas. Consider nearby DART stations as access points.

- Establish discernable "gateways" into the system. Important linkages into the trail network which should be considered are:

Five Mile Creek	Parkdale at Scyene
White Rock Creek	Trinity River State Park
Riverchon Park	Lemon Lake/Joppa Preserve
The KATY trail	Woodland Springs

- Safety measures should incorporate barriers to exclude motor vehicles, 911 call boxes, and lighting in parking lots, underpasses, tunnels, etc. Trails should be farther than "bottle throwing distance" from vehicular roads.

TABLE 7
Ranking of Outdoor Recreation Facility/Resource Needs in Region 4 through 1995

Need by Rank	*Facility/Resource*
1	Trail Miles, Multi-Use (Walk, Bike, Jog)
2	Swimming, Freshwater (1000 yd^2)
3	Playground Areas, Equipped
4	Hiking Trail Miles
5	Horseback Riding Trail Miles
6	Soccer/Football Fields
7	Swimming, Pool (1000 yd^2)
8	Tennis Courts
9	Basketball Goals
10	Baseball Fields
11	Golf Holes
12	Fishing Structures, Freshwater (yd.)
13	Softball Fields
14	Boat Ramp Lanes, Freshwater
15	Campsites
16	Picnic Tables
17	Off-Road Vehicle Riding Acres
18	Lake Acres (BFS Suitable)

Source: Parks Division, TPWD, 1988.

Equestrian

- The primary concern of equestrians is the safety of their animals and equipment. Parking area security is considered very important.

- Provide at least 10 miles of trail, preferably a loop system which permits them to return to their vehicles along a different route. A system with a remote pick-up point is undesirable.

- Consider an overnight camping area. While customary amenities are desirable, the only absolute requirement would be water for the horses.

- Trails should be more primitive than bike trails. Riders prefer a mixture of spatial/visual experiences, such as narrow wooded corridors, open meadows, and high bluffs with expansive views.

- Equestrian users do not mind sharing portions of a trail corridor with other users, but would prefer separate trails within the corridor for horses. Riders could use an unpaved trail running parallel to paved surfaces.

- Access to fishing points or nature study areas along or near the trail would be a definite plus.

RECREATION MASTER PLAN

The regional recreation master plan for the Dallas Floodway Extension is shown in Figure 4. The plan is designed to meet existing needs for passive and non-structured recreational activities within the regional service area, and addresses state and regional shortfalls in faciltiies for walking, hiking, cycling, and jogging identified in the TORP. Facilities proposed for this project are necessary to provide public access, protect sensitive environmental resources and promote safe use of the area. The plan creates linkages between existing recreational areas and public open space areas, both existing and necessary for the Floodway Extension project. Most access points take advantage of existing facilities within local parks and preserves. The plan is consistent with locally adopted recommendations for long range development of a "Great Trinity Forest Park" within the Floodway Extension area. Those facilities proposed for the Dallas Floodway Extension recreation master plan are highlighted in Figure 5 and described below.

Trails

Twenty-six miles of all weather hike/bike trails are proposed. Eighteen miles of trail qualify as cost sharable. These trails would be 10 ft wide concrete, with informational and directional signage and rest stops, including an 8 ft bench or picnic table at one mile intervals. All weather trails will include low water crossings, culverts, grading and drainage. Increasing the width to 12 feet, as desired by the sponsor, would be considered a betterment, and would be a 100 percent non-Federal cost.

A life-cycle cost analysis has been included in this appendix, which verifies the cost efficiency of utilizing concrete trails for the proposed trail locations.

Sixteen miles of natural surface equestrian trails are proposed, of which 8.5 miles are cost sharable. These trails would be 8 ft wide with a 15 ft overhead clearance and would have informational and directional signage and a rest stop every 3 miles, with 8 ft bench or picnic table and a hitching post. Natural surface equestrian trails would require clearing and grubbing, low water crossings, culverts, grading and drainage.

Ten miles of natural surface nature trails are proposed. Five miles are cost sharable. These trails would be 4 ft wide with 8 ft overhead clearance. They would need informational and directional signage and a rest stop with and 8 ft bench at one mile intervals. Nature trails will require clearing and grubbing, low water crossings, culverts, grading and drainage. The plan includes approximately four miles of natural surface off-road bike trails. These trails would be 4 ft wide and would be constructed by volunteers at no cost to the government.

Footbridges

Two footbridges will be required to span the Trinity River. They would need to be 10 ft wide, with 54 inch side rails, and wood decking (necessary for equestrian use), and would require signage for safe use by multiple recreation groups. These bridges would be accessible to maintenance vehicles.

Access Areas

A total of seven access areas are proposed, three of which would be located at existing parks or areas with adequate existing parking areas. These areas are located at Moore Park near Cedar Creek, at Woodland Springs Park near the McCommas Bluff Preserve, and at IH-45 near the Central Wastewater Treatment Plant. Each of these areas would need an entry sign, a 30-foot by 60-foot picnic pavilion, and a trailhead with an informational kiosk. The clubhouse at the Sleepy Hollow Golf Course is included as an access point, but would require no modifications. One of the new access areas would be located near the upstream end of the existing Rochester Park levee, with another located on the east side of the Trinity River across from Lemmon Lake, and the final

Dallas Floodway Extension Wetlands
A proposal for establishment of native aquatic vegetation

Mike Smart and Gary Dick

General Design Concept

This proposal is being submitted as a general guideline for establishment of native aquatic plants in the Dallas Floodway Extension (DFE) wetlands over a two-year period. The primary purpose of the wetland creation project is to enhance waterfowl and other wildlife habitat in a floodwater conveyance. Because the depth (7 ft.) to achieve the necessary hydraulic capacity the conveyance requires will not allow for establishment of diverse aquatic plant communities most beneficial to waterfowl and wildlife, shallow water areas will be added adjacent to the flood conveyance channel. These areas will be designed, planted, and managed to promote the development of highly desirable waterfowl and wildlife habitat

Water levels in some or all of the wetlands will be managed according to a practice commonly referred to as "moist soil management". In this management scheme, water levels are lowered during the summer growing period (summer pool), exposing large areas of soil and promoting the growth of terrestrial and wetland plants. Following plant community development and seed production, water levels are raised during the fall and winter (winter pool), allowing waterfowl access and feeding. This management technique can be improved upon by maintaining a permanent pool of water in a portion of the wetland. This practice allows for establishment of additional wetland and aquatic species that provide valuable winter food sources for waterfowl. Many submersed and emergent aquatic plants provide cover and food for other wildlife, fish and invertebrates in addition to serving as food sources for waterfowl. The additional habitat diversity provided by the permanent pool greatly enhances the value of the wetland.

Following excavation and construction, establishment of native plants will be undertaken. Both emergent and submersed plant species will be planted. All species planted provide food for wintering waterfowl and other wildlife.

Protective devices are necessary to successfully establish desirable native aquatic vegetation in Texas. Although this is a new construction project -- much of our experience has been obtained in older (>10 years) reservoirs -- it is likely that feeding activities of aquatic (carp, turtles, nutria) or terrestrial animals (deer, rabbits, loose cattle, wild hogs) will impede plant establishment. If desirable plant establishment is delayed, the habitat quality of the wetland will be greatly diminished. In addition, a delay in native plant establishment provides an opportunity for undesirable, weedy species such as cattails to invade.

Therefore, we propose inclusion of protective exclosures for many of the plants. This will ensure that at least protected individuals will have the opportunity to grow and begin to spread. If the use of protection proves to be unnecessary, funding and efforts can be shifted towards plants alone in subsequent establishment efforts.

Dallas Floodway Extension Wetlands
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Depth Profile Planting Zones

The following is a description of a cross-section of each floodway pond (Figure 1). During excavation to these specifications, topsoil should be reserved in order to replace 6" over Zones A-D. Note that grading should be done to a depth 6" below those specified below in order to allow for replacement of topsoil.

Zone A: a *transition from upland to wetland* should be graded on a 4:1 slope to a depth of 1 ft, and will be of variable width. This zone serves as the transition from upland habitat to moist soil habitat. It is flooded during winter pool and exposed during summer pool. Topsoil seed banks and moist soil management will be used to promote growth of vegetation in this zone.

Zone B: a *moist soil wetland* should be graded to achieve a 1½-ft deep shelf of variable width (dependent upon contours and configuration of the wetland cell). This zone serves as the moist soil habitat management area. It is flooded during winter pool and exposed during summer pool.

Zone C: a *transitional emergent wetland zone* should be graded on a 4:1 slope to a depth of 3.0 ft. This zone serves as the transition from the moist soil wetland to the aquatic zone. It will be the primary zone for emergent wetland plants. It is permanently flooded.

Zone D: an *aquatic plant zone* should be graded to achieve a 3.0-ft deep shelf of variable width (dependent upon contours and configuration of the wetland cell). This zone serves as the submersed plant zone. It is permanently flooded.

The above zones will vary in width depending on cell configuration. In the narrowest areas (28 ft from bank to 7-ft depth), the shelves at 1½- and 3-ft will be omitted, and the zones will continuously grade into each other on a 4:1 slope. For cells (or portions of cells) that allow for a wider shallow water area, a moist soil management zone will be excavated at a depth of 1½ ft below winter pool. The minimum width for this zone will be the minimum that can be easily achieved with the excavation equipment being used. This minimum is expected to be on the order of 12 ft. For cells (or portions of cells) that allow it, an additional shelf will be excavated to a depth of 3 ft below winter pool. Minimum width of this shelf will likewise be established based on the operating dimensions or characteristics of the equipment being used. No slope shall exceed 4:1. If cell configuration does not allow for the inclusion of shelves, a lesser slope down to a depth of 3 ft should be employed.

Dallas Floodway Extension Wetlands
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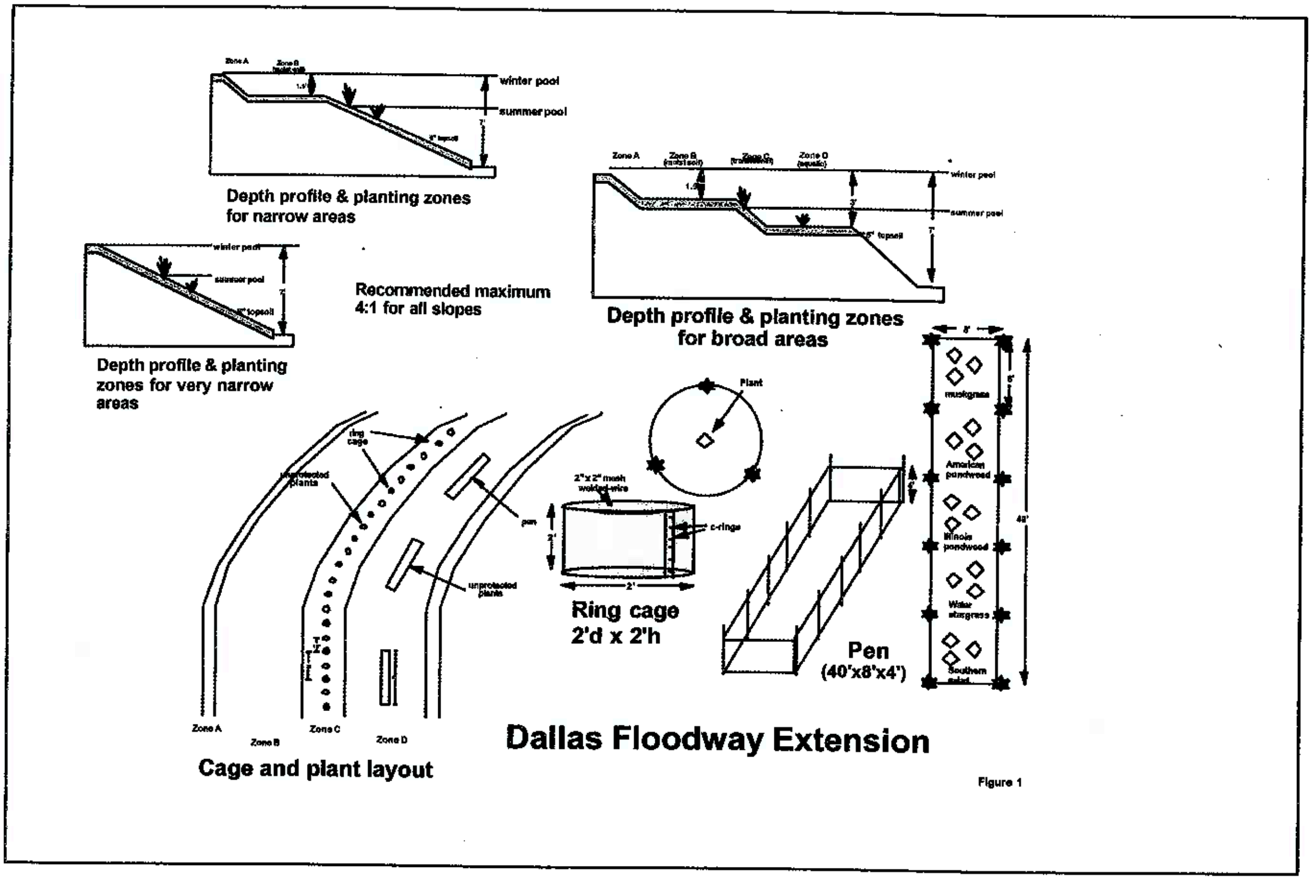


Figure 1. Depth profiles, planting zones, pen and cage construction, and planting schematic for the proposed Dallas Floodway Extension wetlands.

Protective Exclosure Design

Two types of protective exclosures will be constructed (Figure 1 and Appendix A). Materials and construction will be provided by private contractors. Site locations of constructed exclosures will be assigned by Lewisville Aquatic Ecosystem Research Facility (LAERF) personnel. LAERF personnel will also inspect exclosures following construction.

Ring cages are 2-ft diameter x 2-ft tall, open-ended cylinders constructed from 2"x2" mesh, PVC-coated, welded-wire. Ring cages will be anchored to the substrate using pieces of rebar. These cages are designed to protect emergent plant species in shallow water (0 to 18" deep). Construction specifications are given in Appendix A.

Pens are 40-ft long x 8-ft wide x 4-ft tall exclosures constructed from t-posts and 2"x 4" mesh, PVC-coated welded-wire and t-posts set at 8 ft centers. These pens are designed to protect submersed and floating-leaved plants in water 18 to 36" deep. Construction specifications are given in Appendix A.

Cage and Planting Schematic

Zone C, Year I: Ring cages will be installed every 20 feet along the perimeter of the shallowest portion (top of slope) of this zone, roughly at (summer pool) depths of 0-6 inches. Following flooding to summer pool, each ring cage will be planted with an emergent plant species. In order to ascertain the need for protection in each wetland cell, unprotected plants of the same species will be planted on ten-foot centers with the ring cages. Table 1 provides the numbers of cages and plants per DFE wetland cell.

Table 1. Proposed numbers of protected plants (with ring cage) and unprotected plants (without ring cage) in DFE wetland cells planted during Year I.

Cell	Protected plants	Unprotected plants	Total plants
D	224	224	448
E	160	160	320
F	480	480	960
G	432	432	864
Total	1296	1296	2592

All plants will be mature transplants with well-developed root balls, grown in 4 to 6 inch pots at the LAERF. Plant installation (Appendix B) will be provided by contractors, with specific planting sites assigned by LAERF personnel. Plant species will include:

- **Flatstem spikerush, *Eleocharis macrostachya***
- **Squarestem spikerush, *E. quadrangulata***
- **Slender spikerush, *E. acicularis***
- **Bulltongue, *Sagittaria graminea***
- **Softstem bulrush, *Scirpus validus***
- **Waterpepper, *Polygonum hydropiperoides***
- **Arrowhead, *Sagittaria latifolia***
- **Tall burhead, *Echinodorus berteroi***
- **Pickerelweed, *Pontederia cordata***
- **Water hyssop, *Bacopa monnieri***
- **Bullsedge, *Carex lasiocarpa***

Zone C, Year II: In the event establishment of unprotected plants is hampered by herbivory during the Year I growing season, ring cages will be installed at sites previously planted but not protected. Each ring cage will be planted with the emergent plant species lost in Year I. In the event establishment of unprotected plants is not hampered by herbivory during the Year I growing season, additional unprotected plants will be installed to increase the rate of overall establishment in each wetland cell. Table 2 provides the numbers of protected or unprotected plants per DFE wetland cell required during Year II.

Table 2. Proposed numbers of protected plants (with ring cage) or unprotected plants (without ring cage) in DFE wetland cells planted during Year II.

Cell	Protected or unprotected plants
D	224
E	160
F	480
G	432
Total	1296

Zone D, Year I: Pens will be installed at sites selected by LAERF personnel, at (summer pool) depths of approximately 18". Following initial flooding to winter pool, each pen will be planted with groups of three individuals of five submersed plant species. Unprotected colonies of the same species will be planted in similar groupings at selected sites. Water will then be raised to summer pool over a four-week period to allow planting of ring cages. Table 3 provides the numbers of protected and unprotected submersed plants per DFE wetland cell required during Year I.

Table 3. Proposed numbers of protected colonies (with pens) and unprotected colonies (without pens) in DFE wetland cells planted during Year I.

Cell	Protected plantings	Unprotected plantings	Total colonies	Total plants (15 per colony)
D	12	13	25	375
E	6	6	12	180
F	15	15	30	450
G	9	8	17	255
Total	42	42	84	1260

All plants will be mature transplants with well-developed root balls, grown in 4-inch pots at the LAERF. Plant installation (Appendix B) will be provided by contractors, with specific planting sites assigned by LAERF personnel. Plant species will include:

American pondweed, *Potamogeton nodosus*
Illinois pondweed, *P. illinoensis*
Muskgrass, *Chara spp.*
Southern naiad, *Najas guadalupensis*
Water stargrass, *Heteranthera dubia*

Zone D, Year II: In the event establishment of unprotected plant colonies is hampered by herbivory during the Year I growing season, pens will be installed at sites previously planted but not protected. Each pen will be planted with the submersed species lost in Year I. In the event establishment of unprotected plant colonies is not hampered by herbivory during the Year I growing season, additional unprotected colonies will be installed to increase the rate of overall establishment in each wetland cell. Table 4 provides the numbers of protected or unprotected plants per DFE wetland cell required during Year II.

Table 4. Proposed numbers of protected colonies (with pens) or unprotected colonies (without pens) in DFE wetland cells planted during Year II.

Cell	Protected or unprotected colonies	Total plants (15 per colony)
D	13	195
E	6	90
F	15	225
G	8	120
Total	42	630

Moist Soil Management

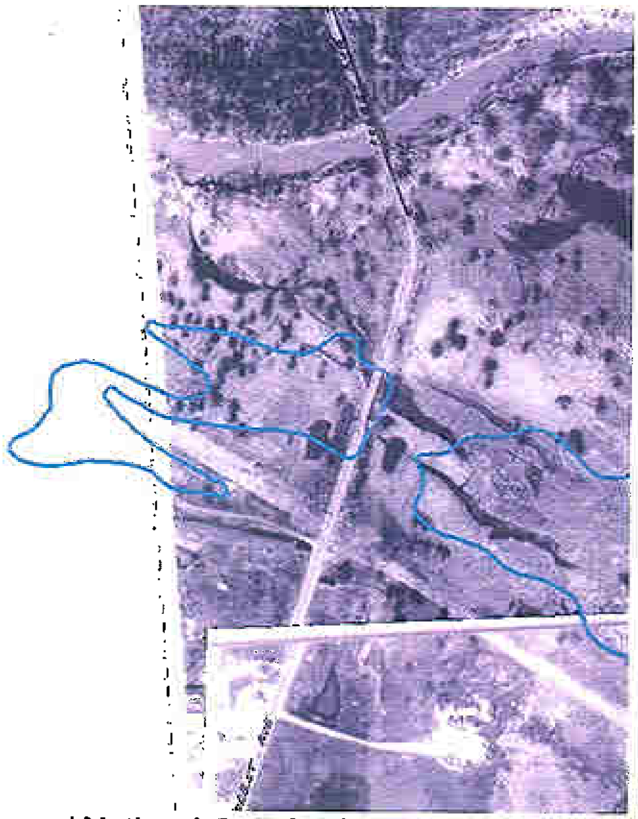
In order to develop waterfowl and other wildlife habitat in the DFE wetland cells, the system should be operated under a moist soil management regimen. Research conducted by Texas A&M water management specialists suggests the most productive moist soil management techniques for North Texas involves incomplete drawdowns conducted twice yearly (spring and fall). This technique provides a permanent pool of water (Zones C and D, Figure 1) in which submersed, floating-leaved, and many emergent species can survive as well as maximizing seed production by grasses, sedges and forbs in the moist soil areas (Zones A and B, Figure 1).

Higher species diversity in moist soil management areas is more beneficial to waterfowl and other wildlife. Greater diversity is maintained by scheduled drawdowns and mowing, both of which promote annual species (as opposed to perennial species) growth. Mowing will also prevent establishment of woody species (trees and shrubs) in the DFE managed areas.

In all likelihood, topsoil at the DFE excavation site possesses a seed bank that includes desirable grasses and forbs. Barnyard grasses (*Echinochloa* spp.), smartweeds (*Polygonum* spp.), panic grasses (*Panicum* spp.), and numerous sedges are common in North Texas seed banks. To ensure establishment of terrestrial and wetland species in Zones A and B, we will introduce seeds (in sediments) of North Texas annuals (terrestrial and wetland) including the genera *Amaranthus, Aster, Carex, Cyperus, Echinochloa, Eleocharis, Euphorbia, Panicum, Phyla, Polygonum, Sagittaria,* and *Setaria* during Year I.

Scheduled operations for DFE wetlands

1) **Early March** --- water should be lowered 1½ feet from winter pool, exposing Zones A and B but leaving zones C and D flooded (summer pool). Drawdowns should be conducted over a two-week period. This will promote germination of terrestrial and wetland annuals (Spring) in the moist soil areas.



Wetland Cell A 1949

Wetland Cell A 2001

Fifty-two Years Of Change In The Great Trinity Forest

TRINITY RIVER CORRIDOR PROJECT

SCALE 1:6000 or 1 INCH = 500 FEET

500 0 500 1000 1500 Feet

Map By: Bryan Klburn, June 2003

N W E S

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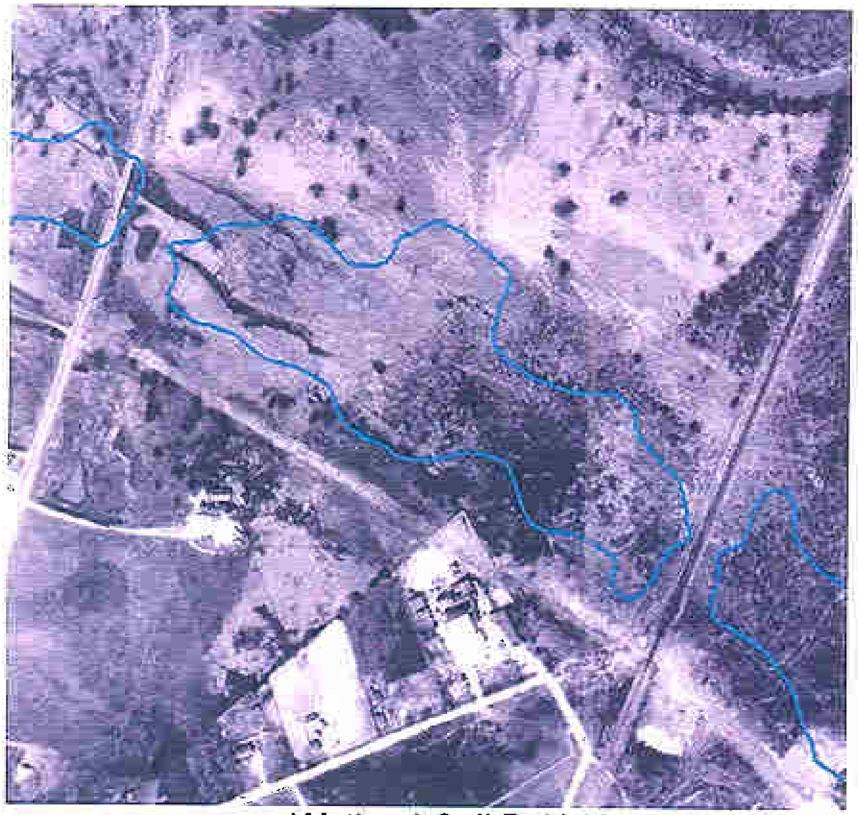
Wetland Cell B

- Due to historic and current illegal dumping and fill activities two distinct tree populations exist in Wetland Cell B
  - In the area on top of the fill, ash, box elder and mulberry are the dominant species
    - These species are also dominant in the understory throughout the cell
    - In the areas where ash and box elder are dominant there may be as many as 670, 4inch stems per acre and as many as 840 total trees per acre
  - In low lying areas with standing water along the edge of the filled areas, willow and cottonwood are the dominant species
    - In the areas where willow and cottonwood are dominant there are approximately 170 trees per acre
  - The mean/average diameter is 7.22 inches
- The majority of trees sampled do not meet the criteria for a protected tree under the City of Dallas Tree Ordinance
  - No hard mast producing trees were recorded inside the sample areas
- Dangerous conditions from the fill and water of unknown depths made it impossible to complete 7 samples



Wetland Cell B 1949

Wetland Cell B 2001

Fifty-two Years Of Change In The Great Trinity Forest

TRINITY RIVER CORRIDOR PROJECT

SCALE 1:6000 or 1 INCH = 500 FEET

500 0 500 1000 1500 Feet

N W E S

Map By: Bryan Klburn, June 2003

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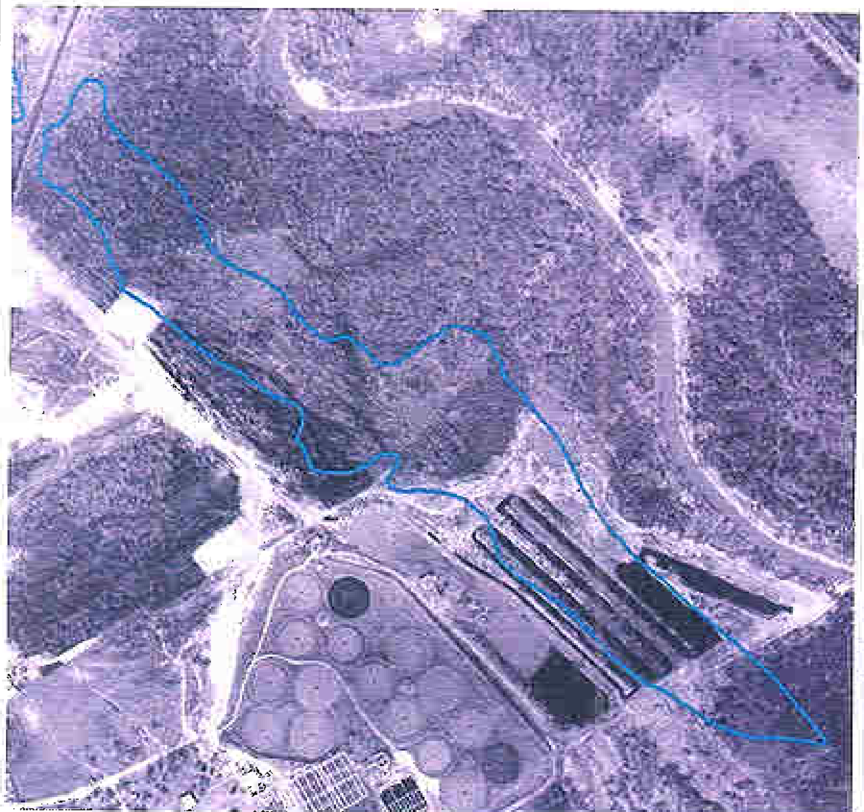
Wetland Cell C

- Water and the cap on an abandoned trench network for the Central Waste Water Treatment Plant are dominant features in Wetland Cell C
- Ash is the dominant species throughout the cell
  - Black willow, box elder, cottonwood, hackberry and mulberry are present as well
- There are approximately 420 trees per acre
  - The mean/average diameter is 7.75 inches
  - The majority of the trees sampled are again in the 4 to 6 inch diameter class
- The majority of trees sampled do not meet the criteria for a protected tree under the City of Dallas Tree Ordinance
  - No hard mast producing trees were recorded inside the sample areas



Wetland Cell C 1949

Wetland Cell C 2001

Fifty-two Years Of Change In The Great Trinity Forest

TRINITY RIVER CORRIDOR PROJECT

SCALE 1:7800 or 1 INCH = 650 FEET

650 0 650 1300 Feet

N W E S

Map By: Bryan Klburn, June 2003

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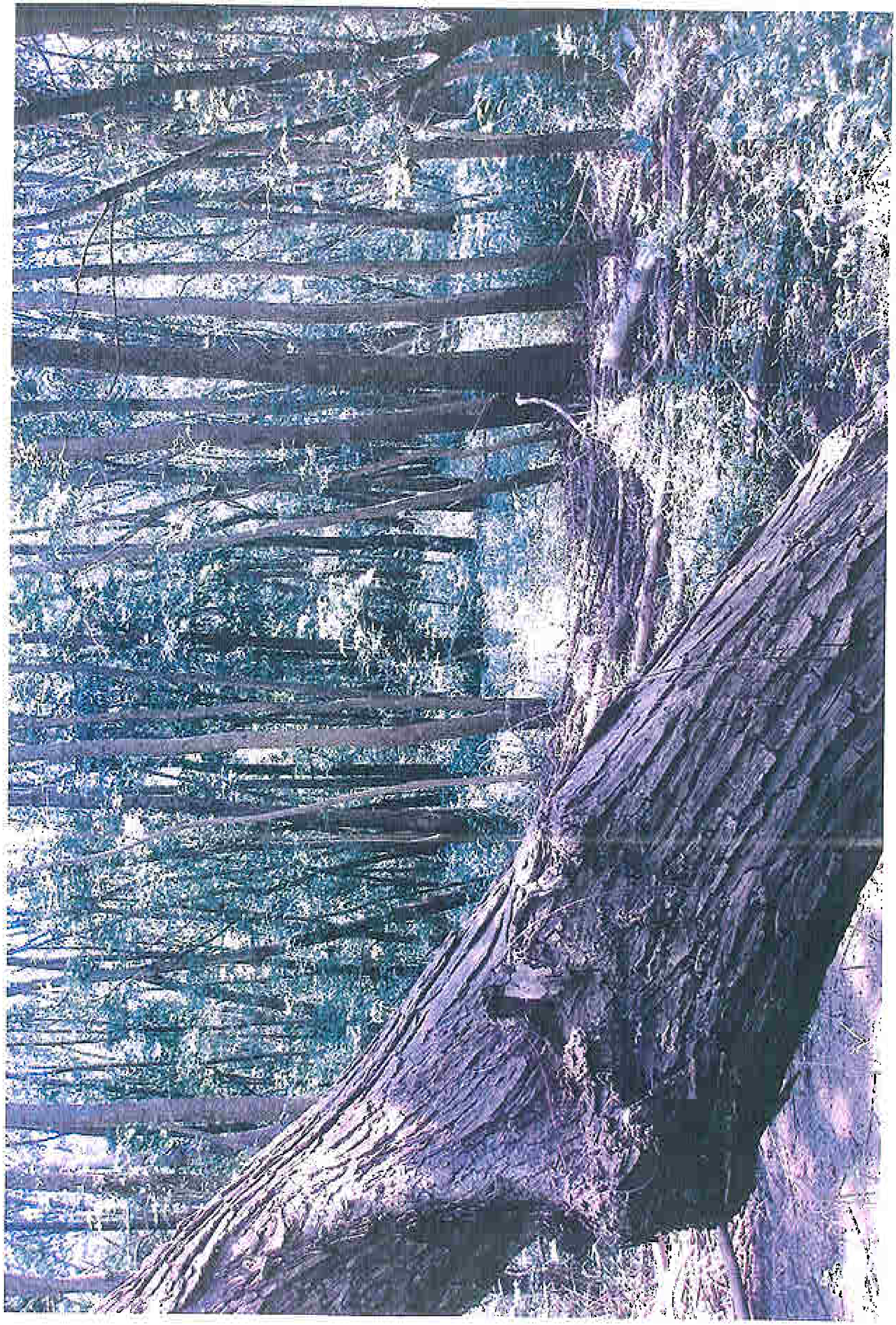

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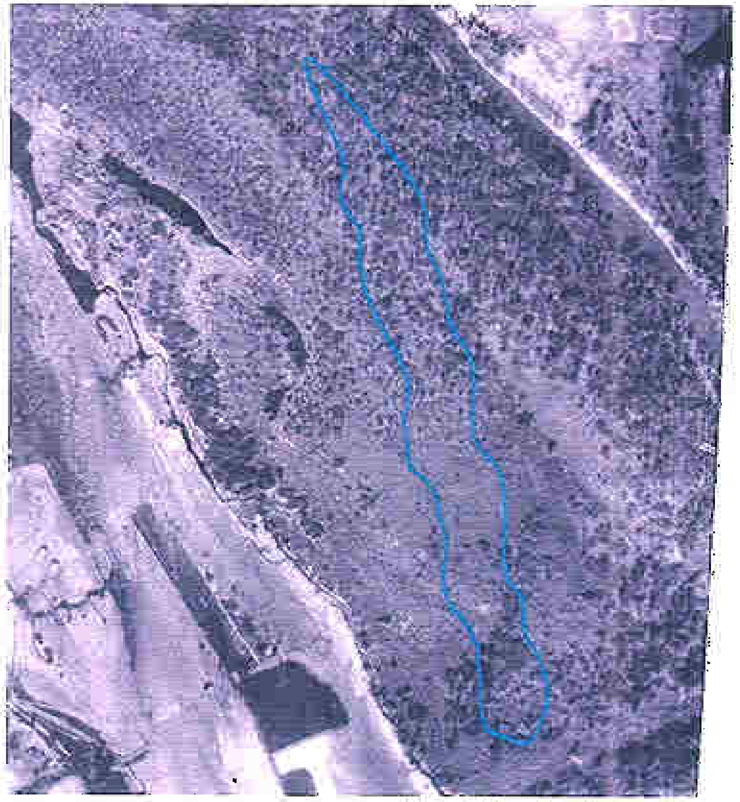
Wetland Cell D

- Wetland Cell D is predominantly swamp privet with a mix of green ash and boxelder
  - Historic dumping created and island of fill; on this island of fill cedar elm and Eastern redcedar are the dominant species
- There are approximately 226 trees per acre
  - The mean/average diameter is 8.08 inches
  - Nearly 70% of the trees to be removed are in the 4 inch diameter class
- The majority of trees sampled do not meet the criteria for a protected tree under the City of Dallas Tree Ordinance
  - No hard mast producing trees were recorded inside the sample areas



Wetland Cell D 1949

Wetland Cell D 2001

Fifty-two Years Of Change In The Great Trinity Forest

TRINITY RIVER CORRIDOR PROJECT

SCALE 1:6000 or 1 INCH = 500 FEET

500 0 500 1000 1500 Feet

N W E S

Map By: Bryan Klburn, June 2003

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