APPENDIX G
USFWS PLANNING AID REPORT (2014) AND FINAL COORDINATION ACT REPORT (2014)

PART I

U.S. FISH AND WILDLIFE SERVICE PLANNING AID REPORT

PART II

COORDINATION ACT REPORT

Note to Reader:

Coordination between the USACE and the USFWS that produced this Planning Aid Report was based on the Proposed Action as presented in the Draft EIS (published April 2014) and therefore reflects terminology used in the Draft EIS.

Following publication of the Draft EIS, the USACE determined that the impacts were too similar between the two action alternatives to warrant their analysis as separate alternatives. Therefore, the USACE changed the names and structure of the alternatives analyzed in the EIS to as follows. The Draft EIS "Alternative 2" is now known as "Alternative 2: Proposed Action design anticipating potential Trinity Parkway construction." Similarly, the Draft EIS "Alternative 3" is now known as "Alternative 2: Proposed Action design without potential Trinity Parkway construction."

The USFWS Planning Aid Report uses the Draft EIS "Alternative 2" and "Alternative 3" language as the Final EIS was produced after receipt of the Planning Aid Report. While the language and organization has been revised in the Final EIS, the analysis remains unchanged.

December 17, 2014

Final

U.S. FISH AND WILDLIFE SERVICE HABITAT CONDITIONS PLANNING AID REPORT FOR THE DALLAS FLOODWAY PROJECT DALLAS COUNTY, TEXAS

SEPTEMBER 2014

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EXECUTIVE SUMMARY

This planning aid report describes fish and wildlife resources within the Dallas Floodway Project study area in Dallas County, Texas. It is intended to assist the U.S. Army Corps of Engineers (USACE) in their planning efforts for the on-going Dallas Floodway Project Feasibility Study and associated Environmental Impact Statement (EIS). U.S. Fish and Wildlife Service (USFWS), Texas Parks and Wildlife Department (TPWD), and USACE personnel cooperated in collecting the habitat field data required to complete this report.

There are five habitat types within the ROI for biological resources: aquatic riverine (421 acres), bottomland hardwood (1,414 acres), emergent wetland (419 acres), grassland (4,283 acres), and open water (206 acres). The study area encompasses a total of 17,142 acres; 6,742 acres were evaluated for wildlife habitat suitability after excluding developed (urban) areas (urban areas total 10,400 acres). The study area includes three evaluation groups: Confluence, Mainstem, and Interior Drainage System (IDS).

The Dallas Floodway Project Proposed Action consists of flood risk management (FRM) elements; ecosystem restoration and recreation enhancements; and Interior Drainage Plan (IDP) improvements. As detailed in the USACE Feasibility Report (USACE 2013a), the USACE proposes to raise the levees to provide management of a 277,000 cubic-feet per second flood event and to modify the AT&SF Railroad Bridge. In addition, the City of Dallas plans to flatten the riverside levee side slopes from 3:1 to 4:1 for maintenance purposes. Proposed ecosystem restoration and recreation features would develop a mix of active, passive, urban and nature-based uses, which would include the development of shallow lakes, wetlands, and play fields. Lastly, the IDP consists of proposed improvements to the existing East and West Levee Interior Drainage Systems (EWLIDS). The objective of the IDP improvements is to reduce flood risk for areas served by the EWLIDS from the 100-year storm event. Implementation of the IDP would reduce the flood risk for structures located within the interior levee protected areas. Two action alternatives (Alternative 2 and Alternative 3) differ in the alignment of the proposed ecosystem restoration and recreation enhancements.

No federally listed threatened or endangered species are likely residents in the ROI; however, there is suitable habitat for special status species within the area. There is also potential for some special status birds species to transit the ROI, using the grassland, bottomland hardwood, wetland, and riverine habitats for resting and feeding during migration. There are 10 listed birds in the ROI; 5 are federally listed, 3 are federally delisted but remain state-listed, and all 10 are state-listed. Also, there are three state-listed mollusks and three state-listed reptiles in Dallas County that have a potential to occur in the ROI. Twenty species of birds listed as Birds of Conservation Concern by the USFWS may occur within the general vicinity of ROI.

The terrestrial data collected were analyzed using the USFWS *Habitat Evaluation Procedures* (HEP) to describe the various existing habitats in the study area. Spatial data depicting habitat cover maps utilized in the analysis and evaluation were provided by the Corps. The 2004 aquatic riverine fisheries and 2010 open water fisheries data were used to analyze aquatic riverine and open water habitat in the study area and are included in this report (Appendix G and I, respectively).

The Dallas Floodway – Trinity River watershed has been heavily impacted by urban development. Of the 68 HEP data sites, all have been somewhat impacted by development. However, there are still some valuable wildlife habitats remaining within the watershed. Under the Future Without Project Condition (FW/OPC), the majority of acreage that would be permanently impacted by already approved projects is average quality grassland habitat. Permanent impacts to aquatic habitat would be mitigated on a project-specific basis to offset impacts to quality and/or coverage. Common aquatic and terrestrial wildlife that occur within the area are likely to continue to occur in the area after the implementation of the FW/OPC. Riverine flood events under the FW/OPC would continue to have a variety of impacts, both beneficial and adverse.

As shown in Table ES-1, under both Alternative 2 and Alternative 3, habitat quality would increase as compared to the FW/OPC. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river. Emergent wetlands would have a small increase due to the creation of higher quality wetlands. The greatest decrease of habitat quality would be to grassland habitat.

Table ES-1. Comparison of Habitat Units at Year 50 for All Alternatives

Habitat Type	*Existing Conditions*	*FW/OPC*		*Alternative 2*		*Alternative 3*	
	HU	*HU*	*Difference*	*HU*	*Difference*	*HU*	*Difference*
Bottomland Hardwood	388.92	389.60	0.68	463.43	74.51	463.00	74.08
Emergent Wetland	97.53	94.48	-3.05	118.54	21.01	119.58	22.05
Grassland	2,309.00	2,227.24	-81.76	2,095.73	-213.27	2,073.98	-235.02
Aquatic Riverine	345.77	332.84	-12.93	444.85	99.08	444.85	99.08
Open Water	143.76	129.90	-13.86	341.25	197.49	341.25	197.49
Total	**3,285.98**	**3,174.06**	**-110.92**	**3,463.80**	**178.82**	**3,442.66**	**157.68**

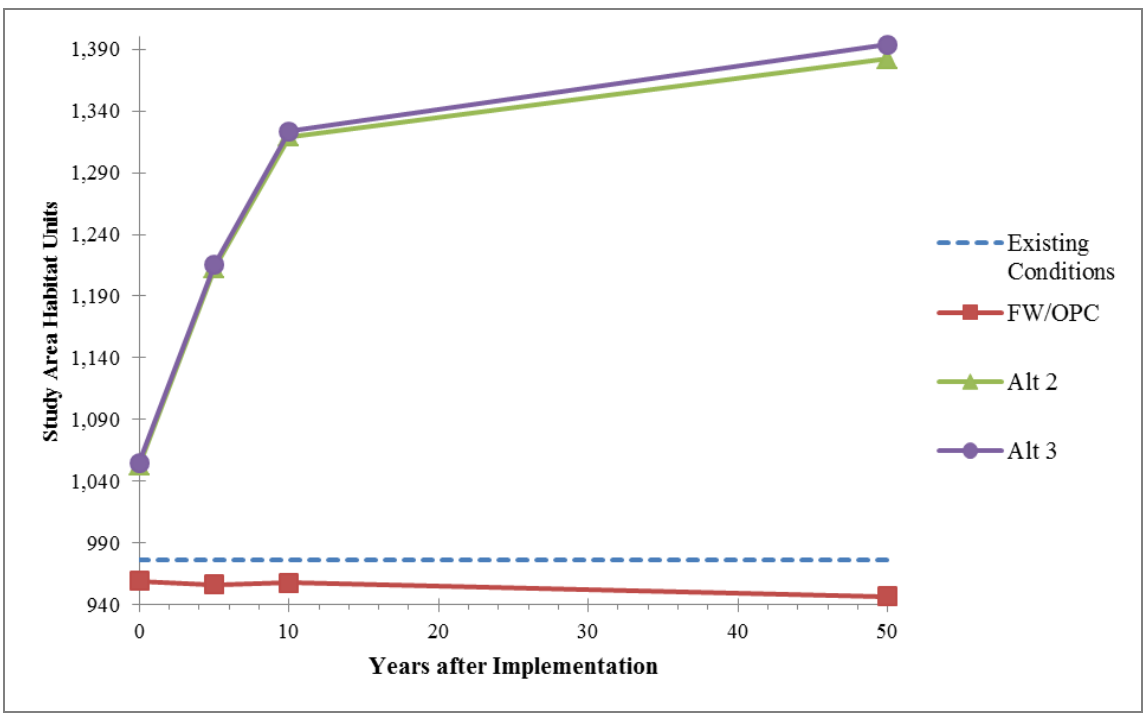
When the identified cumulative projects are included, habitat value (presented as Habitat Units [HU]) of sensitive habitat (including aquatic riverine, emergent wetland, bottomland hardwood and open water) would increase to above existing levels under Alternative 2 and 3, as compared to the FW/OPC (Table ES-2).

Table ES-2. Comparison of Cumulative Habitat Units at Year 50 for All Alternatives

Habitat Type	*Existing Conditions*	*FW/OPC*		*Alternative 2 Cumulative*		*Alternative 3 Cumulative*	
	HU	*HU*	*Difference*	*HU*	*Difference*	*HU*	*Difference*
Bottomland Hardwood	388.92	389.60	0.68	449.67	60.75	458.89	69.97
Emergent Wetland	97.53	94.48	-3.05	145.55	48.02	147.66	50.13
Grassland	2,309.00	2,227.24	-81.76	1,952.33	-356.67	1,982.68	-326.32
Aquatic Riverine	345.77	332.84	-12.93	445.75	99.98	445.75	99.98
Open Water	143.76	129.90	-13.86	341.25	197.49	341.25	197.49
Total	**3,285.98**	**3,174.06**	**-110.92**	**3,334.55**	**49.57**	**3,376.23**	**91.25**

All three alternatives would have significant short term impacts to habitat and the FW/OPC would result in a long term decrease in HUs. However, habitat improvements would develop over time under Alternatives 2 and 3. Chart ES-1 presents all the sensitive habitats HUs combined over time, with the cumulative projects. These HUs would increase the most from year 0 to 10 due to the rapid growth of most wetland and aquatic vegetation.

Chart ES-1. Change in Cumulative Combined Bottomland Hardwood, Emergent Wetland, Open Water, and Aquatic Riverine Habitat Units under All Alternatives



ACKNOWLEDGEMENTS

The Fort Worth District's Planning, Environmental, and Regulatory Division provided the USFWS the information necessary for completing this report. William K. Colbert, Environmental Planner with the Fort Worth District, assisted with field work, reviewed data, and provided essential information. Marcia Hackett, USACE Regional Technical Specialist and Dallas Floodway EIS Project Manager, also reviewed data and provided information critical to completing this document.

Several USFWS biologists assisted with this report. Carol Hale served as lead Biologist for this study between 2004 and 2006, organized and led the field work, and completed preliminary data computation. Contaminants Biologist Craig Giggleman was the lead for the IBI portion of this study. Fisheries Biologist and GIS specialist Jacob Lewis assisted with the IBI and with the GIS information provided by the USACE. Tom Cloud, Field Supervisor, reviewed and provided guidance necessary to complete this report. Sean Edwards, was the lead Biologist from 2008-present.

Tom Heger and Karen Hardin of TPWD assisted with field work and provided input on the habitat assessment and maps.

Dr. Mike Dungan, Melissa Tu, Erica Boulanger, and Shannon Brown of Cardno TEC provided support critical to completing this document.

NOTE TO READER

The associated U.S. Fish and Wildlife Service Coordination Act Report (see Feasibility Report Appendix G, Part II) references the previous version of this Planning Aid Report (PAR), the *Preliminary Final*, prepared in January 2014. No changes have been made from the *Preliminary Final* version to this *Final* version, other than changing the title from "*Preliminary Final*" to "*Final*."

Final

U.S. FISH AND WILDLIFE SERVICE HABITAT CONDITIONS PLANNING AID REPORT FOR THE DALLAS FLOODWAY PROJECT

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SEPTEMBER 2014

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CHAPTER 1
PROJECT OVERVIEW

1.1 INTRODUCTION

In November 2010, the U.S. Fish and Wildlife Service (USFWS) submitted the Habitat Conditions Planning Aid Report (PAR) for the Dallas Floodway Project (DFP), Dallas County, Texas to the U.S. Army Corps of Engineers (USACE) (2010 PAR). The 2010 PAR presented habitat conditions within the Region of Influence (ROI) for the Proposed Action as they existed in 2010. In addition, the 2010 PAR projected the future conditions within the ROI if the Proposed Action were not implemented. As part of that effort, the USFWS, in coordination with the USACE, compiled a list of planned projects within the ROI, and evaluated their respective impacts using Habitat Evaluation Procedures (USFWS 2010). However, since preparing the 2010 PAR, preliminary implementation of some projects and substantial delays in others result in the 2010 PAR no longer accurately representing the existing conditions. In addition, the species used to evaluate existing and predict future habitat conditions have also changed from those approved for use in 2010. This document includes all the applicable information from the 2010 PAR updated to better reflect existing conditions, as well as Chapters 4 through 8 which were not included in the 2010 PAR.

The PAR outline is provided below.

- Chapter 1
  - Project overview
  - Project Description
  - Study Area
  - Alternatives
- Chapter 2
  - Habitat Evaluation Methods
  - Habitat Descriptions
  - Threatened and Endangered Species
  - Recommendations
  - Summary
- Chapter 3 presents the impacts to habitats and habitat value from implementation of Alternative 1, Future Without Project Condition.
- Chapter 4 presents the impacts to habitats and habitat value from implementation of Alternative 2.
- Chapter 5 presents the impacts to habitats and habitat value from implementation of Alternative 3.
- Chapter 6 presents the impacts to habitats and habitat value from implementation of Alternative 2 and cumulative projects.

- Chapter 7 presents the impacts to habitats and habitat value from implementation of Alternative 3 and cumulative projects.

- Chapter 8 presents a summary of the different habitats and habitat value changes over time among Alternatives 1, 2, and 3.

- Chapter 9 presents the references.

1.2 PURPOSE/PROJECT DESCRIPTION

The purpose of the Proposed Action is to reduce flood risk through flood risk management (FRM), enhance ecosystems, and provide greater recreation opportunities within the Trinity River Corridor in Dallas, Texas. Implementation of the Proposed Action is needed to comply with Section 5141 of the Water Resources Development Act (WRDA) of 2007 authorization.

Flooding events on the Trinity River have historically caused loss of lives and damage to property and structures. The Dallas Floodway currently is estimated to provide FRM benefits associated with passage of a flood event with a 1500-year recurrence interval without overtopping. This flood event has an estimated peak flow of 245,000 cubic feet per second (cfs). The current estimated peak flow for the Standard Project Flood (SPF) event is 269,000 cfs. The predicted future SPF peak flow is 277,000 cfs; thus, the Dallas Floodway is currently not able to contain the current or predicted future SPF event. Current hydrologic and hydraulic (H&H) models predict higher water surface profiles for the Dallas Floodway levees as compared to those modeled in 1958 due to a number of changes that have occurred. Some of these changes include watershed development, land use changes, floodplain encroachments, updated design methodology, and improved modeling technology, as described below. Recent local severe rainfall events have also demonstrated that improvements are needed to reduce the risk of flooding of levee interior developments.

In addition, urbanization and past channelization and clearing of the Dallas Floodway have significantly degraded the natural terrestrial and aquatic habitat of the Dallas Floodway. The Trinity River now reflects little of its historic course, water quality, or habitat. Furthermore, the City of Dallas lacks sufficient recreational opportunities for citizens and visitors. There is inadequate access to the Dallas Floodway, and it is not perceived by the public as a desirable destination for recreation.

The Proposed Action consists of three major project components:

- **Balanced Vision Plan (BVP) Study Flood Risk Management (FRM)**. This element includes implementing actions to provide FRM for the 277,000 cubic feet per second (cfs) riverine flood event (the Standard Project Flood). Elements include raising and flattening the levees, modifying the AT&SF Railroad Bridge, removing an embankment, and enacting non-structural improvements.

- **BVP Study Ecosystem Restoration and Recreation Enhancements**. This element includes the development of three lakes, modification to the Trinity River course, construction of approximately 300 acres of new wetlands, construction of 115 acres of groomed athletic fields, and general elements to improve safety and access to the larger BVP Study elements.

- **Interior Drainage Plan (IDP) Improvements**. The IDP improvements consist of improvements to the existing Charlie, Delta, and Hampton, pump stations, construction of a new Trinity-Portland Pump Station, and restoration of sump capacity to provide protection against the one percent chance (100-year) event. These features are defined in the report prepared by the City of Dallas entitled *The Interior Levee Drainage Study Phase-I Report, Dallas, Texas*, dated September 2006 and *The Interior Levee Drainage Study Phase-II Report, Dallas, Texas*, dated January 2009.

This document analyzes the potential comprehensive environmental consequences resulting from the implementation of the Proposed Action. Major elements of the Proposed Action are summarized in Table 1-1.

Table 1-1. Proposed Action Project Elements

Category	*Descriptive Element*
BVP Study Flood Risk Management	
Levees	Raise to 277,000 cfs Flood Height
AT&SF Railroad Bridge	Removal of Wood Bridge Segment
	Removal of Concrete Bridge Segment
	Removal of Embankment Segments
Santa Fe Trestle Trail	Embankment Removal
Levee Widening	Side Slopes at 4:1 Ratio
Nonstructural Flood Control Improvements	Emergency Response
	Public Awareness/Education
	Flood Forecasting
	Warning Systems
BVP Study Ecosystem and Recreation	
Lakes	West Dallas Lake
	Urban Lake
	Natural Lake
River	Realignment and Modification
Wetlands	Marshlands
	Cypress Ponds
	Corinth Wetlands
Athletic Facilities	Potential Flex Fields
	Playgrounds
	River Access Points

General Features	Parking and Public Roads
	Lighting
	Vehicular Access
	Pedestrian Amenities (Trails, Boardwalks, and Sidewalks)
	Restrooms
Interior Drainage Outfall Modifications	Pump Station Outfalls
	Pressure Sewer Outfalls
Interior Drainage Plan	
East Levee	Construct New Hampton Pump Station
	Nobles Branch Sump Improvements
	East Levee Sump Improvements
West Levee	Demolish Charlie Pump Station
	Construct New Charlie Pump Station
	Rehabilitate Existing Delta Pump Station
	Construct New Delta Pumping Station
	Eagle Ford and Trinity-Portland Sump Improvements
	Construct New Trinity-Portland Pumping Plant

1.3 STUDY AREA

1.3.1 Location

An environmental study area was delineated cooperatively by the USACE and the USFWS for use in this PAR. Spatial GIS data provided by the USACE indicate that the study area encompasses 17,142 acres in Dallas County, Texas within the Trinity River Basin (Figure 1). The study area assessed within this document generally equates to the extent of the Federal Emergency Management Agency (FEMA) predicted 500-year riverine flood event.

1.3.2 Dallas Floodway Levee System

The existing Dallas Floodway Levee System, authorized in 1945, extends along the Trinity River upstream from the Atchison, Topeka and Santa Fe (AT&SF) Railroad Bridge at Trinity River Mile (RM) 497.37, to the confluence of the West and Elm Forks at RM 505.50, thence upstream along the West Fork for 2.2 miles and upstream along the Elm Fork approximately 4 miles. Of the 22.6 miles of levees within this reach, the East Levee is 11.7 miles in length and the West Levee is 10.9 miles in length. In addition to the levees, the floodway includes a modified river channel and structures including seven pumping plants, five pressure conduits, and seven drainage structures. Construction of the existing Dallas Floodway Levee System was completed in 1959.

U.S. Fish & Wildlife Service

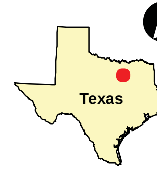
Arlington, Texas, Ecological Services Field Office

Projection: UTM Zone 14N, NAD 1983, GRS 1980

Production Date: 5/12/2010

0 0.25 0.5 1 Miles

0 0.25 0.5 1 Kilometers



● HEP Sites

▭ Study Area

Figure 1. Dallas Floodway Study Area with HEP Sites

1.3.3 Climate, Topography, and Ecology

The climate of Dallas County is moderate humid subtropical with hot summers and mild winters, with an occasional front of extremely cold temperatures. The average low and high temperatures range from 36 °F in January to 96 °F in July. The lowest minimum recorded temperature is 1 °F in 1989 and the highest maximum 112 °F in 1980. Annual precipitation within the City averages 33.7 inches per year. The terrain consists of rolling hills ranging from 380 to 490 feet (115 to 150 meters) in elevation, generally sloping to the east and southeast.

The study area is located in the Blackland Prairie ecological area of Texas (Gould 1962) and is within the identically-named Blackland Prairie natural vegetation area (Diggs et al. 1999). Historically, the area was predominantly tall grass prairie with trees along watercourses, sometimes scattered on the prairie or concentrated in certain areas possibly as a result of locally favorable soil conditions or topography. Fire was probably an important factor in maintenance of the original prairie vegetation and had a major impact on the community structure (Strickland & Fox 1993). Tall grass prairie fires, intensely hot, would have been stopped only by the lack of dry fuel or a change in topography. Even stream bank vegetation was susceptible during dry years. The end result was that trees were rare even along some stream banks, and prairie margins probably extended somewhat beyond the limits of the soil types usually associated with prairie (Hayward & Yelderman 1991). There is considerable variation in the tall grass prairie communities of the Blackland Prairie (Diamond & Smeins 1993) and disagreement about specific community types (Simpson & Pease 1995). However, common dominant grasses of this tall grass prairie ecosystem include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), eastern gamagrass (*Tripsacum dactyloides*), tall dropseed (*Sporobolus compositus*), Texas cupgrass (*Eriochloa sericea*), Florida paspalum (*Paspalum floridanum*), and long-spike tridens (*Tridens strictus*) (Collins et al. 1975). As a whole, most of the Blackland Prairie is a complex mosaic of tall grass communities; an example of this can be seen in northern Grayson County where four of the community types discussed above can be seen within a few miles (Diggs et al. 1999).

With the exception of preserves, small remnants, or native hay meadows, almost nothing remains of the original Blackland Prairie communities. Conversion of the Blackland Prairie for agriculture was the most significant cause of the destruction of this ecosystem, with only marginal, steeply sloped land not rapidly brought under cultivation. High prices for cotton and grains eventually resulted in the cultivation of these areas as well. Once stripped of protective grass, these areas eroded rapidly with disastrous effects. Given the relatively high rainfall and continuing suppression of fire by humans, native trees and shrubs (e.g. eastern red cedar [*Juniperus virginiana*] and cedar elm [*Ulmus crassifolia*]), as well as introduced species, are able to invade and eventually take over areas that were formerly prairie (Diggs et al. 1999).

Five habitat types were mapped and evaluated in the study area and include bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water. The five habitat types will be discussed in more detail in Chapter 2.

Soil-types within the study area are composed largely of the Trinity-Frio, Eddy-Stephen-Austin, Silawa-Silstid-Bastsil, and Austin-Houston Black representing the Tallgrass Prairie Community of soils associated with floodplains, stream terraces, and uplands along this portion of the Trinity River floodplain. This community is characterized by deeper soils underlain at rather shallow depths by dense, hard, clayey material. This “claypan” restricts air and water movements, as well as root penetration. It is typically dominated by warm-season, perennial tallgrasses, with warm-season, perennial midgrasses filling most of the remaining species composition. The warm-season, perennial forb component varies between 5 and 15 percent depending on climatic patterns and local precipitation. Historically, woody species made up a minor component of the community, 5 percent or less (U.S. Department of Agriculture 2009). The tree species noted most often in the study area during data collection were cottonwood (*Populus deltoides*), pecan (*Carya illinoinensis*), black willow (*Salix nigra*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanica*), cedar elm, red mulberry (*Morus rubra*), and bur oak (*Quercus macrocarpa*). Although development has brought upland characteristics to portions of the study area nearest the river, historically more of it was likely dominated by bottomland hardwood forest.

The study area is used by both resident and migratory wildlife species that are tolerant of human activity. Small mammals and migratory and resident passerines use the wooded areas along the forks, Mainstem, and tributaries of the river for nesting, foraging, and as a dispersion corridor. The intact woodlands downstream of the study area are most likely used by a variety of migratory and resident passerine, owl, and hawk species that may disperse upstream. Some common resident bird species that may be observed in the study area are sparrows (various species), northern mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), common grackle (*Quiscalus quiscula*), scissor-tailed flycatcher (*Tyrannus forficatus*), barred owl (*Strix varia*), common crow (*Corvus brachyrhynchos*), American kestrel (*Falco sparverius*), Carolina chickadee (*Parus carolinensis*), and red-tailed hawk (*Buteo jamaicensis*). Mammal species that may utilize appropriate habitats in the study area include raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), eastern cottontail (*Sylvilagus floridanus*), fox squirrel (*Sciurus niger*), and small rodents. Various species of frogs and turtles may be found in less impacted reaches of the river, while lizards and snakes may also persist in viable terrestrial areas within the study area. A list of floral and faunal species that were observed during field investigations in the study area is included on each site observation sheet in Appendix A. Fish species within the study area are discussed in the aquatics and open water reports that were submitted to the USACE in 2004 and 2010 and are included in Appendix G and I, respectively.

1.4 ALTERNATIVES

The potential Trinity Parkway project is currently undergoing NEPA review in a separate EIS lead by the Federal Highway Administration (FHWA). This process includes a review of several alternative alignments, as well as the No-Action Alternative. While the potential Trinity Parkway analysis continues, the City of Dallas has taken steps to develop preliminary designs for the BVP Study features. Recognizing the alternative review process inherent in NEPA, the City of Dallas has initiated preliminary design of two different versions of the BVP Study Ecosystem and Recreation features. The first scenario, presented as Alternative 2, considers the implementation and alignment of the Proposed Action if the Trinity Parkway is constructed within the Dallas Floodway. The second scenario, captured in Alternative 3, considers the implementation of the Proposed Action if the Trinity Parkway is not constructed within the Dallas Floodway.

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CHAPTER 2
EXISTING HABITATS AND WILDLIFE RESOURCES

2.1 HABITAT EVALUATION METHODS

2.1.1 Bottomland Hardwood, Emergent Wetland, and Grassland

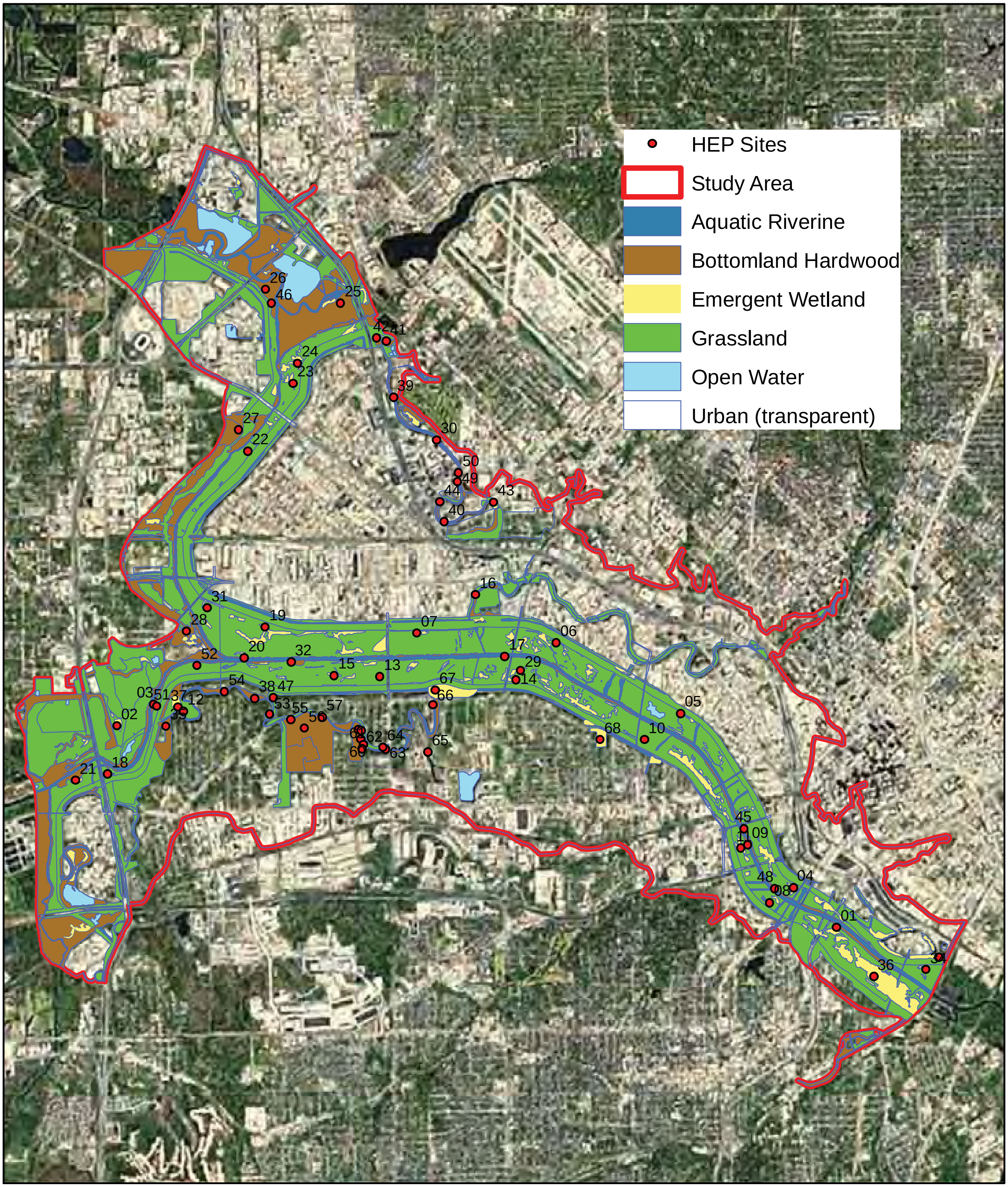
An interagency team composed of USACE, TPWD, and USFWS personnel was convened to conduct a habitat evaluation of the study area. The USFWS's *Habitat Evaluation Procedures* (HEP) (USFWS 1980) were used to analyze and describe the various existing habitats in the study area.

The interagency team comprised of biologists, collected field data on August 30 – September 1, 2004; October 12 – 14, 2005; and April 25, 2006. Data were also used for several of the HEP sites that were collected on May 5, 1999, while the USFWS was conducting another study. Sixty-eight survey sites were randomly selected within the three terrestrial habitat types in the study area: bottomland hardwoods, grasslands, and emergent wetlands. Figure 1 displays the locations of the data sites that were recorded using a Trimble GeoXT handheld unit. These sites are also depicted on aerial maps in Appendix E and their geographical locations are listed in Appendix F. The USACE and Cardno TEC provided spatial data used to analyze and evaluate habitat cover. The habitat cover is provided in Figure 2. Figure 3 presents the evaluation groups which will be discussed in the next section (Habitat Descriptions and Suitability Index Values).

Six different wildlife indicator species were selected to represent the wildlife communities that use the three habitats evaluated. The fox squirrel, barred owl, and wood duck (*Aix sponsa*) were selected to represent those species that use bottomland hardwoods. Species selected for emergent wetland habitat suitability evaluation include the American coot (*Fulica americana*), and wood duck. The eastern meadowlark (*Sturnella magna*), and eastern cottontail were selected to represent the wildlife communities in grasslands.

HEP requires the use of Habitat Suitability Index (HSI) models developed for each indicator species that best represent groups of species that use the habitats. The HEP models contain a list of structural habitat composition variables that are contained in optimum habitat. All variables for each species representing each habitat are compiled and measured in the field (Appendix C). Twenty-one variables were compiled for the bottomland hardwoods (Appendix C-1). There were 11 grassland habitat variables (Appendix C-2), and 14 emergent wetland variables (Appendix C-3). These variables were measured or estimated to a tenth of an acre data site within the habitat they represent. Habitat variables are used to provide a quantifiable value of habitat suitability.

Baseline habitat conditions are expressed as a numeric function (HSI value) ranging from 0.0 to 1.0, where 0.0 represents no suitable habitat for an indicator species and 1.0 represents optimum conditions for the species. HSI values ranging from 0.01 to 0.24 are considered "poor" habitat, 0.25 to 0.49 are considered "below average" habitat, 0.50 to 0.69 are "average" habitat, 0.70 to 0.89 are "good" habitat, and 0.90 to 1.00 are considered "excellent" habitat. Habitat Units (HU) are calculated by multiplying the HSI for each habitat by the amount of acres of the same habitat.



U.S. Fish & Wildlife Service

Arlington, Texas, Ecological Services Field Office

Projection: UTM Zone 14N, NAD 1983, GRS 1980

Production Date: 5/12/2010

0 0.25 0.5 1 Miles

0 0.25 0.5 1 Kilometers

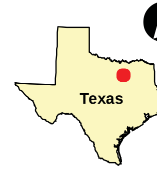
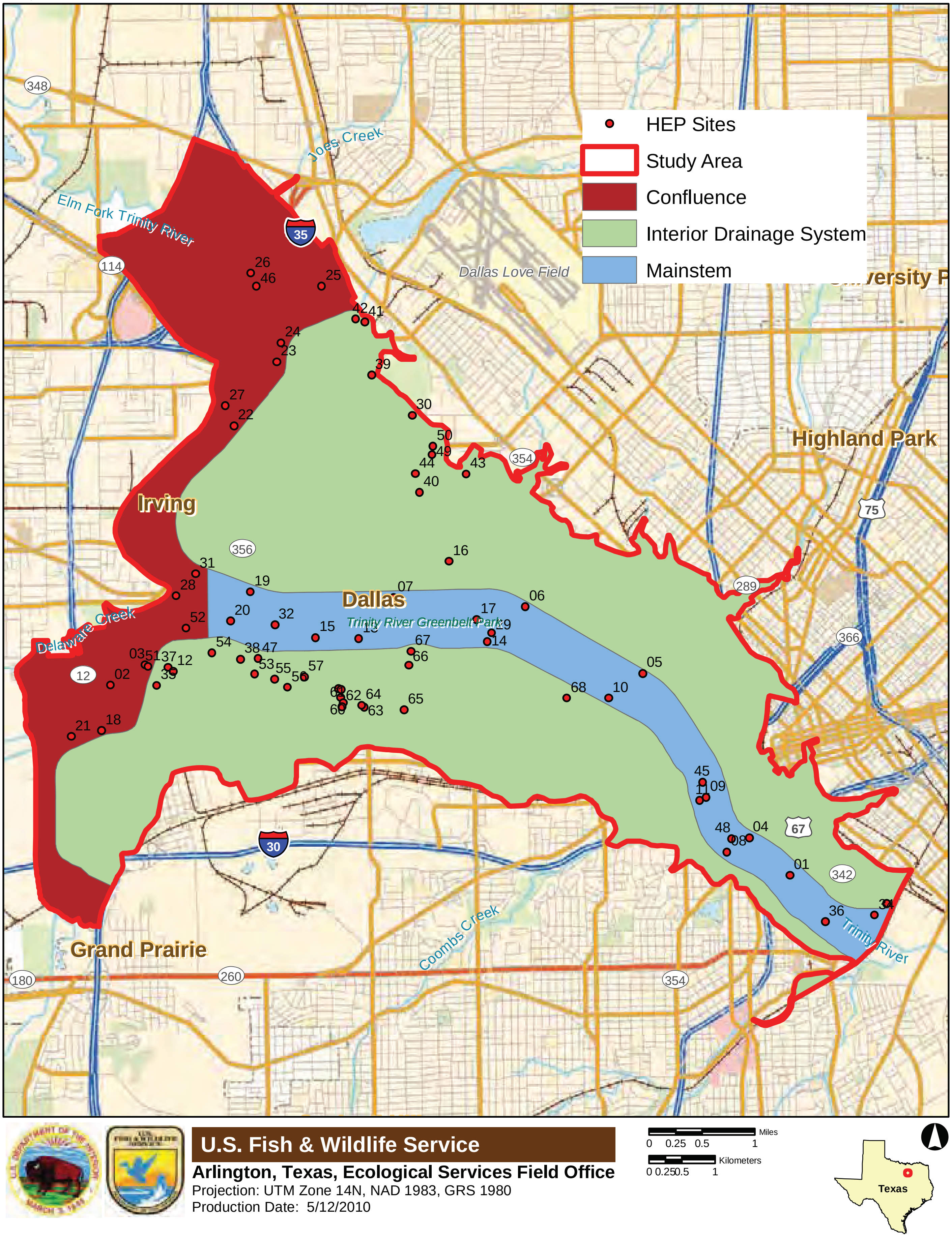


Figure 2. Dallas Floodway Study Area Cover Types



U.S. Fish & Wildlife Service

Arlington, Texas, Ecological Services Field Office

Projection: UTM Zone 14N, NAD 1983, GRS 1980

Production Date: 5/12/2010

Figure 3. Dallas Floodway Evaluation Areas

A complete list of plant species observed during the surveys is included in Appendix A. Appendix B includes the individual site observation sheets that contain a physical description of each site and a list of plants and animals observed at the site. Appendix D contains photographs taken in each compass direction from the center of each survey site.

2.1.2 Habitat Suitability Index Models

This 2014 PAR uses HSI models to quantify current and future habitat values under different alternatives in terms of HU. HUs are calculated by multiplying habitat acreage by the HSI. Table 2-1 identifies the indicator species used for this analysis by applicable habitat type. The HSI models for the indicator species are available in the References, Chapter 9 (USFWS 1982a, 1982b, 1983, 1984, 1985, 1987). A summary of the approved models is available here:

http://www.nwrc.usgs.gov/wdb/pub/hsi/USGS-BRD-ITR_1997-0005.pdf (USGS 1997).

Table 2-1 Indicator Species Used by Habitat Type

Habitat Type	*Species Used*
Bottomland Hardwood	Fox Squirrel
	Barred Owl
	Wood Duck
Emergent Wetland	Wood Duck
	American Coot
Grassland	Eastern Meadowlark
	Eastern Cottontail

2.1.3 Aquatic Riverine

The USFWS and the TPWD conducted a fisheries survey on the Trinity River in Dallas County, Texas from August 30 – September 1, 2004, during summer low flow conditions. The purpose of the survey was to determine baseline fish-community structure within the area of the Trinity River that could be potentially impacted by stream modifications, development, and/or construction activities associated with the proposed Dallas Flood Control Project. Data resulting from the survey were also qualitatively compared to previous fisheries studies conducted within this portion of the Trinity River to evaluate fish community trends within the proposed project area. In addition, 25 fish collected during the survey were retained for chemical analyses to qualitatively assess current contaminant levels in fish within the proposed project area. The results and recommendations from the survey are contained in the USFWS's report, *Assessment of Trinity River Fisheries within the Proposed Dallas Flood Control Project Area, Dallas County*, *Texas* (USFWS 2004) and are included as Appendix G.

Based on the 2004 Trinity River assessment, HSI and HUs were determined for the aquatic riverine habitat within the three evaluation groups in the study area, Confluence, Mainstem, and Interior Drainage System (IDS) (USFWS 2004). During the 2004 assessment, four reaches of the Trinity River were surveyed and are depicted in Figure 4. To assess the index of biotic integrity (IBI) scores and HSI values by habitat groupings (i.e., Mainstem, Confluence, and IDS), the Trinity River Basin Specific IBI scores were recalculated with reaches 1 and 2 representing the Mainstem and reaches 3 and 4 representing the Confluence. Reach 1, the lower reach of the Mainstem, had the lowest HSI of the four reaches and was determined to be the most similar of the four reaches to the IDS. The IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, thus it is expected to have a lower HSI than the rest of the River. The conversion of IBI values into HSI values does not reveal aquatic habitat suitability based upon measured habitat features. Rather, inferences may be made regarding aquatic habitat suitability and the aforementioned ranges (poor to excellent) correspond reasonably. This report is included as Appendix H.

2.1.4 Open Water

A fisheries survey was conducted on open water systems within the Trinity River floodway in Dallas County, Texas, on June 16, 2010, by the USFWS and USACE, with technical assistance provided by the TPWD. Another survey was conducted by USACE Fort Worth District and Lewisville Aquatic Ecosystem Restoration Facility (LAERF) personnel in summer 2009 (see Appendix I) (USACE 2010). The purpose of the surveys was to determine baseline fish-community structure for open-water habitat features within the Trinity River floodplain that could be potentially impacted by development and/or construction activities associated with the proposed Dallas Floodway Project. Data resulting from the surveys would be used to quantify existing open water habitat conditions, so that future with and without project fish community trends, impacts, and benefits can be assessed and compared. Surveys of existing fish communities within the Trinity River floodplain would help forecast the fish species that will likely inhabit the proposed Natural, Urban, and West Dallas lakes that are currently being proposed for implementation as part of the City of Dallas's Balanced Vision Plan (BVP) to be analyzed in the EIS.

To identify the survey sites within the Trinity River floodplain for the open water survey, seven individual screening criteria were used to identify water bodies that would be similar to the proposed Natural, Urban, and West Dallas lakes: (1) Located within the Trinity River floodplain; (2) No permanent connection to a tributary or other water source; (3) Provide water throughout the year; (4) Inundation by the Trinity River from a 0.5 to 2 year event; (5) Have a maximum depth less than 12 feet; (6) Range in size from 5 to 100 acres; and (7) Provide aquatic vegetation within the littoral zone of the water body. Six open water systems were identified that met the initial screening criteria: Crow Lake, Little Lemon Lake, Bart Simpson Lake, John Wiley Price Lake, Big Lemon Lake, and wetland cell D of the Dallas Floodway Extension (DFE) project. Of the six identified sites, three were surveyed: Crow Lake, Bart Simpson Lake, and wetland cell D of the DFE project and are shown on Figure 4. Based on the survey results from the three sites, HSI values for open water habitat were determined. This report is included as Appendix I.

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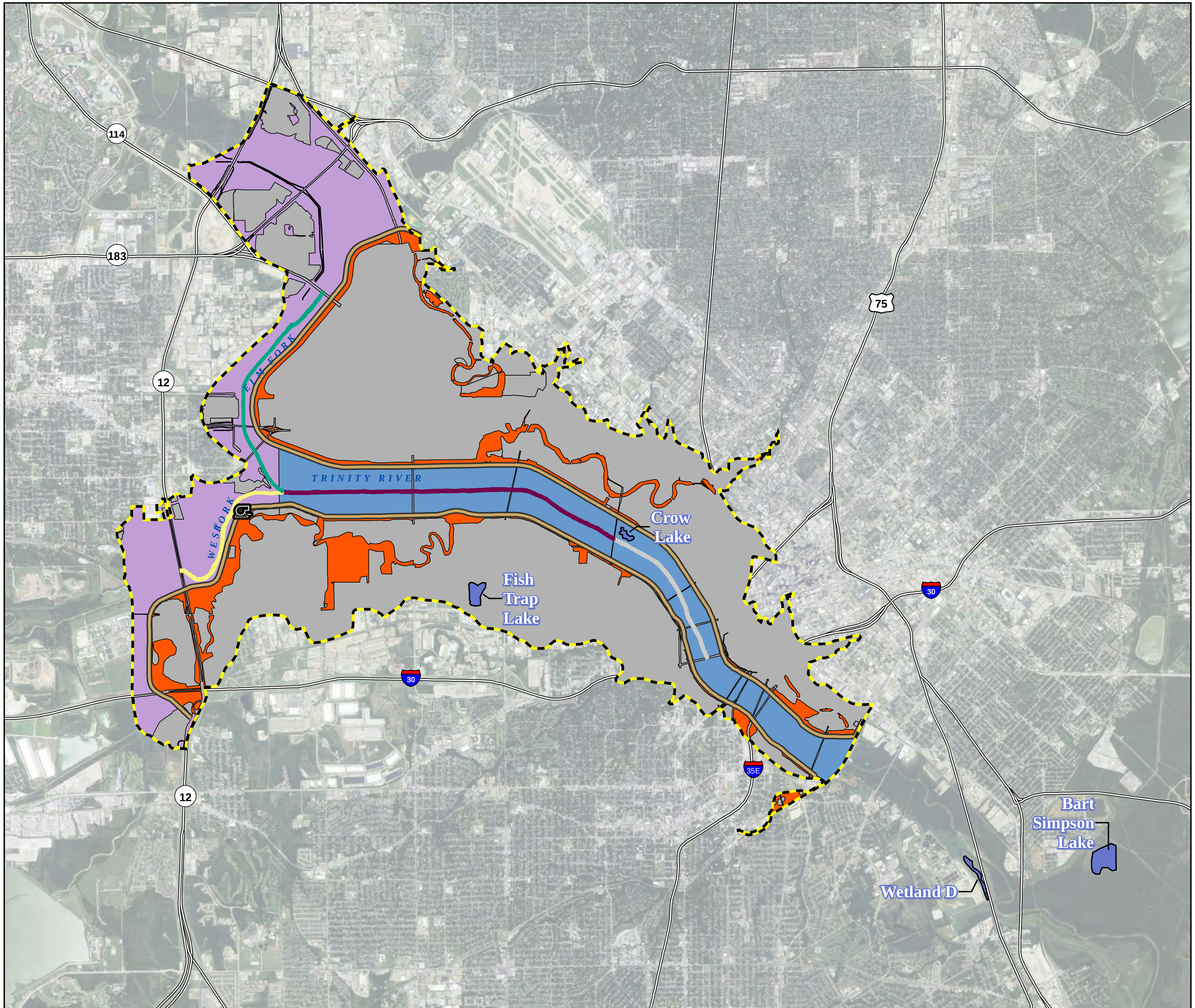


Figure 4
Aquatic Riverine and Open Water Assessment Areas and Evaluation Groups in the Dallas Floodway Study Area

LEGEND

ROI

Aquatic Riverine Survey Sites

- Reach 1
- Reach 2
- Reach 3
- Reach 4

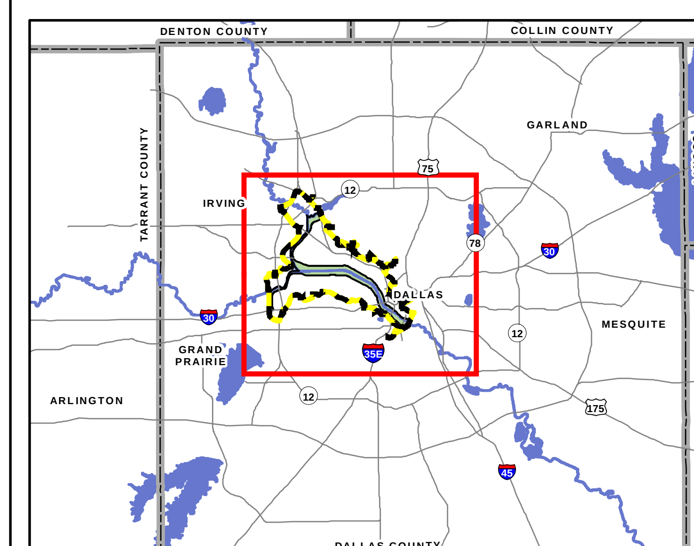
Evaluation Groups

- Confluence
- Mainstem
- Interior Drainage System

Open Water Survey Site

Dallas Floodway Levee

Freeway



0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

GIS Sources: City of Dallas 2008a, NCTCOG 2008, USACE 2013b, USFWS 2006

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2.2 HABITAT DESCRIPTIONS AND SUITABILITY INDEX VALUES

The study area was divided into three evaluation groups: the Confluence, IDS, and Mainstem (refer to Figure 3). Each of these areas is expected to be impacted in different ways by the project and was independently analyzed for habitat suitability in order to assess possible differences in their existing conditions. Existing habitat conditions across these groupings also vary due to differences in topography and past impacts. This targeted approach is intended to better illustrate the likely impact of project alternatives on habitat values within the differing groups.

The project's study area, which roughly corresponds to the FEMA 500-year flood event level, contains 10,400 acres (61 percent of the study area) of urban development and roads. Three wildlife habitat types evaluated for the HEP within the study area include bottomland hardwoods, grasslands, and herbaceous wetlands. The two aquatic habitat types, aquatic riverine and open water, were evaluated separately (see Appendices G through I). The HSI values for bottomland hardwood, emergent wetland, and grassland habitat within the study area ranged from 0.21 (poor) for bottomland hardwoods within the Dallas Floodway evaluation area to 0.70 (good) for both emergent wetlands in the Confluence evaluation area and grasslands within the IDS evaluation area. The HSI values for aquatic riverine and open water ranged from 0.65 (average) for open water in the IDS to 0.90 (excellent) for aquatic riverine in the Confluence.

The following findings and tables contain the HSI for the five habitats per evaluation group per species or survey site and a summary table of the existing habitat acres, HSIs, and HU for each habitat type. Planning recommendations for these habitats are included at the end of this chapter.

2.2.1 Bottomland Hardwood

The HEP defines the bottomland hardwood cover type as wetland areas dominated by deciduous trees, usually along streams, and that are occasionally flooded. In optimum conditions, this cover type provides food, cover, nesting habitat, and living space to riparian forest dependent species. Large trees provide important nesting habitat for the fox squirrel, wood duck, and barred owl, and escape cover for raccoons, wood ducks, and passerines. Large mast producing trees and shrubs provide food for the fox squirrel. Brush piles and snags provide necessary food, cover, and shelter for the raccoon and passerines. The close proximity to water is important for the raccoon and wood duck. Riparian forest habitats are essential in maintaining biodiversity and providing important wildlife travel corridors.

Located primarily along the Trinity River and its inflows, many of these woodlands are periodically flooded and are predominately composed of cottonwood, cedar elm, green ash, pecan, black willow, and box elder. Other trees species present include bur oak, red mulberry, and sugar hackberry.

There are four bottomland hardwood data sites in the Confluence area: Sites 3, 25, 26, and 27. There are thirteen bottomland hardwood data sites in the IDS area: Sites 16, 35, 38, 39, 40, 44, 54, 55, 57, 58, 59, 60, and 66. There are seven bottomland hardwood data sites in the Mainstem area: Sites 1, 9, 17, 20, 32, 45, and 48. Bottomland hardwoods in the Confluence and Mainstem were valued as poor habitat (0-0.24). Those in the IDS were valued as below average habitat (0.25-0.49) (Tables 2-2 and 2-3). The majority of the bottomland hardwood habitat in the study area is in the Confluence (Table 2-3).

Table 2-2. Existing HSI Values for Bottomland Hardwood Habitat per Indicator Species

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Barred Owl	0.31	0.54	0.26
Wood Duck	0.29	0.16	0.11
Fox Squirrel	0.13	0.46	0.28
HSI Average	0.24	0.39	0.21

Table 2-3. Existing Acres, HSI Values, and Habitat Units for Bottomland Hardwood

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	966.49	0.24	231.96
IDS	351.50	0.39	137.09
Mainstem	94.64	0.21	19.87
Total	1,412.63	N/A	388.92

The limiting factors for bottomland hardwood habitat for the three evaluation groups were similar and are listed below.

- Minimal winter and brood cover along the banks for the wood duck.
- Minimal winter food (hard mast producing vegetation) available for the fox squirrel.
- The overstory trees are generally too small to provide nest sites for barred owl.
- Available trees provide minimal nesting opportunities for wood duck (IDS and Mainstem).

2.2.2 Emergent Wetland

Herbaceous emergent wetlands are wetland areas dominated by non-woody vegetation. Wetlands provide food and cover for fish, resident and migratory birds, small mammals, invertebrates, and the predators that feed on these species. Wetlands are important nesting habitat for wading birds and waterfowl and are comprised primarily of rushes, sedges, wetland grasses, and aquatic plants located along the edges of water bodies and creeks, and in seasonally flooded areas. Some of the wetlands evaluated are permanent, but most are likely seasonal.

There are six emergent wetland data sites in the Confluence area: Sites 2, 21, 24, 28, 46, and 52. There are nine emergent wetland data sites in the IDS area: Sites 33, 37, 42, 43, 49, 61, 63, 67, and 68. There are seven emergent wetland data sites in the Mainstem area: Sites 34, 5, 11, 14, 15, 19, and 36. The Confluence was valued at the lower range of below average quality emergent wetland habitat. Wetlands in the IDS and Mainstem were valued as poor quality wetland habitat (Tables 2-4 and 2-5). The majority of the wetland habitat in the study area is in the Mainstem (Table 2-5).

Table 2-4. Existing HSI Values for Emergent Wetland Habitat per Indicator Species

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Wood Duck	0.29	0.16	0.11
American Coot	0.31	0.29	0.33
HSI Average	0.30	0.22	0.22

Table 2-5. Existing Acres, HSI Values, and Habitat Units for Emergent Wetland

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	67.95	0.30	20.39
IDS	87.72	0.22	19.30
Mainstem	262.91	0.22	57.84
Total	418.58	N/A	97.53

The limiting factors for emergent wetland habitat for the three evaluation groups were similar and are listed below.

- Available trees provide minimal nesting opportunities for wood duck.
- Minimal winter and brood cover along the banks for the wood duck.
- Minimal nesting and winter cover along the banks for the American coot.

The HSI calculations for wood duck in the Confluence and IDS did not require interspersion factoring because neither the bottomland hardwoods nor emergent wetlands within those areas scored 0.0 for any life requisite. Although emergent wetlands within the Mainstem area contained a life requisite score of 0.0 for nesting, bottomland hardwoods containing suitable nesting sites are within 800 meters precluding the need for interspersion factoring.

2.2.3 Grassland

Grasslands are dominated by grasses (native or introduced) that are not regularly planted or mowed, and have a canopy cover of 25 percent or less. Grasslands provide open space, a food source for passerines and the eastern cottontail, and cover for escape and nesting by means of tall grass, scattered brush piles, and shrubs for a variety of animals. Red-tailed hawks hunt for prey in open grasslands.

Grasslands within the study area may generally be characterized as “managed” grasslands that are routinely mowed. They are comprised of short native and introduced grasses and forbs, and occasional scattered trees. The grass species found in the data plots were switchgrass, Johnsongrass (*Sorghum halepense)*, Bermuda grass (*Cynodon dactylon*), and dallisgrass (*Paspalum dilatatum)*. Forb species also found include oxalis sp., daisy fleabane (*Erigeron strigosus*), dollarweed (*Hydrocotyle umbellata*), giant ragweed (*Ambrosia trifida*), snow on the prairie (*Euphorbia bicolor*), and balloon vine (*Cardiospermum halicacabum*).

There are five grassland data sites in the Confluence area: Sites 18, 22, 23, 31, and 51. There are ten grassland data sites in the IDS area: Sites 12, 30, 41, 47, 50, 53, 56, 62, 64, and 65. There are seven grassland data sites in the Mainstem area: Sites 6, 7, 8, 10, 13, 29, and 34. The grassland habitat within the Confluence area was valued as below average. Grassland habitats within the IDS and Mainstem were valued as average (Tables 2-6 and 2-7). Grasslands are the dominant habitat type throughout the study area (Table 2-7).

Table 2-6. Existing HSI Values for Grassland Habitat per Indicator Species

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Eastern Meadowlark	0.27	0.54	0.53
Eastern Cottontail	0.59	0.61	0.70
HSI Average	0.43	0.57	0.62

Table 2-7. Existing Acres, HSI Values, and HU for Grassland

Evaluation Area	*Acres*	*HSI Average*	*Hus*
Confluence	1,573.16	0.43	676.46
IDS	958.26	0.57	546.21
Mainstem	1,752.15	0.62	1,086.33
Total	4,283.57	N/A	2,309.00

The limiting factors for grassland habitat for the three evaluation groups were the same and are listed below.

- Distance to perch sites typically too great for eastern meadowlark.
- Minimal cover for eastern cottontail (shrub/tree and persistent herbaceous vegetation).

2.2.4 Aquatic Riverine

Aquatic riverine habitat within the study area includes 421.34 acres of the Elm Fork and West Fork in the Confluence, the main channel of the Trinity River in the Mainstem, and sumps within the IDS.

To assess IBI scores and HSI values by habitat groupings, (Mainstem, Confluence, and IDS), the 2004 Trinity River Basin Specific IBI scores were recalculated with reaches 1 and 2 representing the Mainstem, and reaches 3 and 4 representing the Confluence. A weighted average was used; thus the Mainstem and Confluence HSIs are not just the average of the corresponding reaches. Reach 1, the lower reach of the Mainstem, had the lowest HSI of the four reaches and was determined to be the most similar of the four reaches to the IDS. The IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, thus it is expected to have a lower HSI than the rest of the River.

Aquatic riverine habitat in the Confluence was valued as excellent and aquatic riverine habitat in the IDS and Mainstem was valued as good (Tables 2-8 and 2-9). The IDS contains the most aquatic riverine habitat and the Mainstem contains the least but the difference is only 40 acres (Table 2-9).

Table 2-8. Existing HSI Values for Aquatic Riverine Survey Sites

Reach	*Confluence*	*Mainstem*
1	-	0.75
2	-	0.87
3	0.90	-
4	0.82	-

Table 2-9. Existing Acres, HSI Values, and Habitat Units for Aquatic Riverine Habitat

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	132.42	0.90	119.18
IDS	165.18	0.75	123.89
Mainstem	123.73	0.83	102.70
Total	421.33	N/A	345.77

The limiting factors for aquatic riverine habitat for the Confluence and Mainstem are from the 2004 USFWS IBI report (Appendix G) and are listed below (USFWS 2004). The limiting factors for the IDS are assumed to be the same limiting factors as listed below.

- Number of benthic invertivore species (Confluence).
- Percent of individuals as tolerants (Mainstem).
- Percent of individuals as omnivores (Confluence and Mainstem).
- Percent of individuals as invertivores (Mainstem).
- Number of individuals per seine haul (Confluence and Mainstem).
- Number of individuals per minute of electro-fishing (Confluence and Mainstem).
- Percent of individuals with disease or other anomaly (Confluence).
- Total number of intolerant species (Confluence).

2.2.5 Open Water

Outside of the river and drainage channels, the study area contains 206.65 acres of open water, including Crow Lake in the Mainstem, Fish Trap Lake in the IDS, and other ponds in the IDS and Confluence.

For the Dallas Floodway project, three lakes (Crow Lake, Bart Simpson Lake, and DFE Wetland Cell D) were surveyed to establish HSIs for the study area. Crow Lake is within the Mainstem, and Bart Simpson Lake and DFE Wetland Cell D are southeast of the project area (see Appendix I).

The HSI for the Confluence and the Mainstem were determined by using the average of the three survey sites (Tables 2-10 and 2-11). Because the IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, it is expected to have a lower HSI than the Mainstem or Confluence areas of the Trinity River. Thus, the average open water HSI score was adjusted to 0.71 (Table 2-10).

The open water habitat within the Confluence and Mainstem are on the low end of good. The open water habitat in the IDS is on the high end of average (Tables 2-10 and 2-11). The majority of the open water habitat in the study area occurs in the Confluence (Table 2-11).

Table 2-10. Existing HSI Values for Open Water Survey Sites

Survey Site	*HSI*
Crow Lake	0.77
Bart Simpson Lake	0.77
DFE Wetland Cell D	0.60
Average	0.71

Table 2-11. Existing Acres, HSI Values, and Habitat Units for Open Water

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	150.93	0.71	107.16
IDS	49.30	0.65	32.05
Mainstem	6.41	0.71	4.55
Total	206.64	N/A	143.76

The limiting factors for open water habitat for the three evaluation groups were assumed to be the same as the limiting factors for the open water survey sites (Crow Lake, Bart Simpson Lake, and DFE Wetland Cell D) (Appendix I) and are listed below.

- Total number of fish species.
- Number of cyprinid species.
- Number of catfish species.
- Number of intolerant species.

2.3 HABITAT UNITS SUMMARY

Table 2-12 presents a summary of total HUs for each habitat type within the study area. The majority of the habitat and HUs in the study area is grassland. Grassland is the dominant vegetation in the floodway and on the levees. Open water and emergent wetlands have the lowest HUs in the project area. Open water has the least habitat acreage in the study area including Crow Lake, Fish Trap Lake, and other ponds in the Confluence and IDS. However, emergent wetlands have the fewest HUs (97.53) in the study area due to limited habitat, disturbance, and low HSIs.

Table 2-12. Existing HUs per Habitat Type

Habitat Types	*Baseline HU*
Bottomland Hardwood	388.92
Emergent Wetland	97.53
Grassland	2,309.00
Aquatic Riverine	345.77
Open Water	143.76
Total	3,284.98

2.4 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

The federally-listed threatened or endangered species known to occur in Dallas County include the endangered whooping crane (*Grus americana*), interior least tern (*Sternula antillarum*), black-capped vireo (*Vireo atricapilla*), golden-cheeked warbler (*Dendroica chrysoparia*), and the threatened piping plover (*Charadrius melodus*).

Endangered whooping cranes may be encountered in any county in north central Texas during migration. Autumn migration normally begins in mid-September, with most birds arriving on the wintering grounds at Aransas National Wildlife Refuge between late October and mid-November. Spring migration occurs during March and April. Whooping cranes prefer isolated areas away from human activity for feeding and roosting, with vegetated wetlands and wetlands adjacent to cropland being utilized along the migration route. Foods consumed usually include frogs, fish, plant tubers, crayfish, insects, and waste grains in harvested fields. It is possible that whooping cranes may temporarily utilize habitats present within the study area during their annual migration but an encounter would be a rare occurrence. It is unlikely that any of the current activities or proposed modifications to the floodplain would have an adverse impact on this species.

The endangered interior least tern nests in colonies on bare to sparsely vegetated sandbars along rivers and streams in Texas from May through August. Nesting areas are ephemeral, changing as sandbars form, move, and become vegetated. Because natural nesting sites have become sparse, interior least terns have nested in atypical/non-natural areas, which provide similar habitat requirements. For example, one colony has been nesting for several years at the Southside Wastewater Treatment Plant in Dallas. Non-natural nesting sites include sandpits, exposed areas near reservoirs, gravel levee roads, dredge islands, gravel rooftops, and dike-fields. In recent years, terns have been utilizing artificial habitat more frequently within the Dallas area with small colonies being established in highly developed areas. Ground disturbance related to construction activities near the Trinity River may incidentally create areas that are attractive to least terns for use as potential nesting sites. Should least terns arrive at any of the project areas during the breeding season, the USFWS should be notified to discuss alternative development plans or the need for consultation under Section 7 of the Endangered Species Act.

The golden-cheeked warbler's habitat is generally described as mature (at least 12 feet tall) oak-juniper woodlands, with 50 percent or greater canopy cover, although warblers have been found in habitat with as little as 30 percent canopy cover. Steep, narrow canyons, with deciduous trees located along the drainage bottoms and juniper on the side slopes, provide an ideal mix of vegetation for this species. However, suitable habitat may also occur on hilltops or other relatively flat areas. Ideal habitat areas have a diverse mixture of juniper and hardwood trees, including oaks, hackberry, sycamore, and cedar elm.

The black-capped vireo is a habitat specialist, nesting in mid-successional brushy areas (i.e., before the area develops into a mature woodland) where the dominant woody species are oaks, sumacs, persimmon, and other broad-leaved shrubs. Juniper may be common in vireo habitat, but juniper prominence is not essential or even preferred by the species. Typical nesting habitat is composed of a shrub layer extending from the ground to about 6 feet and covering about 35-55 percent of the total area, combined with a tree layer that may reach to 30 feet or more. Open, sometimes grassy spaces separate clumps of trees and shrubs. The vireo also depends on broad-leaved shrubs and trees, especially oaks, which provide insects on which the vireo feeds.

The habitat evaluation team did not encounter any habitats that appeared suitable for nesting golden-cheeked warblers or black-capped vireos. Therefore, it is unlikely that either species would be present within the study area.

The threatened piping plover is considered to be a statewide migrant in Texas. Current information indicates that this species may stop-over during migration in Grayson County, especially near Lake Texoma and the Red River. Winters are spent along the Gulf Coast. Habitat requirements include bare to sparsely vegetated river sandbars for nesting and foraging. Its diet consists mainly of marine worms, mollusks, crustaceans, and insects. Although piping plovers have been seen in Dallas County, an encounter would be expected to be a very rare event. Therefore, it is unlikely that any of the current activities or proposed modifications to the floodplain would have an adverse impact on this species.

The bald eagle (*Haliaeetus leucocephalus*) was formerly listed in Dallas County but was removed from the federal threatened and endangered species list effective August 8, 2007. However, bald eagles are still afforded safeguards under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. We recommend all activities be conducted in accordance with the USFWS's National Bald Eagle Management Guidelines which may be accessed at:

http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

The USFWS published the *Birds of Conservation Concern 2008* (BCC) in December 2008. "The overall goal of the BCC is to accurately identify the migratory and non-migratory bird species (beyond those already designated as Federally threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action" (USFWS 2008).

Copies of the Birds of Conservation Concern 2008 may be obtained by writing to the Chief, Division of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Mail Stop 4107, Arlington, VA 22203-1610, ATTN: BCC 2008. It is also available for downloading on the Division of Migratory Bird Management's web page at:

http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf.

The following are 21 species on the BCC lists that may utilize appropriate habitat types within the general vicinity of study area:

- little blue heron (*Egretta caerulea*) - inlands marshes and ponds
- peregrine falcon (*Falco peregrinus*) -generalist
- long-billed curlew (*Numenius americanus*) – open water, prairies, and savannas
- Hudsonian godwit (*Limosa haemastica*) - inlands marshes
- buff-breasted sandpiper (*Tryngites subruficollis*) - prairies, margins of lakes
- red-headed woodpecker (*Melanerpes erythrocephalus*) - woodlands
- scissor-tailed flycatcher (*Tyrannus forficatus*) – prairies, savannas, and open shrubland
- loggerhead shrike (*Lanius excubitor*) – open savanna, shrubland
- Bell's vireo (*Vireo bellii*) - dense thicket
- Sprague's pipit (*Anthus spragueii*) - short grass prairie
- prothonotary warbler (*Protonotaria citrea*) – riparian woodland
- worm-eating warbler (*Helmitheros vermivorum*) -woodlands
- Swainson's warbler (*Limnothlypis swainsonii*) - riparian woodland
- Kentucky warbler (*Oporornis formosus*) - riparian woodland
- field sparrow (*Spizella pusilla*) – old fields, scrubland, forest edge
- Henslow's sparrow (*Ammodramus henslowii*) – grasslands with scattered shrub
- Le Conte's sparrow (*Ammodramus caudacutus*) – thick, damp grassy areas, wetlands
- Harris' sparrow (*Zonotrichia querula*) - scrub, undergrowth in open woodlands and savanna, thickets, brushy fields, and hedgerows
- Smith's longspur (*Calcarius pictus*) – short grassland
- chestnut-collared longspur (*Calcarius ornatus*) - shortgrass prairie, plowed field, overgrazed pasture
- painted bunting (*Passerina ciris*) - riparian and thorn forest, oak woodlands, savanna, brushy pastures, and hedgerows

Because some of these species could potentially utilize appropriate habitats within the study area**,** especially as temporary stopover breaks during annual migration, we recommend that future projects avoid and/or minimize adverse impacts to intact upland and riparian habitats whenever possible.

2.5 RECOMMENDATIONS

The habitat analysis indicates the following specific measures could be beneficial for the restoration of natural habitats impacted by urban development within the study area.

1. Widen the riparian woodland corridors along the creeks and their associated tributaries as much as possible (up to 150 feet on each side) by planting native mast producing trees and shrubs to create a more functional riparian buffer zone. Riparian buffer zones provide several benefits for terrestrial and aquatic resources.
    a. First, riparian zones stabilize eroding banks by absorbing the erosive force of flowing water while roots hold soil in place.
    b. Second, riparian zones filter sediment, nutrients, pesticides, and animal waste runoff.
    c. Finally, riparian zones provide shade, shelter, and food for wildlife and aquatic organisms.

   d. Native mast producing trees and shrubs, such as pecan, bur oak, red oak, black walnut (*Juglans nigra*), wild plum (*Prunus mexicana*), sumac (*Rhus* sp.), hawthorne (*Crataegus* sp.), and coral-berry, should be planted in the expanded portion of the riparian woodland to improve canopy cover and food base.

   e. Recommend planting 70 percent woody stems, with no more that 25 percent consisting of soft mast producers. Shrubs should be planted at no more than 30 percent stems. Some scattered open spaces should be maintained for fox squirrel movement.

2. Thin portions, but not all, of the existing riparian corridor and upland deciduous forest under mast producing trees where the understory is too dense in order to improve fox squirrel habitat and to open the stands as preferred by numerous species.

3. Recommend planting mast producing trees and shrubs in the existing woodlands where they are lacking to improve the canopy cover and food base. The thick overstory and/or understory may need to be thinned and cleared around young trees to provide space and sunlight. Leave snags standing and let downed logs remain. Existing mast producing trees should be allowed to mature and increase in size.

4. Provide brush and log piles in all existing habitats where needed to provide cover for small mammals.

5. If hazardous materials contamination testing has not been conducted in areas to be restored as habitat, USFWS recommends that it be done before any restoration work is initiated.

6. Herbaceous wetlands could be created off stream in addition to water bodies planned for construction which are not designed specifically for typical wetland functions. Wetlands constructed off stream could provide nonpoint source pollution control. In this role, wetlands would provide several benefits that contribute to water quality improvements.

   a. First, the wetlands provide water quality function through solids settling, nutrient transformation, and biological uptake.

   b. Second, because they provide a fairly large surface area, wetlands provide floodwater storage and serve to collect peak flood flows known to carry most of the polluted runoff from nonpoint sources.

   c. Finally, wetlands provide diversity in the landscape and supply a unique habitat for many plant and animal species.

7. Plant locally available native aquatic plants and shrubs around the water edges. We recommend the use of locally available sedges, water-willow (*Justicia americana*), softstem bulrush (*Schoenoplectus tabernaemontani*), water pennywort (*Hydrocotyle umbellata*), switchgrass, smartweeds (*Polygonum* sp.), and buttonbush (*Cephalanthus occidentalis*). The wetland should not be mowed unless it is absolutely necessary to manage non-desirable plant species (i.e., invasives/exotics).

   a. Recommend that mowing be reduced as much as possible near the water's edge.

8. Recommend that water bodies within the project area be constructed with shelved floors of variable depths and appropriate substrates such as boulders and cobbles, where possible, to provide adequate habitat cover and spawning conditions within riverine and open-water systems.

9. In riverine and open water systems, a fish stocking plan is recommended.
    a. Fish are often available from and can be delivered by TPWD.
    b. Do not stock carp for vegetation control.
10. Conduct native aquatic vegetation planting and monitoring program.
11. In riverine systems, habitat suitability might greatly benefit from attempts to mimic natural flow systems with the construction of "riffle, pool, and run" sections where conditions allow.
12. Canopy overhang, which shades this littoral zone, might also improve habitat conditions and should be left intact where possible.
13. Create native grasslands, where possible, throughout the study area to replace Bermuda grass and Johnsongrass.
    a. Recommend planting native grass and forb species appropriate for the soils. Little bluestem, big bluestem, Indian grass, sideoats grama (*Bouteloua* sp.), switchgrass, vine-mesquite, Illinois bundle-flower (*Desmanthus illinoensis*), Maximilian sunflower (*Helianthus maximiliani*), and Engelmann's daisy (*Engelmannia peristenia*) are excellent forage and seed producing species to consider.
    b. Plant shrub mottes and briar thickets in grasslands, and shrub and tree savannas, but maintain them to only about 5 percent canopy cover.
14. Any mowing schedule that may be developed should promote tall grass growth, but not interfere with tall-grass nesting birds.
    a. The grassland should not be mowed until after July 15.
    b. Maintain a "no mow" zone around herbaceous wetlands and stream shorelines, to the extent these actions are possible in public parklands.
15. Recommend that the direct, indirect, and cumulative impacts and conservation needs of the *Birds of Conservation Concern 2008* be considered during any Dallas Floodway restoration or flood control project planning.
16. Recommend that a biological analysis is conducted every few years using the same habitat evaluation technique to monitor and quantify habitat impacts resulting from future flood-control or restoration projects. Such an analysis would provide information for adaptive management and for future habitat restoration planning projects.

In addition, the following are some general recommendations for improving and maintaining lands in and adjacent to the study area for wildlife habitat that the city could practice and recommend to landowners:

1. Reduce mowing on city lands and along the water's edge.
    a. Reseed and manage portions of these areas as native grasslands or emergent wetlands.
2. Develop a program to eradicate exotic plants on city lands.
    a. Use only native plants during the restoration project.
3. Control bank erosion through use of biological engineering to the extent possible and necessary.

4. Develop a plan to greatly reduce or eliminate the use of fertilizers, pesticides, and herbicides on public lands.
5. Initiate a program to help landowners/developers avoid and minimize impacts to sensitive areas and provide upland buffers adjacent to streams.

2.6 SUMMARY

The Dallas Floodway – Trinity River watershed has been heavily impacted by urban development. Of the 68 HEP data sites, all have been somewhat impacted by development. However, there are still some valuable wildlife habitats remaining within the watershed. The specific habitat restoration measures recommended in this report could help restore some of the natural habitats that have been lost and improve habitat diversity and quality of remaining habitats; therefore, benefitting a variety of resident and migratory wildlife species.

CHAPTER 3
ALTERNATIVE 1 - FUTURE WITHOUT PROJECT CONDITION

3.1 INTRODUCTION

This chapter describes potential impacts to fish and wildlife habitats from the implementation of the identified 19 cumulative projects as part of Alternative 1, the Future without Project Condition (FW/OPC), over the next 50 years within the ROI. The study area, habitat types (bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water) and evaluation groups (Confluence, IDS, and Mainstem) from Chapter 2 are used for the FW/OPC evaluation. Alternative 1 presents the estimated future conditions in the absence of the Proposed Action. The 19 FW/OPC projects in the study area are described below and shown in Figure 5.

3.1.1 Able Pumping Plant (A)

The City of Dallas and the USACE are planning to relocate and improve the Able Pumping Plant in order to reduce the potential for stormwater flooding impacts to people and property in the Able Basin. The Proposed Action consists of constructing a new 875,000-gpm capacity pump station and outfall, and decommissioning and removing the existing Small Able and Large Able pump stations. The new Able Pumping Plant would be located near the existing Bellevue Pressure Sewer, adjacent to Riverfront Boulevard near the east levee. In addition, the Proposed Action includes implementing stormwater conveyance improvements in the Able Sump ponds (HDR 2013). The construction of the Able Pumping Plant would likely have small negative impacts to fish and wildlife through temporary and permanent impacts to forage, shelter, and breeding habitat. The project area is small and would impact small areas of habitat.

3.1.2 Baker Pumping Plant (B)

The City of Dallas and USACE are planning to improve the Baker Pumping Plant in order to reduce the potential stormwater flood risk to people and property in the City of Dallas and extend the service life of existing facilities for at least another 50 years. Improvements would include constructing a new pump station (which would work along with the 1975 Baker Pump Station), rehabilitating the Baker Pump Station to modernize the electrical system of the building, and decommissioning the Old Baker Pumping Plant. The project area is approximately 4.5 acres. Construction began in 2013 and will last for 18 months (USACE 2012). The construction of the Baker Pumping Plant would likely have small negative impacts to fish and wildlife through temporary and permanent impacts to forage, shelter, and breeding habitat. The project would only impact small areas of habitat.

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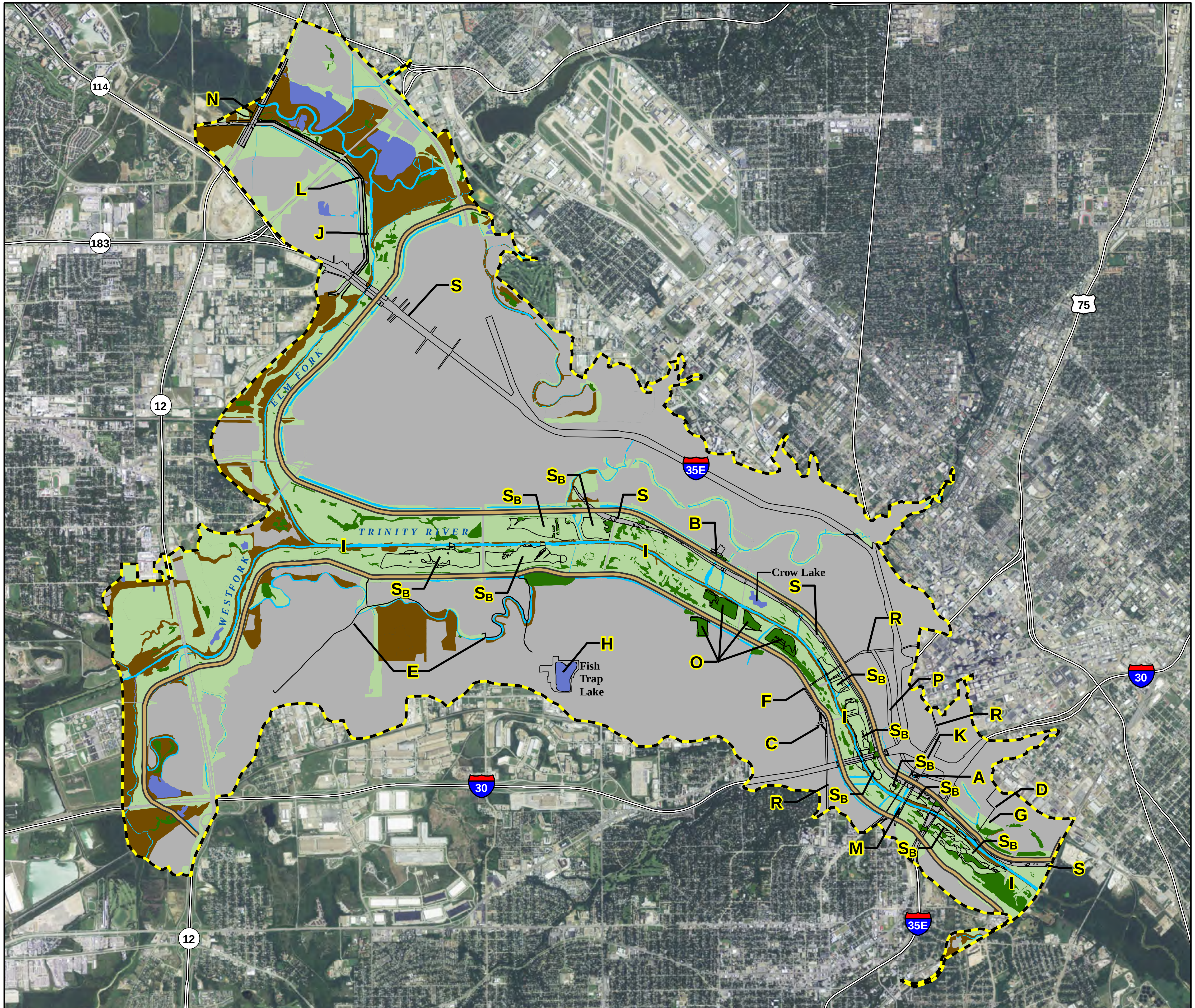

Figure 5
Habitat Types Under the Future Without Project Condition

Future Without Project Condition Projects

- A Able Pumping Plant
- B Baker Pumping Plant
- C Beckley Avenue Improvements
- D Belleview Trail Connector
- E Bernal Trail
- F Continental Pedestrian Bridge
- G Dallas Maritime Museum
- H Dallas Watersports Complex
- I Dallas Water Utility Lines
- J EF2 Wastewater Interceptor Line & Laterals
- K Horseshoe Project
- L Irving Northwest Levee Repair
- M Jefferson-Memorial Bridge
- N Loop 12 Bridge
- O Pavaho Wetlands
- P Riverfront Boulevard
- Q SH-183 Bridge
- R Trinity Lakes Streetcar Loop
- S Trinity Parkway
- S_B Trinity Parkway Borrow Pits

ROI
Dallas Floodway Levee
Freeway

Habitat Types

- Aquatic Riverine
- Bottomland Hardwood
- Emergent Wetland
- Grassland
- Open Water
- Urban

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

GIS Sources: Black and Veatch 2010; City of Dallas 2008a, 2010a; TxDOT 2010; USACE 2007; USFWS 2006

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3.1.3 Beckley Avenue Improvements (C)

The City of Dallas plans to improve Beckley Avenue at Commerce Street by adding four new vehicle lanes, reinforced concrete sidewalks, a new major drainage system, and upgraded water and wastewater mains. The project area is approximately 3 acres. Construction is estimated to begin in fall 2014 (City of Dallas 2012a). The proposed project area for the Beckley Avenue Improvements is within an area that is already developed/urban; therefore, no impacts to habitat types or fish and wildlife are expected. Temporary impacts to aquatic habitats could occur from runoff and siltation during construction.

3.1.4 Belleview Trail Connector (D)

The City of Dallas proposes to construct a trail connecting development, entertainment, and art districts via mass transit in the Cedars District. The trail would be slightly less than an acre and would connect the proposed Trinity Park to the DART Cedars Station. This project does not currently have an estimated start date (City of Dallas 2012b). The implementation of the Belleview Trail Connector would permanently impact up to 0.02 acre of emergent wetland and 0.11 acre of grassland habitat within the study area. The construction of the Belleview Trail Connector could negatively impact terrestrial habitats and runoff from the trails could negatively impact aquatic habitats in the area. Wildlife in the area could be negatively impacted by noise from the trail, trash, and an increase in predators.

3.1.5 Bernal Trail (E)

The City of Dallas would extend the existing Bernal Trail to link the Westmoreland Heights area to the Trinity Levee Trail along the West Levee. The trail would go from Emma Carter Park to Tipton Park, and would be approximately 4.6 acres. This project currently has no funding for construction and does not have an estimated start date (City of Dallas 2012b). The construction of the Bernal Trail could permanently impact up to 0.24 acre of aquatic riverine, 0.04 acre of bottomland hardwood, 0.11 acre of emergent wetland, and 1.00 acre of grassland habitat within the study area. Runoff from the trail could negatively impact aquatic habitats in the area. Wildlife in the area could be negatively impacted by noise from the trail, trash, and an increase in predators. The construction of the trail could increase the spread of invasive plant species.

3.1.6 Continental Pedestrian Bridge (F)

The existing Continental Avenue Bridge would be converted from vehicular use to pedestrian and bicycle use. The vehicle to pedestrian conversion and associated ancillary elements would cover 4.6 acres. The project is estimated to be completed in 2014 (City of Dallas 2012c). Since the purpose of the proposed project is to convert an existing vehicle bridge to a pedestrian bridge, no impacts to habitat types or fish and wildlife are expected.

3.1.7 Dallas Maritime Museum (G)

The Dallas Maritime Museum is a proposed 3.5-acre museum located along the Trinity River, at 1501 Riverfront Boulevard in a currently undeveloped grassland parcel. The $80 million project is sponsored by a non-profit organization, the Dallas Maritime Museum Foundation. The museum plans to acquire and display the 362-foot USS Dallas and other vessels next to the 30,000 square-foot museum building

(Dallas Morning News 2013). Permanent impacts to grassland habitat would occur from the implementation of proposed project.

3.1.8 Dallas Watersports Complex (H)

The Dallas Watersports Complex (DWC) would include a waterskiing cableway, a pro-shop, snack bar, full-service restaurant, and viewing deck. The DWC would be located on Fish Trap Lake at the intersection of Hampton Road and Singleton Boulevard in West Dallas, and cover approximately 42 acres. This project does not currently have an estimated start date (DWC 2012). The Dallas Watersports Complex consists of 18.74 acres of urban area and 22.75 acres of open water (Fish Trap Lake). As part of the project, 0.28 acre of emergent wetlands would be created within the open water habitat. The area would mostly be used for recreation so it would only provide limited habitat for fish and wildlife. Transporting boats in and out of the area could introduce invasive aquatic species.

3.1.9 Dallas Water Utility Lines (I)

The Dallas waterlines project proposes to relocate four water mains and one drainage pipeline that currently underlie the floodway and/or the levees. In addition to the relocation of the existing pipelines, the City of Dallas may also remove all or part of three force mains, one wastewater bypass main, two wastewater mains, and four water mains that have previously been abandoned and that currently underlie the floodway and/or the levees (City of Dallas 2008b). Temporary impacts would occur from the implementation of the proposed utility lines.

3.1.10 EF2 Wastewater Interceptor Line and Laterals (J)

This project consists of a new 108-inch diameter wastewater interceptor that would be installed parallel to and riverward, of an existing 90-inch wastewater line located within the Dallas Floodway and immediately adjacent to the Northwest Levee in Irving. Also included in this project are four lateral wastewater lines (points of entry) that are proposed to cross beneath the levee and connect to either the existing 90-inch line or the new 108-inch line. The project area would be approximately 3.7 acres. The Trinity River Authority anticipates the construction period to last 2 years, beginning in late 2012 (Black & Veatch Corporation 2011; City of Dallas 2012d). This project would result in temporary impacts to aquatic and terrestrial habitat from pipeline construction; however, the construction of the junction boxes would permanently impact as much as 0.26 acre of grassland. Minimal impacts to fish and wildlife are expected.

3.1.11 Horseshoe Project (K)

A subset of the larger Project Pegasus, the Horseshoe Project would replace two key bridges and connecting roadways crossing the Trinity River at IH-30 and IH-35, as well as upgrade outdated roadway geometry, improve safety, and increase capacity and mobility. The project would begin at Sylvan Avenue on IH-30, extend to the IH-30/IH-35 interchange (commonly referred to as the Mixmaster) and head south on IH-35 to cross the Trinity River, ending just south of Colorado Boulevard. The project started construction in 2013 and is to be completed by late 2016 (Texas Department of Transportation [TxDOT] 2012a). The construction of the Horseshoe Project would likely negatively impact fish and wildlife through temporary and permanent impacts to forage, shelter, and breeding habitat. Aquatic surveys for this project found the state threatened Texas pigtoe mussel in the Trinity River.

3.1.12 Irving Northwest Levee Repair (L)

This 23-acre project would complete the rehabilitation of the Irving Northwest Levee for re-certification and re-accreditation for protection from up to and including a 100-year riverine flood event. This project consists of installing a slurry wall on the riverside toe of the existing levee (approximately 13,000 feet long and 25 feet deep) to minimize the potential for under seepage issues associated with the levee during major flood events. It would also include the rehabilitation of a portion of the levee, by either overlaying with clay material or grouting the sand to reduce the potential for through seepage of the levee during flood events. The project is currently on hold (Halff Associates 2012). No permanent impacts to habitat are expected from the Irving Northwest Levee Repair. The levee repair would temporarily impact grassland habitat from the construction of a slurry wall. Minimal impacts to fish and wildlife are expected.

Please note that outside of the DFP documentation, this project is occasionally referred to as the Conceptual Levee Height Restoration Project.

3.1.13 Jefferson-Memorial Bridge (M)

The Jefferson-Memorial Bridge would replace the existing Jefferson Street Bridge; the project is currently in the planning stage at TxDOT. The new bridge would provide a direct connection to and from IH-35E (TxDOT 2012b). The construction of the Jefferson Memorial Bridge would likely negatively impact fish and wildlife through temporary and permanent impacts to forage, shelter, and breeding habitat.

3.1.14 Loop 12 Bridge (N)

Under this project the Loop 12 corridor, near the western SH-183 crossing, would be reconstructed to accommodate eight general-purpose lanes (plus auxiliary lanes), four continuous frontage road lanes (plus auxiliary lanes near ramp locations and cross-streets), and a reversible High-Occupancy Vehicle (HOV)/Managed facility. The Loop 12 project will be the first in a series of TxDOT reconstruction projects surrounding the former Texas Stadium site, collectively to be known as the Irving Diamond Interchange. The project area would cover approximately 34 acres; construction scheduling is on hold pending funding (Bridgefarmer & Associates 2012, 2013). The construction of the Loop 12 Bridge would permanently impact up to 3.38 acres of bottomland hardwood, 0.03 acre of emergent wetland, and 11.47 acres of grassland habitat within the study area. Permanent habitat impacts are expected to be much less because the majority of the existing habitat would remain unaffected under the bridge. Permanent impacts would only occur where the bridge pylons permanently impact the habitat. The construction of the Loop 12 Bridge would likely negatively impact fish and wildlife through the destruction of forage, shelter, and breeding habitat and potentially degrade aquatic habitats long-term from increased runoff.

3.1.15 Pavaho Wetlands (O)

The proposed Pavaho Stormwater Wetland Project would include construction of approximately 64 acres of wetlands consisting of four separate cells located near the Pavaho Pumping Plant outfall. The wetland area is intended to provide water quality improvement for storm flows collected in the sump prior to conveyance to the river by the Pavaho Pumping Plant. The primary purpose for the three wetland cells located on the river side of the West Levee would be to create diverse, high quality wetland habitat for multiple migratory and resident wildlife and bird species. To a lesser degree the wetland cells would provide water quality improvement for stormwater runoff from the adjacent floodplain area and during flood events. Construction is expected to start in 2014 (USACE 2013b).

3.1.16 Riverfront Boulevard (P)

This 27-acre project involves converting Riverfront Boulevard (formerly Industrial Boulevard) to a 1.5-mile, eight-lane thoroughfare with a 150-foot wide right of way. Riverfront Boulevard would become a "complete street" and include landscape zones, bicycle lanes, and pedestrian sidewalks. The project would also include an upgrade of the drainage system and replacement/upgrade of existing water and wastewater transmission and distribution lines. Construction is estimated to begin in January 2014 (City of Dallas 2012d). The proposed project area for Riverfront Boulevard improvements is within an area that is already developed/urban; therefore, no impacts to habitat types or fish and wildlife are expected. Temporary impacts to aquatic habitats could occur from runoff and siltation during construction.

3.1.17 SH-183 Bridge (Q)

The TxDOT is planning a new bridge crossing at the Elm Fork of the Trinity River as part of an overall development plan for SH-183. The TxDOT is studying several alternatives in order to develop a plan for improvements; currently the project would cover approximately 76 acres. In addition to the bridge, alternatives include revising the HOV lanes to provide three lanes in each direction. Subject to funding availability, construction is estimated to begin in January 2017 (TxDOT 2012c).

3.1.18 Trinity Lakes Streetcar Loop (R)

The proposed Trinity Lake Streetcar Loop would improve the connection of Oak Cliff and West Dallas to downtown. The approximately 5-mile route would zigzag from the convention center hotel, down the east-west commercial district, and up to the Arts District. It would create economic development opportunities for downtown along with West Dallas, the Design District, and Oak Cliff (DART 2012).

The majority of the project footprint within the study area is urban (18.75 acres). As much as 0.13 acre of aquatic riverine habitat would be permanently impacted by the Trinity Lakes Streetcar Loop project. Minimal impacts to fish and wildlife are expected.

3.1.19 Trinity Parkway (S)

The Trinity Parkway project is a proposed 9-mile toll road that would extend from the SH-183/IH 35E juncture to U.S. 175/Spur 310. Several route alternatives are currently being reviewed by the FHWA. The North Texas Tollway Authority is currently working on an EIS for this roadway. The Trinity Parkway would be a tolled reliever route around downtown Dallas, and would assist in managing traffic congestions on IH 30 and IH 35E. As this project has the potential to affect the form and function of the Dallas Floodway Levee System, the USACE is a cooperating agency in the development of the FHWA Trinity Parkway EIS (Trinity River Corridor Project 2013).

The construction of the Trinity Parkway would likely negatively impact fish and wildlife through temporary and permanent impacts to forage, shelter, and breeding habitat. During construction of the Trinity Parkway, large borrow pits would be excavated in the Mainstem. The borrow pits would remain primarily grassland habitat but may retain water following rain events.

3.2 Changes to Habitat Acreages Under The Future Without Project Condition

As presented in Table 3-1, 192.57 acres of existing habitat would become urban from the implementation of the 19 identified cumulative FW/OPC projects. A breakdown of changes in each of the three evaluation groups is described in the following sections.

Table 3-1. Estimated Changes to Habitat Acreages under the Future Without Project Condition

Habitat Type	*Acres*		
	Existing Conditions (2013)	*FW/OPC (Year 0)*	*Change*
Bottomland Hardwood	1412.63	1402.23	-10.40
Emergent Wetland	418.58	417.36	-1.22
Grassland	4,283.57	4,112.00	-171.57
Aquatic Riverine	421.33	412.23	-9.10
Open Water	206.64	206.36	-0.28
Habitat Subtotal	*6,742.75*	*6,550.18*	*-192.57*
Urban Area	10,400.01	10,592.58	192.57
Total	**17,142.76**	**17,142.76**	**0.00**

In 2010, the USFWS and the USACE predicted acreage modifications for the habitat types in the three groups, Confluence, Mainstem, and IDS over the next 50 years. Year 0 is assumed to be after the FW/OPC projects are implemented. Overtime habitat acreages are expected to decrease due to population increases in the Dallas area, development, invasive species, and climate change. Climate change is expected to create warmer (increases in temperature) and drier (decreases in precipitation) conditions in the region; thus, areas of aquatic, open water, and emergent wetland habitat are expected to convert to drier habitats (bottomland hardwoods and grasslands).

3.2.1 Confluence

The Confluence Group includes the Elm Fork and West Fork of the Trinity River and the associated emergent wetland and upland habitat in the area. Table 3-2 presents the predicted acreages for the habitat types in the Confluence Group over the next 50 years.

Table 3-2. Estimated Changes in Habitat Acreages in the Confluence Group over the Next 50 Years

Habitat Type	*Year*				
	Existing Conditions	*0*	*5*	*10*	*50*
Bottomland Hardwood	966.49	963.41	963.41	973.13	1,011.20
Emergent Wetland	67.95	67.95	67.95	67.95	67.27
Grassland	1,573.16	1,501.04	1,501.04	1,471.02	1,412.86
Aquatic Riverine	132.42	132.36	132.36	131.04	124.49
Open Water	150.93	150.93	150.93	147.91	136.08
Habitat Subtotal	*2,890.95*	*2,815.69*	*2,815.69*	*2,791.05*	*2,751.90*
Urban Area	926.58	1,001.84	1,001.84	1,026.48	1,065.63
Total	**3,817.53**	**3,817.53**	**3,817.53**	**3,817.53**	**3,817.53**

Note: Year 0 is after FW/OPC projects' implementation.

Bottomland Hardwood. The bottomland hardwood acreage is expected to remain at 963 acres from year 0 to 5. Bottomland hardwood areas within the confluence are expected to decrease over time due to development. At years 5 and 10, one percent of the bottomland hardwood habitat is expected to be developed. However, at years 10 and 50, the total bottomland hardwood acreage is expected to increase from the conversion of aquatic riverine, grassland, and open water habitat to bottomland hardwood as a result of drier conditions.

Grassland. From year 0 to 5, the grassland acreage is expected to remain at 1,501 acres. At year 10, one percent of grassland habitat is expected to be converted to bottomland hardwood and one percent is expected to be developed. At year 50, two percent of grassland habitat is expected to be converted to bottomland hardwood from drier conditions and two percent is expected to be developed.

Aquatic Riverine. The aquatic riverine acreage is expected to remain at 132 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods due to less water reaching the Confluence. This could be from drier conditions and/or residents and business retaining more water on their properties. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open Water. The open water acreage would remain at 151 acres from year 0 to 5. At year 10, two percent of open water is expected to be converted to bottomland hardwood. The habitat conversion is expected to occur as a result of sedimentation and less rainfall. At year 50, conditions are expected to be drier from climate change; thus, 8 percent of open water is expected to convert to bottomland hardwoods.

Urban. Urban habitat would increase, from the development of Elm Fork Trail, Loop 12 Bridge, SH-183 Bridge, and other development projects that occur in the IDS over the next 50 years. At year 10, and 50 additional grassland habitat and bottomland hardwood habitat are expected develop.

3.2.2 Mainstem

The habitat in the Mainstem Group has existed in its current state for the last 50 years. The majority of the aquatic riverine habitat in the Mainstem is the main channel of the Trinity River. The only open water in the Mainstem is Crow Park Lake. Grassland habitat within the Mainstem is regularly mowed and maintained. Bottomland hardwood habitat occurs as fringe habitat along the edge of the Trinity River; it does not expand because of the routine mowing of the area. Emergent wetlands in the Mainstem are low quality wetlands. Table 3-3 presents the predicted acreages for the habitat types in the Mainstem Group over the next 50 years.

Table 3-3. Estimated Changes in Habitat Acreages in the Mainstem Group over the Next 50 Years

Habitat Type	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood	94.64	87.35	87.35	88.50	94.19
Emergent Wetland	262.91	260.41	260.41	260.41	257.81
Grassland	1,752.15	1,669.64	1,669.64	1,669.64	1,672.24
Aquatic Riverine	123.73	114.95	114.95	113.80	108.11
Open Water	6.41	6.41	6.41	6.41	6.41
Habitat Subtotal	*2,239.84*	*2,138.76*	*2,138.76*	*2,138.76*	*2,138.76*
Urban Area	36.15	137.23	137.23	137.23	137.23
Total	**2,275.99**	**2,275.99**	**2,275.99**	**2,275.99**	**2,275.99**

Bottomland Hardwood. The acreage of bottomland hardwoods is not expected to increase from year 0 to year 5 because the adjacent grasslands are mowed which does not allow new trees to become established or the bottomland hardwood habitat to expand. At year 10 and 50, an increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood.

Emergent Wetland. The emergent wetlands are periodically flooded and probably mowed when dry. Due to the maintenance and mowing in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland due to siltation and warmer and drier conditions from climate change.

Grassland. The grasslands are regularly mowed and maintained. The maintenance is expected to continue; thus, no change to acreage is expected over the next 50 years. At year 50 the acreage is expected to increase by one percent due to the conversion of emergent wetland to grassland.

Aquatic Riverine. The aquatic riverine acreage is expected to remain at 115 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods due to less water reaching the Mainstem. This could be a result of warmer and drier conditions and/or residents and business retaining more water on their properties. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open Water. The only open water is Crow Park Lake, 6.41 acres. The lake is maintained within a park; therefore, no change to acreage is expected over the next 50 years.

3.2.3 Interior Drainage Systems

The IDS Group is primarily an urban area with pockets of habitat surrounding the existing sumps, pumps, and drainage channels. Table 3-4 presents the predicted acreages for the habitat types in the IDS Group over the next 50 years.

Table 3-4. Estimated Changes in Habitat Acreages in the Interior Drainage Systems Group over the Next 50 Years

Habitat Type	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood	351.50	351.47	347.96	339.66	325.97
Emergent Wetland	87.72	89.00	89.00	89.00	89.00
Grassland	958.26	941.32	931.91	903.95	840.67
Aquatic Riverine	165.18	164.92	164.92	163.27	155.11
Open Water	49.30	49.02	49.02	48.04	44.20
Habitat Subtotal	*1,611.96*	*1,595.73*	*1,582.81*	*1,543.92*	*1,454.95*
Urban Area	9,437.28	9,453.51	9,466.44	9,505.33	9,594.30
Total	**11,049.24**	**11,049.24**	**11,049.25**	**11,049.25**	**11,049.25**

Bottomland Hardwood. At year 5, one percent of bottomland hardwood habitat is expected to be developed. At year 10, three percent of bottomland hardwood habitat is expected to be developed. At year 50, seven percent of bottomland hardwood habitat is expected to be lost to urban development.

Emergent Wetland. The emergent wetlands are part of the sump pump areas and would remain. No change to acreage is expected over the next 50 years. The primary purpose of the emergent wetland areas is flood control, not to provide habitat.

Grassland. At year 5, one percent of grassland habitat is expected to be developed. At year 10, three percent of grassland habitat is expected to be developed. At year 50, seven percent of grassland habitat is expected to be lost to urban development.

Aquatic Riverine. The aquatic riverine acreage is expected to remain at 165 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods due to less water from the urban area reaching the IDS. This could be due to warmer and drier conditions and/or residents and businesses retaining more water on their properties so less water reaches the storm drains. By year 50, five percent of the aquatic riverine habitat is expected to convert to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open Water. Open water includes the proposed Dallas Watersports Complex at Fish Trap Lake (22.75 acres) and ponds associated with the IDS in the southwestern section of the study area. As part of the

Dallas Watersports Complex, 0.28 acre of open water would be converted to emergent wetlands. The open water acreage would remain the same from year 0 to 5. At year 10, two percent of open water is expected to convert to bottomland hardwood (1 percent) and urban (1 percent). The habitat conversion is expected to occur from the open water filling in due to siltation and as a result of less rainfall and more evaporation from warmer temperatures. It is anticipated that half the area would grow into bottomland hardwood and the other half would become disturbed (urban). At year 50, conditions are expected to be warmer and drier from climate change, thus more habitat would convert to bottomland hardwoods and disturbed (urban) areas.

3.3 HABITAT SUITABILITY INDEXES AND HABITAT UNIT VALUES

Below are HSI, acreage, and HU tables for the habitats within the Confluence, Mainstem, and IDS Groups. HSIs in aquatic habitats are expected to increase over the next 50 years due to increased regulations and technological advances to increase water quality. HUs are determined by multiplying HSI and acreage.

3.3.1 Confluence

Table 3-5 presents FW/OPC HSIs, acres, and HUs for the Confluence for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. The habitat in the Confluence Group has existed in its current state as partially maintained and partially natural for the last 50 years. It is an extension of the Mainstem Group; therefore, the HSIs are expected to change very little over the next 50 years. The quality (HSI) of bottomland hardwoods and open water is expected to remain the same over the next 50 years whereas emergent wetland, grassland, and aquatic riverine would only increase slightly. The aquatic riverine HSI is from the Trinity River IBI for reaches 3 and 4 (USFWS 2004). The HSI is expected to remain constant from year 0 to 10. At year 50, the HSI is expected to improve due to increased regulations and technology for improvements to water quality. The open water HSI was determined from 2010 fisheries sampling (USACE 2010). No change to the quality (HSI) of the open water is expected over the next 50 years.

Table 3-5. Estimated HSIs, Acreages, and HUs for Habitat Types in the Confluence Group over the Next 50 Years under the Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.24	0.24	0.24	0.24	0.24
Acres	966.49	963.41	963.41	973.13	1,011.20
HUs	231.96	231.22	231.22	233.55	242.69
Emergent Wetland					
HSI	0.30	0.30	0.30	0.30	0.31
Acres	67.95	67.95	67.95	67.95	67.27
HUs	20.39	20.39	20.39	20.39	20.85

Grassland					
HSI	0.43	0.43	0.43	0.43	0.45
Acres	1,573.16	1,501.04	1,501.04	1,471.02	1,412.86
HUs	676.46	645.45	645.45	632.54	635.79
Aquatic Riverine					
HSI	0.9	0.9	0.9	0.9	0.93
Acres	132.42	132.36	132.36	131.04	124.49
HUs	119.18	119.12	119.12	117.94	115.78
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	150.93	150.93	150.93	147.91	136.08
HUs	107.16	107.16	107.16	105.02	96.62

3.3.2 Mainstem

Below is Table 3-6 for FW/OPC HSIs, acres, and HUs for the Mainstem for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. The habitat in the Mainstem Group has existed in its current state for the last 50 years and is highly maintained. Therefore, the HSIs are not expected to change over the next 50 years. The bottomland hardwoods are not expected to increase because the adjacent grasslands are mowed which does not allow new trees to become established or allow the bottomland hardwood habitat to expand. The maintenance is expected to continue; thus, no change to HSI or acreage is expected over the next 50 years. The emergent wetlands are periodically flooded and probably mowed when dry. Due to the maintenance and mowing, the HSI of emergent wetlands are expected to stay the same over the next 50 years. The grasslands are regularly mowed and maintained. The maintenance is expected to continue; thus, only slight change to HSI is expected over the next 50 years. The aquatic riverine HSI is from the Trinity River IBI for Reaches 1 and 2 (USFWS 2004). The aquatic riverine HSI would be constant from year 0 to 10. At year 50 the HSI is expected to increase due to increased regulations and technology for improvements to water quality. The open water HSI was determined from 2010 fisheries sampling in Crow Lake, Bart Simpson Lake, and Cell D of the Dallas Floodway Extension (USACE 2010). The only open water is Crow Park Lake. The lake is maintained within a park; therefore, no change to HSI or acreage is expected over the next 50 years.

Table 3-6. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under the Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.21	0.22	0.21	0.21	0.21
Acres	94.64	87.35	87.35	88.50	94.19
HUs	19.87	19.22	18.34	18.59	19.78
Emergent Wetland					
HSI	0.22	0.22	0.22	0.22	0.22
Acres	262.91	260.41	260.41	260.41	257.81
HUs	57.84	57.29	57.29	57.29	56.72
Grassland					
HSI	0.62	0.62	0.62	0.62	0.64
Acres	1,752.15	1,669.64	1,669.64	1,669.64	1,672.24
HUs	1,086.33	1,035.18	1,035.18	1,035.18	1,070.23
Aquatic Riverine					
HSI	0.83	0.83	0.83	0.83	0.86
Acres	123.73	114.95	114.95	113.80	108.11
HUs	102.70	95.41	95.41	94.45	92.97
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	6.41	6.41	6.41	6.41	6.41
HUs	4.55	4.55	4.55	4.55	4.55

3.3.3 Interior Drainage Systems

Table 3-7 presents the FW/OPC HSIs, acres, and HUs for the IDS for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. The majority of the bottomland hardwoods occur along the drainage channels. The quality (HSI) of the bottomland hardwoods are expected to be consistent over time. However, bottomland hardwood areas within the IDS are expected to decrease over time due to development. Bottomland hardwood habitats do not have any special protection from development, and thus the quantity of bottomland hardwood would decrease even as the HSI remains the same.

The emergent wetlands are part of the sump pump areas and will remain. Drier conditions would reduce the quality of the emergent wetland habitat under long term (50 year) conditions. The primary purpose of the emergent wetland areas are flood control, not to provide habitat.

The majority of the grasslands occur along the drainage channels. The quality (HSI) of the grassland habitat would increase slightly in the long term as trees in the urban forest provide increased foraging opportunities for grassland species. Grassland areas are expected to decrease over time because of development. Grassland habitats do not have any special protection from development.

The aquatic riverine HSI was determined using the Trinity River IBI (USFWS 2004). Reach 1, the lower reach of the Mainstem, had the lowest HSI of the four reaches and was determined to be the most similar of the four reaches to the aquatic riverine habitat within the IDS. The IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, thus it is expected to have a lower HSI than the rest of the River. The HSI is expected to remain at 0.7 from year 0 to 5 due to siltation, erosion, and other temporary impacts from construction. At year 10, the HSI is expected to be back at 0.75 (pre-construction conditions). By year 50, the HSI is expected to increase to 0.80 due to increased regulations and technology for improvements to water quality.

The open water HSI was determined from 2010 fisheries sampling (USACE 2010). Because the IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, it is expected to have a lower HSI than the Mainstem or Confluence areas of the Trinity River. Thus, the average open water HSI score was adjusted to 0.65. The water quality in the open water is not expected to change in next 50 years; therefore, the HSI would remain the same for the next 50 years.

Table 3-7. Estimated HSIs, Acreages, and HUs for Habitat Types in the Interior Drainage System Group over the Next 50 Years under the Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.39	0.39	0.39	0.39	0.39
Acres	351.50	351.47	347.96	339.66	325.97
HUs	137.09	137.07	135.70	132.47	127.13
Emergent Wetland					
HSI	0.22	0.23	0.22	0.22	0.19
Acres	87.72	89.00	89.00	89.00	89.00
HUs	19.30	20.47	19.58	19.58	16.91
Grassland					
HSI	0.57	0.57	0.57	0.57	0.62
Acres	958.26	941.32	931.91	903.95	840.67
HUs	546.21	536.55	531.19	515.25	521.22
Aquatic Riverine					
HSI	0.75	0.70	0.70	0.75	0.80
Acres	165.18	164.92	164.92	163.27	155.11
HUs	123.89	115.44	115.44	122.45	124.09

Open Water					
HSI	0.65	0.65	0.65	0.65	0.65
Acres	49.30	49.02	49.02	48.04	44.20
HUs	32.05	31.86	31.86	31.23	28.73

3.4 HABITAT UNITS SUMMARY

As presented in Table 3-8, overall HUs would decrease in 50 years under the FW/OPC. The greatest loss of HUs would occur to grassland habitat. Aquatic Riverine HUs would decrease the least.

Table 3-8. Habitat Units per Habitat Type Within the Study Area under the Future Without Project Condition

Habitat Types	*HUs*		
	Baseline	*FW/OPC (Year 50)*	*Change*
Bottomland Hardwood	388.92	389.6	0.68
Emergent Wetland	97.53	94.48	-3.05
Grassland	2,309.00	2,227.24	-81.76
Aquatic Riverine	345.77	332.84	-12.93
Open Water	143.76	129.9	-13.86
Total	**3,284.98**	**3,174.06**	**-110.92**

Table 3-9 presents the existing conditions (baseline) and FW/OPC (Year 50) HUs for the five habitat types in the Confluence, IDS, and Mainstem. The majority of the bottomland hardwood HUs are within the Confluence. Bottomland hardwood HUs in the Confluence would increase in 50 years under the FW/OPC due to grassland, aquatic riverine, and open water habitat converting to bottomland hardwood. However, the bottomland hardwood HUs in the IDS would decrease due bottomland hardwood habitat being developed. Emergent wetland HUs in the IDS and Mainstem would decrease in 50 years under the FW/OPC due to emergent wetlands converting to grasslands due to warmer and drier conditions. Grassland HUs in the Confluence, IDS, and Mainstem would decrease in 50 years under the FW/OPC due to development and grassland converting to bottomland hardwoods. The majority of the grassland HUs would be lost in the Confluence due to development. Aquatic riverine HUs in the Confluence and Mainstem would decrease in 50 years under the FW/OPC due to aquatic riverine habitat converting to bottomland hardwoods from warmer and drier conditions. Aquatic riverine HUs in the IDS would increase in 50 years under the FW/OPC due to increased regulations and technological advances to increase water quality. Open water HUs in the Confluence and IDS would decrease in 50 years under the FW/OPC due to development in the IDS and open water habitat converting to bottomland hardwoods in the Confluence and IDS from warmer and drier conditions. Open water HUs in the Mainstem are expected to remain unchanged in 50 years under the FW/OPC.

Table 3-9. Estimated HU Values for Habitats within the Study Area under Baseline and Future Without Project Condition (Year 50)

Evaluation Areas	*HUs*		
	Baseline	*FW/OPC*	*Change*
Bottomland Hardwood			
Confluence	231.96	242.69	10.73
IDS	137.09	127.13	-9.96
Mainstem	19.87	19.78	-0.09
Total	**388.92**	**389.60**	**0.68**
Emergent Wetland			
Confluence	20.39	20.85	0.46
IDS	19.30	16.91	-2.39
Mainstem	57.84	56.72	-1.12
Total	**97.53**	**94.48**	**-3.05**
Grassland			
Confluence	676.46	635.79	-40.67
IDS	546.21	521.22	-24.99
Mainstem	1,086.33	1,070.23	-16.10
Total	**2,309.00**	**2,227.24**	**-81.76**
Aquatic Riverine			
Confluence	119.18	115.78	-3.40
IDS	123.89	124.09	0.20
Mainstem	102.70	92.97	-9.73
Total	**345.77**	**332.84**	**-12.93**
Open Water			
Confluence	107.16	96.62	-10.54
IDS	32.05	28.73	-3.32
Mainstem	4.55	4.55	0.00
Total	**143.76**	**129.90**	**-13.86**

3.5 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

Please refer to Section 2.3 for a description of threatened and endangered species and birds of conservation concern within the project area.

The bald eagle (*Haliaeetus leucocephalus*) was removed from the federally threatened and endangered species list on August 8, 2007. However, bald eagles are still protected under the Bald and Golden Eagle Protection Act, as well as the Migratory Bird Treaty Act (which protects all migratory birds). The *2010 Post-delisting Monitoring Plan for the Bald Eagle (Haliaeetus leucocephalus) in the Contiguous 48 States* may be accessed via this link:

http://ecos.fws.gov/docs/species/doc3240.pdf.

It is recommended that all activities be conducted in accordance with the USFWS National Bald Eagle Management Guidelines, which may be accessed via this link:

http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

The updated 2008 list of Birds of Conservation Concern is described previously in Section 2.3 and is available via this link:

http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf.

3.6 RECOMMENDATIONS

The planning recommendations for the implementation of Alternative 1 are the same as those recommended in Chapter 2 Section 2.4.

3.7 SUMMARY

Under the FW/OPC, the majority of acreage that would be permanently impacted is average quality grassland habitat. Identified permanent impacts to aquatic habitat would be mitigated on a project-specific basis to offset impacts to quality and/or coverage. Common aquatic and terrestrial wildlife that occur within the area are likely to continue to occur in the area after the implementation of the FW/OPC. Riverine flood events under the FW/OPC would continue to have a variety of impacts, both beneficial and adverse.

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CHAPTER 4
ALTERNATIVE 2 – PROPOSED ACTION WITH PARKWAY

4.1 INTRODUCTION

This chapter describes potential impacts to fish and wildlife habitats from the implementation of Alternative 2 over the next 50 years. The study area habitat types (bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open-water) and evaluation groups (Confluence, IDS, and Mainstem) from Chapter 2 are used for the Alternative 2 evaluation. The impacts to fish and wildlife habitats from the implementation of Alternative 2, including the implementation of the BVP Study features, FRM elements, and IDP improvements, are described below and shown in Figure 6. The BVP Study features are still notional in nature. As a result, the impacts of these features cannot be determined with the same precision as the existing conditions. Thus, impacts from DFP implementation are estimated to the nearest whole acre. Similarly, existing conditions have also been recalculated to the nearest whole acre to maintain a consistent level of precision for comparison with the Alternative 2 predicted habitats. In some cases, this has resulted in slightly different values as compared to those presented in Chapter 3.

4.2 CHANGES TO HABITAT ACREAGES

As presented in Table 4-1, 99 acres of existing habitat would become urban from the implementation of Alternative 2. Open water habitat would increase under Alternative 2 from the creation of the Urban, Natural, and West lakes. Bottomland hardwood acreage would also increase with hardwoods planted along the Trinity River; the largest amount of hardwoods would be planted at the southeastern end of the project area. Aquatic riverine acreage would increase from the realignment of the river. The greatest decrease of habitat would be to grassland habitat.

Table 4-1. Estimated Changes to Habitat Acreages under Alternative 2

Habitat Type	*Acres*		
	Existing Conditions	*Alternative 2 (Year 0)*	*Change*
Bottomland Hardwood	1,414	1,511	97
Emergent Wetland	419	319	-100
Grassland	4,283	3,783	-500
Aquatic Riverine[1]	421	545	124
Open Water	206	486	280
Habitat Subtotal	*6,743*	*6,644*	*-99*
Urban Area	10,400	10,499	99
Total	**17,143**	**17,143**	**0**

Note: [1]Alternative 2 aquatic riverine includes fringe riparian habitat.

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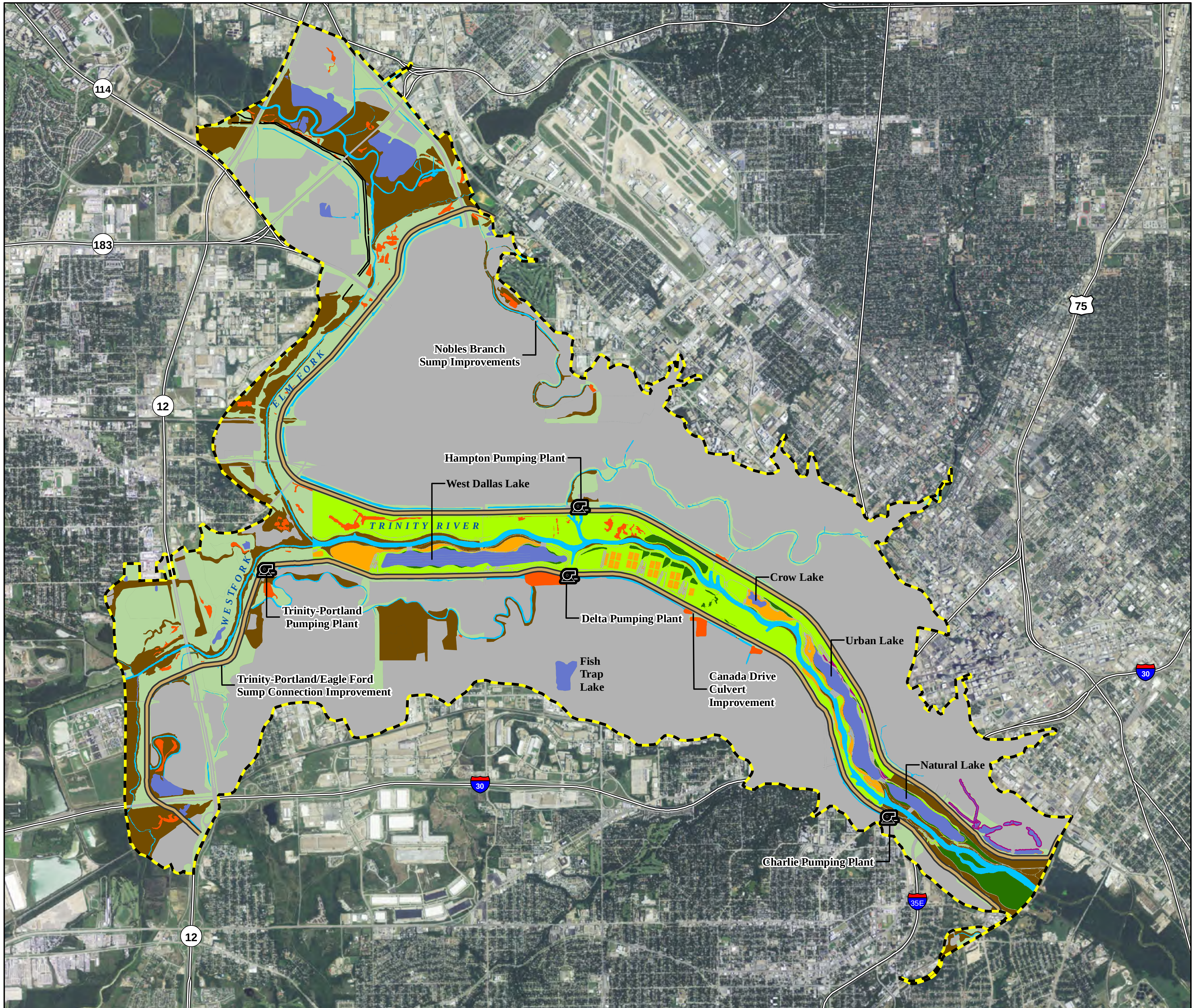
Figure 6
Habitat Types Under Alternative 2

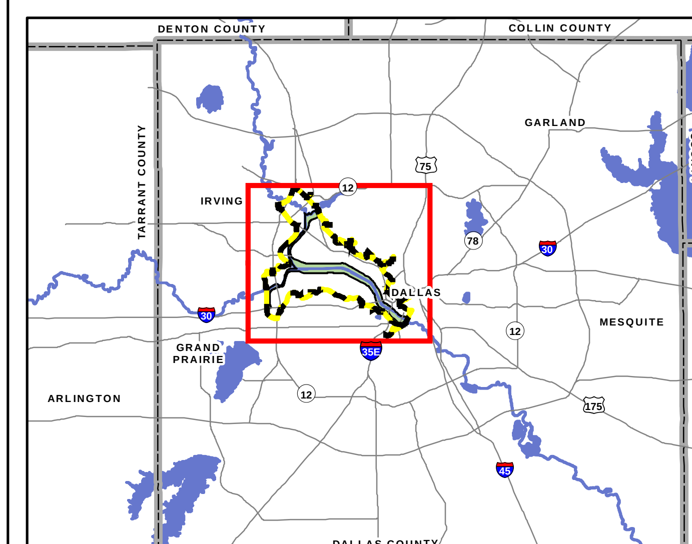


LEGEND

- ROI
- Dallas Floodway Levee
- IDP Pumping Plant
- Freeway

Habitat Types (At Year 0)

- Aquatic Riverine
- Bottomland Hardwood
- Emergent Wetland
- Remaining Existing Emergent Wetland
- Grassland
- Meadow
- Turf
- Urban Forest
- Open Water
- Urban



0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

GIS Sources:City of Dallas 2008a, NCTCOG 2008, USACE 2013b, USFWS 2006

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4.2.1 Confluence

The Confluence Group includes the Elm Fork and West Fork of the Trinity River and the associated emergent wetland and upland habitat in the area. The Alternative 2 actions in the Confluence consist of the FRM Elements and the IDP Trinity-Portland Pumping Plant and Eagle Ford and Trinity-Portland sump improvements.

Table 4-2 presents the predicted acreages for the habitat types in the Confluence Group over the next 50 years from the implementation of Alternative 2.

Table 4-2. Estimated Changes in Habitat Acreages in the Confluence Group over the Next 50 Years under Alternative 2

Habitat Type	*Existing Conditions*	*Year (acres)*			
		0	*5*	*10*	*50*
Bottomland Hardwood	967	966	966	976	1,016
Emergent Wetland	68	68	68	68	67
Grassland	1,573	1,574	1,574	1,543	1,482
Aquatic Riverine	132	133	133	132	125
Open Water	151	151	151	148	136
Habitat Subtotal	*2,891*	*2,892*	*2,892*	*2,867*	*2,826*
Urban Area	927	926	926	951	992
Total	**3,818**	**3,818**	**3,818**	**3,818**	**3,818**

Bottomland Hardwood. The acreage of bottomland hardwoods under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Emergent Wetland. The acreage of emergent wetlands under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Grassland. The acreage of grasslands under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Aquatic Riverine. The Aquatic Riverine progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.1).

Open Water. The open water progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.1).

4.2.2 Mainstem

The habitat in the Mainstem Group has existed in its current state for the last 50 years. Under Alternative 2, most of the habitat in the Mainstem would be temporarily impacted during the implementation of the BVP Study features. After the 10-year construction period for the BVP Study features is complete (2015-

2025), most of the habitat would be restored to a higher habitat value than its current state. Three large lakes, re-alignment of the Trinity River, fringe riparian habitat, native grassland meadows, additional bottomland hardwoods, and additional higher quality wetlands would be created with the implementation of the BVP (refer to Figure 6). Alternative 2 FRM elements would improve the levees and have minimal impacts on habitat. Alternative 2 IDP improvements would add a small amount of aquatic riverine acreage to the Mainstem from the creation of outfalls at Charlie and Hampton pump stations. The majority of the increase in aquatic riverine habitat results from the river modification proposed under Alternative 2.

Table 4-3 presents the predicted acreages for the habitat types in the Mainstem Group over the next 50 years with the implementation of Alternative 2.

Table 4-3. Estimated Changes in Habitat Acreages in the Mainstem Group over the Next 50 Years under Alternative 2

Habitat Type	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood	**95**	**195**	**195**	**195**	**198**	**203**	**215**
Emergent Wetland							
Existing	263	32	32	32	32	32	32
Proposed	-	152	152	152	152	152	150
Total Emergent Wetlands	*263*	*184*	*184*	*184*	*184*	*184*	*182*
Grassland							
Existing Maintenance Levels	1,752	192	192	192	192	192	194
Meadow	-	887	887	887	887	887	887
Urban Forest	-	5	5	5	5	5	5
Turf	-	158	158	158	158	158	158
Total Grasslands	*1,752*	*1,242*	*1,242*	*1,242*	*1,242*	*1,242*	*1,244*
Aquatic Riverine[1]	**124**	**250**	**250**	**250**	**247**	**242**	**230**
Open Water							
Existing - Crow Lake	6	6	6	6	6	6	6
Natural Lake	-	50	50	50	50	50	50
Urban and West Dallas Lake	-	207	207	207	207	207	207
Total Open Water	*6*	*263*	*263*	*263*	*263*	*263*	*263*
Habitat Subtotal	***2,240***	***2,134***	***2,134***	***2,134***	***2,134***	***2,134***	***2,134***
Urban Area	36	142	142	142	142	142	142
Total	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**

Note: [1]Aquatic riverine includes fringe riparian habitat.

Bottomland Hardwood. Under Alternative 2, most of the existing bottomland hardwoods would be removed during the re-alignment of the Trinity River under the BVP Study features. During the implementation of the BVP Study features, 195 acres of bottomland hardwood would be planted in the Mainstem, primarily along the southeastern section of the new Trinity River channel.

The bottomland hardwoods would be planted in an area adjacent to the levee and would be managed to prevent any impact to the levee. At years 10, 25, and 50, an increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood.

Emergent Wetland. The Mainstem wetlands under Alternative 2 would comprise approximately 184 acres, 32 acres of existing wetlands and 152 acres of wetlands created from the implementation of the BVP Study features. The created wetlands would include Corinth, Cypress, and fringe marsh wetlands along the edge of the lakes.

With the proposed maintenance of the BVP in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 to 25 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland because of siltation and warmer and drier conditions from climate change.

Grassland. With the implementation of the BVP Study features, the majority of the existing grasslands would be temporarily disturbed and would be replanted and realigned.. The grasslands would consist of low quality mowed turf, native meadows, and urban forests.

Due to the proposed maintenance of the grasslands in the Mainstem, no change to BVP grassland acreage is expected over the next 50 years. At year 50, the acreage is expected to increase due to the emergent wetland converting to grassland.

Aquatic Riverine. The aquatic riverine habitat value and acreage in the Mainstem would change significantly under Alternative 2. As a result of the BVP Study features the Trinity River is proposed to be re-routed to increase sinuosity and increase habitat value. The Mainstem aquatic riverine would include fringe riparian habitat.

The aquatic riverine acreage is expected to remain at 250 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods as a result of less water reaching the Mainstem. This could be due to warmer and drier conditions and/or residents and businesses retaining more water on their properties. At year 25, two percent of aquatic riverine is expected to be converted to bottomland hardwoods. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open Water. Under Alternative 2, the Mainstem would comprise 263 acres of open water, including the existing Crow Lake and three BVP Study lakes, Urban, West, and Natural. The lakes would be maintained; therefore, no change to open water acreage is expected over the next 50 years.

4.2.3 Interior Drainage Systems

The IDS Group is primarily an urban area with pockets of habitat surrounding the existing sumps, pumps, and drainage channels. Alternative 2 actions in the IDS consist of the Charlie, Delta, and Hampton, Pumping Plant improvements, and the Nobles Branch and East Levee sump improvements. Table 4-4 presents the predicted acreages for the habitat types in the IDS Group over the next 50 years with the implementation of Alternative 2.

Bottomland Hardwood. The acreage of bottomland hardwoods under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Emergent Wetland. The acreage of emergent wetlands under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Grassland. The acreage of grasslands that would be maintained under Alternative 2 would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Due to the proposed maintenance of the urban forest landscaping, primarily around the Able Sumps, no change to urban forest-type grassland acreage is expected over the next 50 years.

Aquatic Riverine. The aquatic riverine progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.3).

Open Water. The open water progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.3).

Table 4-4. Estimated Changes in Habitat Acreages in the Interior Drainage Systems Group over the Next 50 Years under Alternative 2

Habitat Type	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood	352	350	347	339	326
Emergent Wetland	88	67	67	67	67
Grassland					
Existing Maintenance Levels	958	945	936	908	844
Urban Forest	-	22	22	22	22
Grassland Subtotal	*958*	*967*	*958*	*930*	*866*
Aquatic Riverine	165	162	162	160	152
Open Water	49	72	72	71	65
Habitat Subtotal	***1,612***	***1,618***	***1,606***	***1,567***	***1,476***
Urban Area	9,437	9,431	9,443	9,482	9,573
Total	**11,049**	**11,049**	**11,049**	**11,049**	**11,049**

4.3 HABITAT SUITABILITY INDEXES AND HABITAT UNIT VALUES

HSI values for Alternative 2 were based in the species models used for the baseline assessment (Section 2.2) (USACE 2013c). In April 2013, the USFWS hosted the USACE to coordinate and assist in prediction of the future conditions with the action alternative completed. The *Trinity River Corridor Design Guidelines* (City of Dallas 2009) was used to inform the models in terms of future plant assemblage and habitat anticipated within the Floodway.

4.3.1 Confluence

The HSI and HU values progressions for the Confluence are presented in Table 4-5. The analysis associated with the progressions predicted is the same as that presented for Alternative 1 (refer to Section 3.3.1).

Table 4-5. Estimated HSIs, Acreages, and HUs for Habitat Types in the Confluence Group over the Next 50 Years under Alternative 2

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.24	0.24	0.24	0.24	0.24
Acres	966.49	966	966	976	1016
HUs	231.96	231.84	231.84	234.24	243.84
Emergent Wetland					
HSI	0.30	0.30	0.30	0.30	0.31
Acres	67.95	68	68	68	67
HUs	20.39	20.40	20.40	20.40	20.77
Grassland					
HSI	0.43	0.43	0.43	0.43	0.45
Acres	1,573.16	1,574	1,574	1,543	1,482
HUs	676.46	676.82	676.82	663.49	666.90
Aquatic Riverine					
HSI	0.90	0.90	0.90	0.90	0.93
Acres	132.42	133	133	132	125
HUs	119.18	119.7	119.7	118.8	116.25
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	150.93	151	151	148	136
HUs	107.16	107.21	107.21	105.08	96.56

Note: Existing conditions acreages are to 100th of an acre to be consistent with the existing condition HUs in Chapter 3. The Proposed Action acreages are presented in whole numbers.

4.3.2 Mainstem

Table 4-6 presents the Alternative 2 HSIs, acres, and HUs for the Mainstem for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. With the implementation of the BVP Study features, most of the habitat in the Mainstem would be temporarily disturbed. Following the implementation of the BVP Study features (years 0, 1, and 5), the bottomland hardwood, emergent wetland, and urban forest HSIs would be low because the habitats would have just been created and would take time to become established. The bottomland hardwood HSIs are expected to increase over time as the trees mature, and the emergent wetland HSIs are expected to increase over time as the wetlands become more established.

The Mainstem grasslands would consist of native meadow, turf, and urban forest. The native meadow is expected to have a higher HSI than the existing non-native dominated grassland and is expected to increase in value over the next 50 years from increased native species diversity. The turf HSI is not expected to change over time because mowed grass is expected to remain at the same low habitat value over the next 50 years. Urban forest is considered a subset of grassland because the majority of the proposed trees would be non-native ornamental trees and do not provide the same habitat value as a native forest.

Aquatic riverine and open water habitat HSIs are not expected to increase much over time because they would contain water and are expected to be functioning aquatic ecosystems once the BVP Study features are completed. At year 50, the aquatic riverine HSI is expected to increase due to increased regulations and technology for improvements to water quality. The open water HSI was determined by referring to the 2010 fisheries sampling in Crow Lake, Bart Simpson Lake, and Cell D of the Dallas Floodway Extension (USACE 2010).

Table 4-6. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under Alternative 2

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	195	195	195	198	203	215
HUs	19.87	17.55	17.55	17.55	25.74	42.63	92.45
Emergent Wetland							
Existing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	32	32	32	32	32	32
HUs	57.84	7.04	7.04	7.04	7.04	7.04	7.04

Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	152	152	152	152	152	150
HUs	0.00	19.76	19.76	51.68	63.84	71.44	78
Total Wetland HU	**57.84**	**26.8**	**26.8**	**58.72**	**70.88**	**78.48**	**85.04**
Grassland							
Existing Maintenance Levels							
HSI	0.62	0.40	0.40	0.40	0.40	0.40	0.40
Acres	1,752.15	192	192	192	192	192	194
HUs	1,086.33	76.8	76.8	76.8	76.8	76.8	77.6
Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	887	887	887	887	887	887
HUs	0.00	443.50	532.20	620.90	576.55	620.90	753.95
Landscaping: Turf							
HSI	-	0	0	0.40	0.40	0.40	0.40
Acres	-	158	158	158	158	158	158
HUs	0.00	0.00	0.00	63.20	63.20	63.20	63.20
Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	5	5	5	5	5	5
HUs	0.00	2.50	2.50	2.00	2.00	2.00	2.00
Total Grassland HU	**1,086.33**	**522.8**	**611.5**	**762.9**	**718.55**	**762.9**	**896.75**
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	250	250	250	247	242	230
HUs	102.70	207.50	187.50	207.50	209.95	210.54	207.00
Open Water							
Crow Lake							
HSI	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Acres	6.41	6.41	6.41	6.41	6.41	6.41	6.41
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55

Urban Lake & West Dallas Lake							
HSI	-	0.00	0.00	0.43	0.77	0.77	0.77
Acres	-	207	207	207	207	207	207
HUs	-	0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI	-	0.00	0.00	0.60	0.77	0.77	0.77
Acres	-	50	50	50	50	50	50
HUs	-	0.00	0.00	30.00	38.50	38.50	38.50
Total Open Water HU	**4.55**	**4.55**	**4.55**	**123.56**	**202.44**	**202.44**	**202.44**

4.3.3 Interior Drainage Systems

Table 4-7 presents the Alternative 2 HSIs, acres, and HUs for the IDS for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years.

The majority of the bottomland hardwoods occur along the drainage channels. Bottomland hardwood areas within the IDS are expected to decrease over time due to development. Bottomland hardwood habitats do not have any special protection from development.

The emergent wetlands are part of the sump pump areas and will remain. As a drying trend is predicted for the region, the quality and quantity of emergent wetlands is expected to decrease in the long term. The primary purpose of the emergent wetland areas are flood control, not to provide habitat.

The majority of the grasslands occur along the drainage channels. The quality (HSI) of the grassland habitat would increase slightly in the long term as trees in the urban forest provide increased foraging opportunities for grassland species. Grassland areas are expected to decrease over time because of development. Grassland habitats do not have any special protection from development.

The aquatic riverine HSI was determined using the Trinity River IBI (USFWS 2004). Reach 1, the lower reach of the Mainstem, had the lowest HSI of the four reaches and was determined to be the most similar of the four reaches to the IDS. The IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal; therefore, it is expected to have a lower HSI than the rest of the River. The HSI is expected to remain at 0.7 from year 0 to 5 because of siltation, erosion, and other temporary impacts from construction. At year 10, the HSI is expected to be back at 0.75 (pre-construction conditions). By year 50, the HSI is expected to increase to 0.80 due to increased regulations and technology for improvements to water quality.

The open water HSI was determined from 2010 fisheries sampling (USACE 2010). Because the IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, it is expected to have a lower HSI than the Mainstem or Confluence areas of the Trinity River. Therefore, the average open water HSI score was adjusted to 0.65. The water quality in the open water is not expected to change in the next 50 years; therefore, the HSI would remain the same for the next 50 years.

Table 4-7. Estimated HSIs, Acreages, and HUs for Habitat Types in the Interior Drainage System Group over the Next 50 Years under Alternative 2

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.39	0.39	0.39	0.39	0.39
Acres	351.50	350	347	339	326
HUs	137.09	136.50	135.33	132.21	127.14
Emergent Wetland					
HSI	0.22	0.23	0.22	0.22	0.19
Acres	87.72	67	67	67	67
HUs	19.3	15.41	14.74	14.74	12.73
Grassland					
Existing Maintenance Levels					
HSI	0.57	0.57	0.57	0.57	0.62
Acres	958.26	945	936	908	844
HUs	546.21	538.65	533.52	517.56	523.28
Landscaping: Urban Forest					
HSI		0.50	0.40	0.40	0.40
Acres		22	22	22	22
HUs	0	11	8.8	8.8	8.8
Total Grassland HU	**546.21**	**549.65**	**542.32**	**526.36**	**532.08**
Aquatic Riverine					
HSI	0.75	0.70	0.70	0.75	0.80
Acres	165.18	162	162	160	152
HUs	123.89	113.40	113.40	120.00	121.60
Open Water					
HSI	0.65	0.65	0.65	0.65	0.65
Acres	49.30	72	72	71	65
HUs	32.05	46.80	46.80	46.15	42.25

4.4 HABITAT UNITS SUMMARY

As presented in Table 4-8, overall HUs would increase under Alternative 2 over the next 50 years. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic Riverine habitat would increase from the realignment of the river. The greatest decrease of HUs would be to grassland habitat.

Table 4-8. HUs per Habitat Type Within the Study Area under Alternative 2

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	463.43	74.51
Emergent Wetland	97.53	118.54	21.01
Grassland	2,309.00	2,095.73	-213.27
Aquatic Riverine	345.77	444.85	99.08
Open Water	143.76	341.25	197.49
Total	3,284.98	3,463.80	178.82

Table 4-9 presents the existing conditions (baseline) and Alternative 2 (Year 50) HUs for the five habitat types in the Confluence, IDS, and Mainstem.

Table 4-9. Estimated HU Values for Habitats within the Study Area under Baseline and Alternative 2 (Year 50)

Evaluation Areas	*HUs*		
	Baseline	*Alternative 2*	*Change*
Bottomland Hardwood			
Confluence	231.96	243.84	11.88
IDS	137.09	127.14	-9.95
Mainstem	19.87	92.45	72.58
Total	**388.92**	**463.43**	**74.51**
Emergent Wetland			
Confluence	20.39	20.77	0.38
IDS	19.30	12.73	-6.57
Mainstem	57.84	85.04	27.20
Total	**97.53**	**118.54**	**21.01**
Grassland			
Confluence	676.46	666.90	-9.56
IDS	546.21	532.08	-14.13
Mainstem	1,086.33	896.75	-189.58
Total	**2,309.00**	**2,095.73**	**-213.27**

Aquatic Riverine			
Confluence	119.18	116.25	-2.93
IDS	123.89	121.60	-2.29
Mainstem	102.70	207.00	104.30
Total	**345.77**	**444.85**	**99.08**
Open Water			
Confluence	107.16	96.56	-10.60
IDS	32.05	42.25	10.20
Mainstem	4.55	202.44	197.89
Total	**143.76**	**341.25**	**197.49**

Bottomland Hardwood. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 2 due to bottomland hardwoods being planted as part of the BVP Study features, and grassland, aquatic riverine, and open water habitat converting to bottomland hardwood. However, the bottomland hardwood HUs in the IDS would decrease due bottomland hardwood habitat being developed.

Emergent Wetland. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 2 due to the creation and maintenance of more emergent wetlands. Emergent wetland HUs in the IDS would decrease in 50 years under Alternative 2 due to emergent wetlands converting to grasslands as a result of warmer and drier conditions.

Grassland. HUs in the Confluence, IDS, and Mainstem would decrease in 50 years under Alternative 2 due to development and grassland converting to bottomland hardwoods. The majority of the grassland HUs would be lost in the Mainstem due to development.

Aquatic Riverine. HUs in the Mainstem would increase in 50 years under Alternative 2 due to the realignment of the Trinity River and increased regulations and technological advances to increase water quality. Aquatic riverine HUs in the Confluence and IDS would decrease in 50 years under Alternative 2 due to aquatic riverine habitat converting to bottomland hardwoods from warmer and drier conditions.

Open Water. HUs in the Mainstem would increase in 50 years due to the creation of West, Urban, and Natural Lakes. Open water HUs in the Confluence would decrease in 50 years under Alternative 2 due to open water habitat converting to bottomland hardwoods in the Confluence from warmer and drier conditions.

4.5 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

The potential for threatened or endangered species, or birds of conservation concern within the study area under Alternative 2 is anticipated to be the same as that under Alternative 1 (refer to Section 3.5).

Alternative 2 would create higher habitat values than both those of the existing conditions and those predicted under the FW/OPC. However, as under Alternative 1, federally-listed species are not likely to breed or establish permanent residences in the study area under Alternative 2.

4.6 RECOMMENDATIONS

The planning recommendations for the implementation of Alternative 2 are the same as those recommended for Alternative 1, refer to Section 2.4.

4.7 SUMMARY

Under Alternative 2, overall HUs would increase. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river. Emergent wetlands would have a small increase due to the creation of higher quality wetlands. The greatest decrease of HUs would be to grassland habitat.

CHAPTER 5
ALTERNATIVE 3 – PROPOSED ACTION WITHOUT PARKWAY

5.1 INTRODUCTION

This chapter describes potential impacts to fish and wildlife habitats from the implementation of Alternative 3 over the next 50 years. The study area, habitat types (bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water) and evaluation groups (Confluence, IDS, and Mainstem) from Chapter 2 are used for the Alternative 3 evaluation. The impacts to fish and wildlife habitats from the implementation of the Alternative 3, including the implementation of the FRM elements, BVP Study features, and IDP improvements are described below and shown in Figure 7.

5.2 CHANGES TO HABITAT ACREAGES

As presented in Table 5-1, 104 acres of existing habitat would become urban from the implementation of Alternative 3. Under Alternative 2, 99 acres of existing habitat would become urban. Therefore, Alternative 3 would create five more acres of urban habitat than would Alternative 2.

The greatest decrease of habitat would be to grassland. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river.

Table 5-1. Estimated Changes to Habitat Acreages under Alternative 3

Habitat Type	*Acres*		
	Existing Conditions	*Alternative 3 (Year 0)*	*Change*
Bottomland Hardwood	1,414	1,510	96
Emergent Wetland	419	321	-98
Grassland	4,283	3,777	-506
Aquatic Riverine	421	545	124
Open Water	206	486	280
Habitat Subtotal	*6,743*	*6,639*	*-104*
Urban Area	10,400	10,504	104
Total	**17,143**	**17,143**	**0**

5.2.1 Confluence

Alternative 3 and Alternative 2 propose the same activities in the Confluence area with the same impacts. Therefore, the changes in habitat acreages within the Confluence would be the same under Alternative 3 as with Alternative 2. Please refer to Section 4.2.1.

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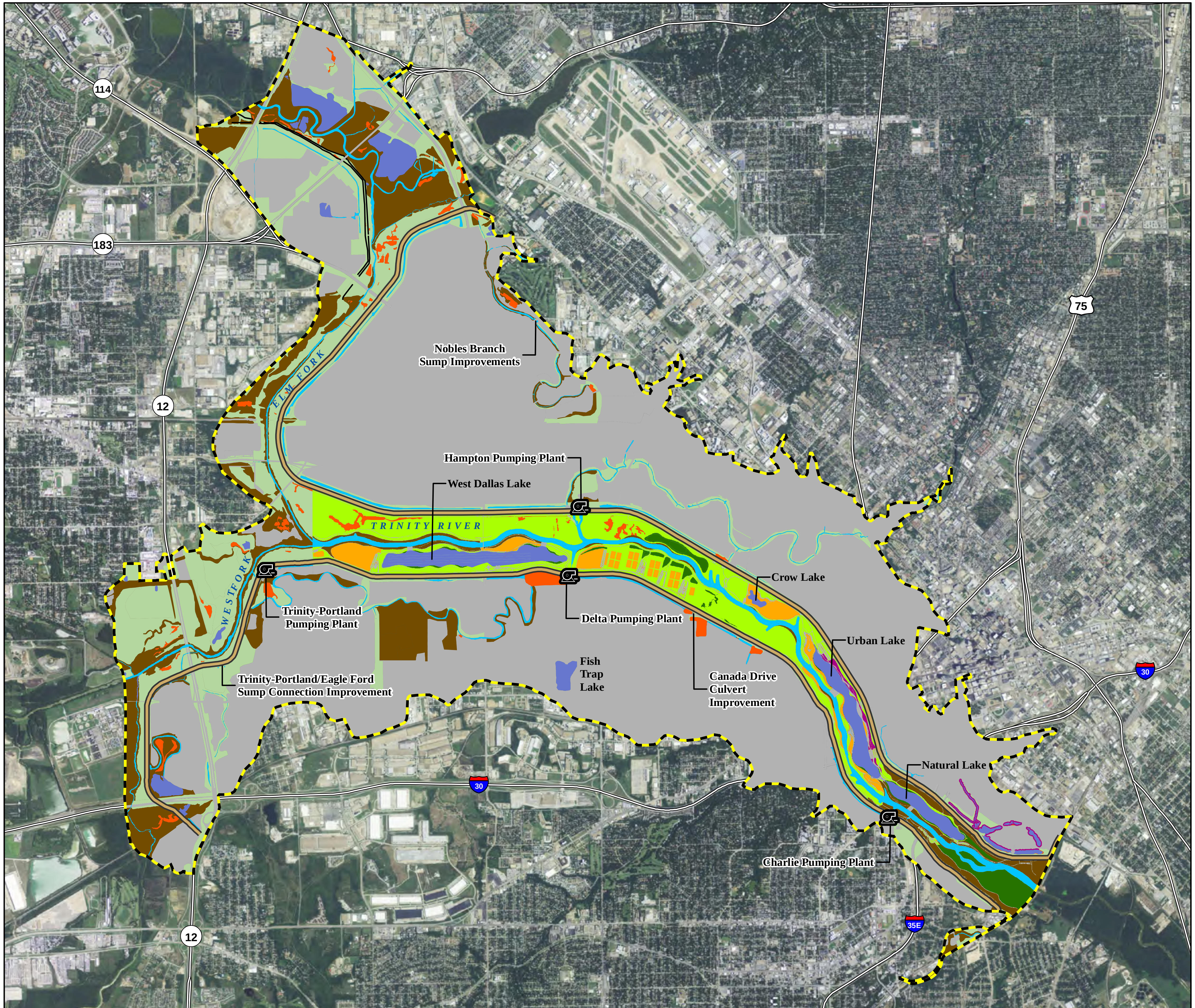
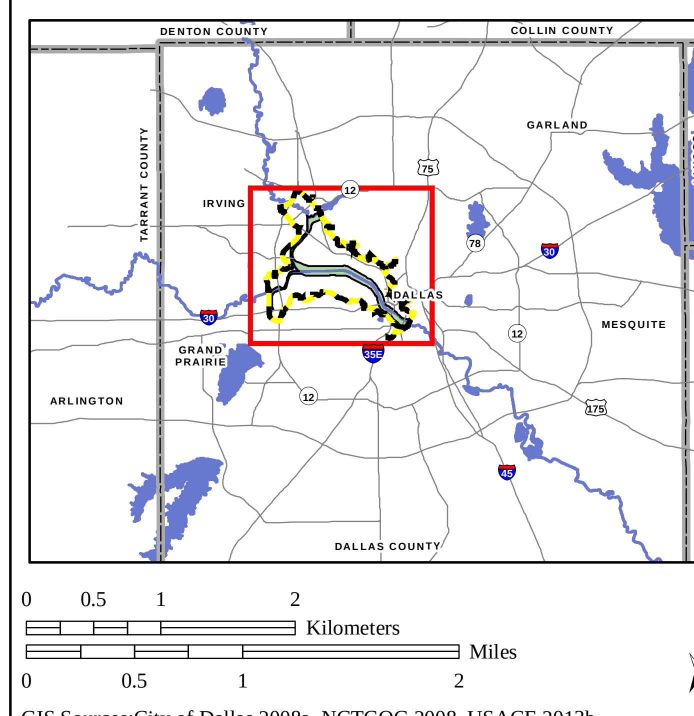
Figure 7
Habitat Types Under Alternative 3





GIS Sources:City of Dallas 2008a, NCTCOG 2008, USACE 2013b, USFWS 2006

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5.2.2 Mainstem

The habitat in the Mainstem Group has existed in its current state for the last 50 years. Under Alternative 3, most of the habitat in the Mainstem would be temporarily impacted during the implementation of the BVP Study features. After the 10-year construction period for the BVP Study features (2015-2025), most of the habitat would be restored to a higher habitat value than its current state. Three large lakes, realignment and modification of the Trinity River, fringe riparian habitat, native grassland meadows, additional bottomland hardwoods, and additional higher quality wetlands would be created with the implementation of the BVP Study features. Alternative 3 FRM elements would improve the levees but would have minimal impacts on habitat. Alternative 3 IDP improvements would add a small amount of aquatic riverine acreage to the Mainstem from the creation of outfalls at Charlie and Hampton pump stations. Table 5-2 presents the predicted acreages for the habitat types in the Mainstem Group over the next 50 years with the implementation of Alternative 3.

Table 5-2. Estimated Changes in Habitat Acreages in the Mainstem Group over the Next 50 Years under Alternative 3

Habitat Type	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood	**95**	**194**	**194**	**194**	**197**	**202**	**214**
Emergent Wetland							
Existing	263	32	32	32	32	32	32
Proposed	-	154	154	154	154	154	152
Total Emergent Wetland	**263**	**186**	**186**	**186**	**186**	**186**	**184**
Grassland							
Existing Maintenance Levels	1,752	191	191	191	191	191	193
Landscaping: Meadow		844	844	844	844	844	844
Landscaping: Urban Forest		15	15	15	15	15	15
Landscaping: Turf		186	186	186	186	186	186
Total Grassland	*1,752*	*1,236*	*1,236*	*1,236*	*1,236*	*1,236*	*1,238*
Aquatic Riverine[1]	**124**	**250**	**250**	**250**	**247**	**242**	**230**
Open Water							
Existing - Crow Lake	6	6	6	6	6	6	6
Natural Lake		50	50	50	50	50	50
Urban and West Dallas Lake	-	207	207	207	207	207	207

Total Open Water	*6*	*263*	*263*	*263*	*263*	*263*	*263*
Habitat Subtotal	***2,240***	***2,129***	***2,129***	***2,129***	***2,129***	***2,129***	***2,129***
Urban Area	36	147	147	147	147	147	147
Total	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**

Note: [1]Aquatic riverine includes fringe riparian habitat.

Bottomland Hardwood. Under Alternative 3, most of the existing bottomland hardwoods would be removed during the realignment and modification of the Trinity River under the BVP Study features. During the implementation of the BVP Study features, 194 acres of bottomland hardwood would be planted in the Mainstem, primarily along the southeastern section of the new Trinity River channel.

The acreage of bottomland hardwoods is not expected to increase because the hardwoods would be planted in an area adjacent to the levee and would not be allowed to expand next to the levee. Therefore, no change to acreage is expected over the next 10 years. At years 10 and 50, an increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood.

Emergent Wetland. The Mainstem wetlands under Alternative 3 would consist of approximately 186 acres of wetlands consisting of approximately 32 acres of existing wetlands and approximately 154 of wetlands created from the implementation of the BVP Study features. The created wetlands would include Corinth, Cypress, and fringe marsh wetlands along the edge of the lakes.

Due to the proposed maintenance of the BVP Study features in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland due to siltation and warmer and drier conditions resulting from climate change.

Grassland. With the implementation of the BVP Study features, the majority of the existing grasslands would be temporarily disturbed and would be replanted and realigned after the completion of the BVP Study features. BVP grasslands would consist of low quality mowed turf, native meadows, and urban forests.

Due to the proposed maintenance of the BVP Study features in the Mainstem, no changes to grassland acreage is expected over the next 50 years. At year 50, the acreage is expected to increase by one percent, due to the emergent wetland converting to grassland.

Aquatic Riverine. The aquatic riverine habitat value and acreage in the Mainstem would change significantly under Alternative 3. Under the BVP Study features, the Trinity River is proposed to be realigned and modified to increase sinuosity and increase habitat value. The Mainstem aquatic riverine would include fringe riparian habitat.

The aquatic riverine acreage is expected to remain at 250 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods due to less water reaching the Mainstem. This could be from warmer and drier conditions and/or residents and businesses retaining more water on their properties. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions resulting from climate change.

Open Water. The Mainstem under Alternative 3 would encompass 263 acres of open water consisting of the existing Crow Lake and Urban, West, and Natural lakes which would be created under the BVP Study features. The lakes would be maintained; therefore, no change to open water acreage is expected over the next 50 years.

5.2.3 Interior Drainage Systems

Alternative 3 and Alternative 2 propose the same activities in the IDS with the same impacts. Therefore, the changes in habitat acreages within the IDS would be the same under Alternative 3 as with Alternative 2. Please refer to Section 4.2.3.

5.3 HABITAT SUITABILITY INDEX VALUES

HSIs for Alternative 3 were based in the species models used for the baseline assessment (Section 2.2) (USACE 2013c). In April 2013, the USFWS hosted the USACE to coordinate and assist in prediction of the future conditions with the action alternative completed. The *Trinity River Corridor Design Guidelines* (City of Dallas 2009) was used to inform the models in terms of future plant assemblage and habitat anticipated within the Floodway.

5.3.1 Confluence

Alternative 3 and Alternative 2 propose the same activities in the Confluence area with the same impacts. Therefore, The HSI and HU values for the Confluence are anticipated to be the same as those under Alternative 2 (refer to Section 4.3.1).

5.3.2 Mainstem

Table 5-3 provides HSIs, acres, and HUs under Alternative 3 for the Mainstem for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. With the implementation of the BVP Study features, most of the habitat in the Mainstem would be temporarily disturbed. Following the implementation of the BVP Study features (Years 0, 1, and 5), the bottomland hardwood, emergent wetland, and urban forest HSIs would be low because the habitats would take time to become established. The bottomland hardwood HSIs are expected to increase over time as the trees mature, and the emergent wetland HSIs are expected to increase over time as the wetlands become more established.

The Mainstem grasslands would consist of native meadow, turf, and urban forest. The native meadow is expected to have a higher HSI than the existing non-native dominated grassland, and is expected to increase in value over the next 50 years from increased native diversity. The turf HSI is not expected to change over time because mowed grass is expected to remain at the same low habitat value over the next 50 years. Urban forest is considered a subset of grassland because the majority of the trees are planted non-native ornamental trees and do not provide the same habitat value as a native forest.

Aquatic riverine and open water habitat HSIs are not expected to increase much over time because they would contain water and are expected to be functioning aquatic ecosystems once the BVP is completed. At year 50, the aquatic riverine HSI is expected to increase due to increased regulations and technology for improvements to water quality. The open water HSI was determined by referencing the 2010 fisheries sampling in Crow Lake, Bart Simpson Lake, and Cell D of the Dallas Floodway Extension (USACE 2010).

Table 5-3. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under Alternative 3

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	194	194	194	197	202	214
HUs	19.87	17.46	17.46	17.46	25.61	42.42	92.02
Emergent Wetland							
Existing/Continuing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	32	32	32	32	32	32
HUs	57.84	7.04	7.04	7.04	7.04	7.04	7.04
Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	154	154	154	154	154	152
HUs	0	20.02	20.02	52.36	64.68	72.38	79.04
Emergent Wetland HU	***57.84***	***27.06***	***27.06***	***59.4***	***71.72***	***79.42***	***86.08***
Grassland							
Existing Maintenance Levels							
HSI	0.62	0.40	0.40	0.40	0.40	0.40	0.40
Acres	1,752.15	191	191	191	191	191	193
HUs	1,086.33	76.40	76.40	76.40	76.40	76.40	77.20
Landscaping: Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	844	844	844	844	844	844
HUs	0.00	422.00	506.40	590.80	548.60	590.80	717.40
Landscaping: Turf							
HSI	-	0.00	0.00	0.40	0.40	0.40	0.40
Acres	-	186	186	186	186	186	186
HUs	0.00	0.00	0.00	74.40	74.40	74.40	74.40

Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	15	15	15	15	15	15
HUs	0.00	7.50	7.50	6.00	6.00	6.00	6.00
Grassland HU	***1,086.33***	***505.90***	***590.30***	***747.60***	***705.40***	***747.60***	***875.00***
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	250	250	250	247	242	230
HUs	102.70	207.50	187.50	207.50	209.95	210.54	207.00
Open Water							
Crow Lake							
HSI	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Acres	6.41	6.41	6.41	6.41	6.41	6.41	6.41
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Urban Lake & West Dallas Lake							
HSI		0.00	0.00	0.43	0.77	0.77	0.77
Acres		207	207	207	207	207	207
HUs		0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI		0.00	0.00	0.60	0.77	0.77	0.77
Acres		50	50	50	50	50	50
HUs		0.00	0.00	30.00	38.50	38.50	38.50
Open Water HU	***4.55***	***4.55***	***4.55***	***123.56***	***202.44***	***202.44***	***202.44***

5.3.3 Interior Drainage Systems

Alternative 3 and Alternative 2 propose the same activities in the IDS with the same impacts. Therefore, The HSI and HU values for the IDS are anticipated to be the same as those under Alternative 2 (refer to Section 4.3.3).

5.4 HABITAT UNITS SUMMARY

As presented in Table 5-4, overall HUs would decrease in 50 years under Alternative 3. The greatest decrease of HUs would occur to grassland habitat. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river.

Table 5-4. HUs per Habitat Type Within the Study Area under Alternative 3

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	463.00	74.08
Emergent Wetland	97.53	119.58	22.05
Grassland	2,309.00	2,073.98	-235.02
Aquatic Riverine	345.77	444.85	99.08
Open Water	143.76	341.25	197.49
Total	3,284.98	3,442.66	157.68

Table 5-5 presents the existing conditions (baseline) and Alternative 3 (Year 50) HUs for the five habitat types in the Confluence, IDS, and Mainstem.

Bottomland Hardwood. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 3 due to bottomland hardwoods being planted as part of the BVP Study features and grassland, aquatic riverine, and open water habitats converting to bottomland hardwood. However, the bottomland hardwood HUs in the IDS would decrease due to bottomland hardwood habitat being developed.

Emergent Wetland. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 3 due to the creation and maintenance of more emergent wetlands. Emergent wetland HUs in the IDS would decrease in 50 years under Alternative 3 due to emergent wetlands converting to grasslands because of warmer and drier conditions.

Grassland. HUs in the Confluence, IDS, and Mainstem would decrease in 50 years under Alternative 3 due to development and grassland converting to bottomland hardwoods. The majority of the grassland HUs would be lost in the Mainstem due to development.

Aquatic Riverine. HUs in the Mainstem would increase in 50 years under Alternative 3 due to the realignment of the Trinity River and increased regulations and technological advances to increase water quality. Aquatic riverine HUs in the Confluence and IDS would decrease in 50 years under Alternative 3 due to aquatic riverine habitat converting to bottomland hardwoods from warmer and drier conditions.

Open Water. HUs in the Mainstem would increase in 50 years due to the creation of West, Urban, and Natural Lakes. Open water HUs in the Confluence would decrease in 50 years under the Alternative 3 due to open water habitat converting to bottomland hardwoods in the Confluence from warmer and drier conditions.

Table 5-5. Estimated HU Values for Habitats within the Study Area under Baseline and Alternative 3 (Year 50)

Evaluation Areas	*HUs*		
	Baseline	*Alternative 3*	*Change*
Bottomland Hardwood			
Confluence	231.96	243.84	11.88
IDS	137.09	127.14	-9.95
Mainstem	19.87	92.02	72.15
Total	**388.92**	**463.00**	**74.08**
Emergent Wetland			
Confluence	20.39	20.77	0.38
IDS	19.30	12.73	-6.57
Mainstem	57.84	86.08	28.24
Total	**97.53**	**119.58**	**22.05**
Grassland			
Confluence	676.46	666.90	-9.56
IDS	546.21	532.08	-14.13
Mainstem	1,086.33	875.00	-211.33
Total	**2,309.00**	**2,073.98**	**-235.02**
Aquatic Riverine			
Confluence	119.18	116.25	-2.93
IDS	123.89	121.60	-2.29
Mainstem	102.70	207.00	104.30
Total	**345.77**	**444.85**	**99.08**
Open Water			
Confluence	107.16	96.56	-10.60
IDS	32.05	42.25	10.20
Mainstem	4.55	202.44	197.89
Total	**143.76**	**341.25**	**197.49**

5.5 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

The potential for threatened or endangered species, or birds of conservation concern within the study area under Alternative 3 is anticipated to be the same as that under Alternative 1 (refer to Section 3.5).

Alternative 3 would create higher habitat values than both those of the existing conditions and those predicted under the FW/OPC. However, as under Alternative 1, federally-listed species are not likely to breed or establish permanent residences in the study area under Alternative 3.

5.6 RECOMMENDATIONS

The planning recommendations for the implementation of Alternative 3 are the same as those recommended for Alternative 1, refer to Section 2.4.

5.7 SUMMARY

Overall, HUs would increase in 50 years under Alternative 3. The greatest decrease of HUs would occur to grassland habitat. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river.

CHAPTER 6
CUMULATIVE IMPACT ASSESSMENT ALTERNATIVE 2

6.1 INTRODUCTION

This chapter describes potential impacts to fish and wildlife habitats from the implementation of Alternative 2 and the cumulative projects over the next 50 years. The study area habitat types (bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water) and evaluation groups (Confluence, IDS, and Mainstem) from Chapter 2 are used for the Alternative 2 and cumulative projects evaluation. The impacts to fish and wildlife habitats from the implementation of Alternative 2 and cumulative projects, including the implementation of the BVP Study features, FRM elements, IDP improvements, and FW/OPC projects described in Chapter 3 are described below and shown in Figure 8. The BVP Study features are notional in nature. As a result, the impacts of these features cannot be determined with the same precision as the existing conditions. Thus, impacts from DFP implementation are estimated to the nearest whole acre.

6.2 CHANGES TO HABITAT ACREAGES

As presented in Table 6-1, 295 acres of existing habitat would become Urban from the implementation of Alternative 2 and the other cumulative projects. Open water habitat would increase under Alternative 2 and the cumulative projects from the creation of Urban, West, and Natural lakes. Bottomland hardwood acreage would also increase with hardwoods planted along the Trinity River; the largest amount of hardwoods would be planted at the southeastern end of the project area. Aquatic riverine acreage would increase from the realignment of the river. The greatest decrease of habitat would be to grassland habitat.

Table 6-1. Estimated Cumulative Changes to Habitat Acreages with Alternative 2

Habitat Type	*Acres*		
	Existing Conditions	*Alternative 2 (Year 0)*	*Change*
Bottomland Hardwood	1,414	1,480	66
Emergent Wetland	419	371	-48
Grassland	4,283	3,565	-718
Aquatic Riverine[1]	421	546	125
Open Water	206	486	280
Habitat Subtotal	*6,743*	*6,448*	*-295*
Urban Area	10,400	10,695	295
Total	**17,143**	**17,143**	**0**

Note: [1]Aquatic riverine includes fringe riparian habitat.

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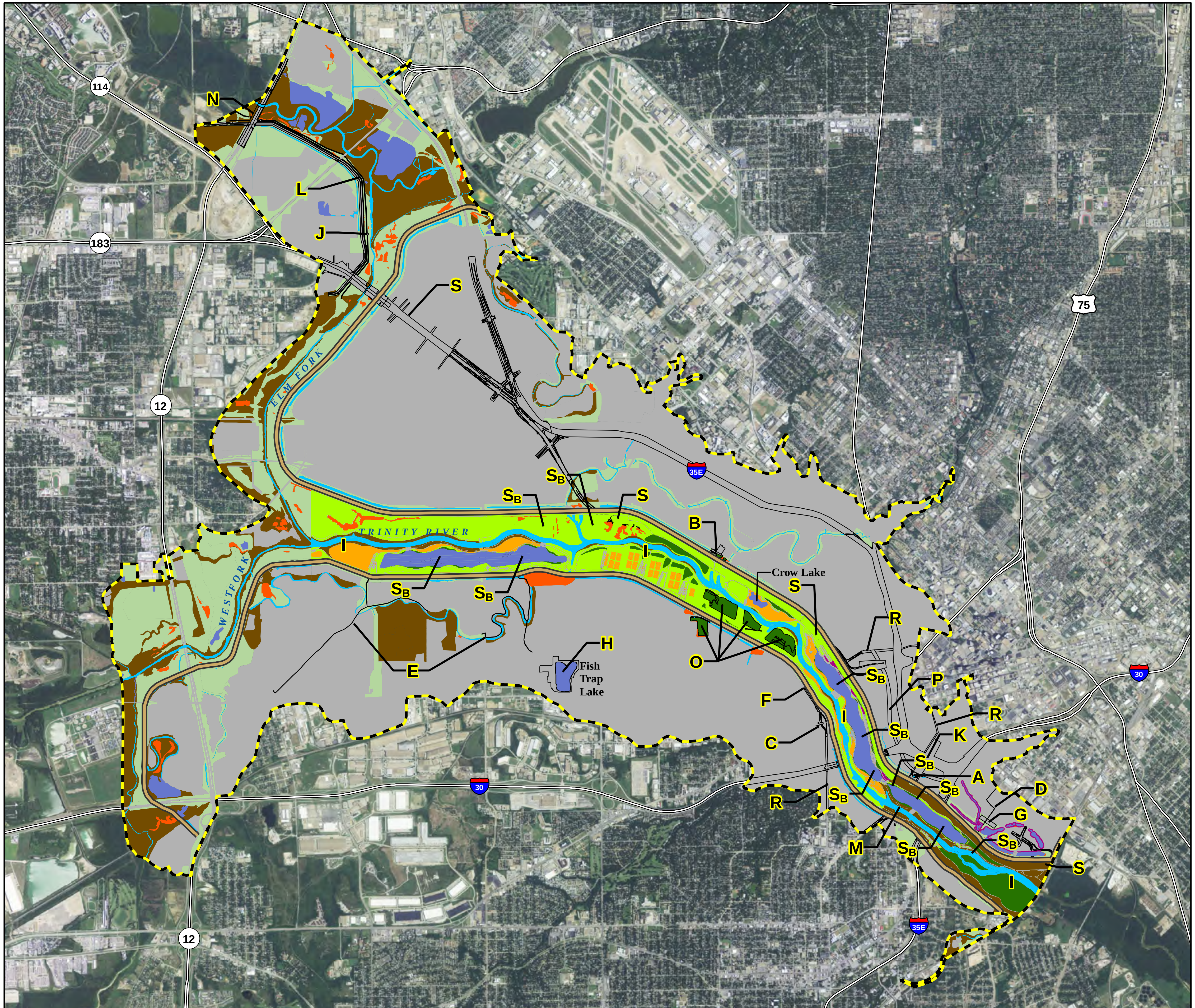


Figure 8
Habitat Types Under Alternative 2 with Cumulative Projects

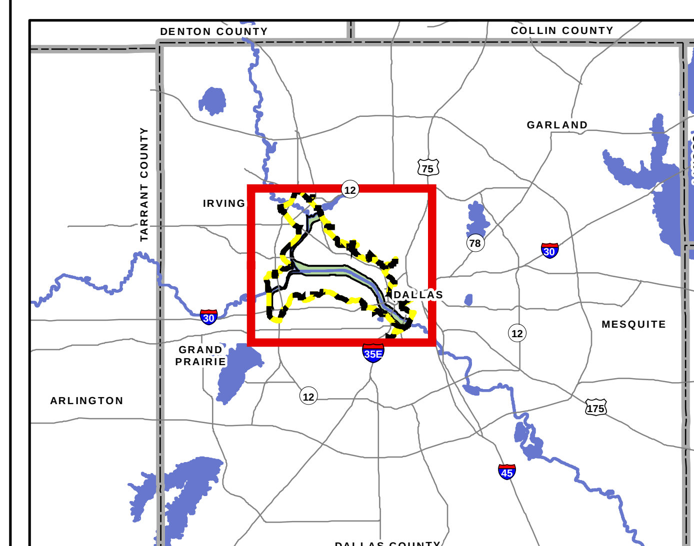
Future Without Project Condition Projects

- A Able Pumping Plant
- B Baker Pumping Plant
- C Beckley Avenue Improvements
- D Belleview Trail Connector
- E Bernal Trail
- F Continental Pedestrian Bridge
- G Dallas Maritime Museum
- H Dallas Watersports Complex
- I Dallas Water Utility Lines
- J EF2 Wastewater Interceptor Line & Laterals
- K Horseshoe Project
- L Irving Northwest Levee Repair
- M Jefferson-Memorial Bridge
- N Loop 12 Bridge
- O Pavaho Wetlands
- P Riverfront Boulevard
- Q SH-183 Bridge
- R Trinity Lakes Streetcar Loop
- S Trinity Parkway
- S_B Trinity Parkway Borrow Pits

ROI
Dallas Floodway Levee
Freeway

Habitat Types (At Year 0)

- Aquatic Riverine
- Bottomland Hardwood
- Emergent Wetland
- Remaining Existing Emergent Wetland
- Grassland
- Meadow
- Turf
- Urban Forest
- Open Water
- Urban



0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

GIS Sources: Black and Veatch 2010; City of Dallas 2008a, 2010a; TxDOT 2010; USACE 2007, 2013b; USFWS 2006

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6.2.1 Confluence

The Confluence Group includes the Elm Fork and West Fork of the Trinity River and the associated emergent wetland and upland habitat in the area. The Alternative 2 actions and cumulative projects in the Confluence consist of the IDP Trinity-Portland Pumping Plant and Eagle Ford and Trinity-Portland sump improvements, FRM Elements, EF2 Wastewater Interceptor Line and Laterals, the Irving Northwest Levee Repair, and the Loop 12 Bridge. Table 6-2 presents the predicted acreages for the habitat types in the Confluence Group over the next 50 years from the implementation of Alternative 2 and the cumulative projects.

Table 6-2. Estimated Cumulative Changes in Habitat Acreages in the Confluence Group over the Next 50 Years with Alternative 2

Habitat Type	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood	967	967	967	977	1,016
Emergent Wetland	68	68	68	68	67
Grassland	1,573	1,499	1,499	1,469	1,411
Aquatic Riverine	132	133	133	132	125
Open Water	151	151	151	148	136
Habitat Subtotal	*2,891*	*2,818*	*2,818*	*2,794*	*2,755*
Urban Area	927	1,000	1,000	1,024	1,063
Total	**3,818**	**3,818**	**3,818**	**3,818**	**3,818**

Bottomland Hardwood. The acreage of bottomland hardwoods under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Emergent Wetland. The acreage of emergent wetlands under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Grassland. The acreage of grasslands under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.1).

Aquatic Riverine. The aquatic riverine progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.1).

Open Water. The open water progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.1).

6.2.2 Mainstem

The habitat in the Mainstem Group has existed in its current state for the last 50 years. Under Alternative 2 and cumulative projects, most of the habitat in the Mainstem would be temporarily impacted during the implementation of the BVP Study features. After the 10-year construction period for the BVP Study features is complete (2015-2025), most of the habitat would be restored to a higher habitat value than its current state. Three large lakes, re-alignment of the Trinity River, fringe riparian habitat, native grassland meadows, additional bottomland hardwoods, and additional higher quality wetlands would be created with the implementation of the BVP (refer to Figure 8). Alternative 2 FRM elements would improve the levees and have minimal impacts on habitat. Table 6-3 presents the predicted acreages for the habitat types in the Mainstem Group over the next 50 years with the implementation of Alternative 2 and cumulative projects.

Bottomland Hardwood. Under Alternative 2, most of the existing bottomland hardwoods would be removed during the re-alignment of the Trinity River as part of the BVP Study features. During the implementation of the BVP Study features, 163 acres of bottomland hardwood would be planted in the Mainstem, primarily along the southeastern section of the new Trinity River channel.

The acreage of bottomland hardwoods is not expected to increase because the hardwoods would be planted in an area adjacent to the levee and would not be allowed to expand next to the levee. Therefore, no change to acreage is expected over the next 5 years. At years 10, 25, and 50, an increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood.

Table 6-3. Estimated Cumulative Changes in Habitat Acreages in the Mainstem Group over the Next 50 Years with Alternative 2

Habitat Type	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood	**95**	**163**	**163**	**163**	**166**	**171**	**183**
Emergent Wetland							
Existing	263	31	31	31	31	31	31
Proposed	-	204	204	204	204	204	202
Total Emergent Wetland	*263*	*235*	*235*	*235*	*235*	*235*	*233*
Grassland							
Existing Maintenance Levels	1,752	182	182	182	182	182	184
Landscaping: Meadow	-	772	772	772	772	772	772
Landscaping: Urban Forest	-	5	5	5	5	5	5
Landscaping: Turf	-	157	157	157	157	157	157
Total Grassland	*1,752*	*1,116*	*1,116*	*1,116*	*1,116*	*1,116*	*1,118*
Aquatic Riverine [1]	**124**	**251**	**251**	**251**	**248**	**243**	**231**
Open Water							
Existing - Crow Lake	6	6	6	6	6	6	6
Natural Lake	-	50	50	50	50	50	50
Urban and West Dallas Lake	-	207	207	207	207	207	207

Total Open Water	*6*	*263*	*263*	*263*	*263*	*263*	*263*
Habitat Subtotal	***2,240***	***2,028***	***2,028***	***2,028***	***2,028***	***2,028***	***2,028***
Urban Area	36	248	248	248	248	248	248
Total	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**

Note: [1]Aquatic riverine includes fringe riparian habitat.

Emergent Wetland. The Mainstem wetlands under Alternative 2 would comprise approximately 235 acres: 31 acres of existing wetlands and 204 acres of wetlands created from the implementation of the BVP Study features. The created wetlands would include Corinth, Cypress, and fringe marsh wetlands along the edge of the lakes.

With the proposed maintenance of the BVP in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 to 25 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland because of siltation and warmer and drier conditions from climate change.

Grassland. With the implementation of the BVP Study features, the majority of the existing grasslands would be temporarily disturbed and would be replanted and realigned after the completion of the BVP Study features. The grasslands would consist of low quality mowed turf, native meadows, and urban forests.

Due to the proposed maintenance of the grasslands in the Mainstem, no change to BVP grassland acreage is expected over the next 50 years. At year 50, the acreage is expected to increase due to one percent of emergent wetland converting to grassland.

Aquatic Riverine. The aquatic riverine habitat value and acreage in the Mainstem would change significantly under Alternative 2 and cumulative projects. Under the BVP Study features, the Trinity River is proposed to be re-routed to increase sinuosity and increase habitat value. The Mainstem aquatic riverine would include fringe riparian habitat.

The aquatic riverine acreage is expected to remain at 251 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods as a result of less water reaching the Mainstem. This could be from warmer and drier conditions and/or residents and businesses retaining more water on their properties. At year 25, two percent of aquatic riverine is expected to be converted to bottomland hardwoods. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open Water. Under Alternative 2 and cumulative projects, the Mainstem would comprise 263 acres of open water, including the existing Crow Lake and three BVP Study lakes, Urban, West, and Natural. The lakes would be maintained; therefore, no change to open water acreage is expected over the next 50 years.

6.2.3 Interior Drainage Systems

The IDS Group is primarily an urban area with pockets of habitat surrounding the existing sumps, pumps, and drainage channels. Alternative 2 actions and cumulative projects in the IDS consist of the Charlie, Delta, and Hampton, Pumping Plant improvements, the Nobles Branch and East Levee sump improvements, and 12 cumulative projects. Table 6-4 presents the predicted acreages for the habitat types in the IDS Group over the next 50 years with the implementation of Alternative 2 and cumulative projects.

Table 6-4. Estimated Cumulative Changes in Habitat Acreages in the Interior Drainage Systems Group over the Next 50 Years with Alternative 2

Habitat Type	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood	352	350	347	339	326
Emergent Wetland	88	68	68	68	68
Grassland					
Existing Maintenance Levels	958	928	919	891	829
Urban Forest	-	22	22	22	22
Grassland Subtotal	*958*	*950*	*941*	*913*	*851*
Aquatic Riverine	165	162	162	160	152
Open Water	49	72	72	71	65
Habitat Subtotal	*1,612*	*1,602*	*1,590*	*1,551*	*1,462*
Urban Area	9,437	9,447	9,459	9,498	9,587
Total	**11,049**	**11,049**	**11,049**	**11,049**	**11,049**

Bottomland Hardwood. The acreage of bottomland hardwoods under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Emergent Wetland. The acreage of emergent wetlands under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Grassland. The acreage of grasslands under Alternative 2 and cumulative projects would follow the same progression predicted under Alternative 1 (refer to Section 3.2.3).

Aquatic Riverine. The aquatic riverine progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.3).

Open Water. The open water progression is anticipated to be the same as that under Alternative 1 (refer to Section 3.2.3).

6.3 HABITAT SUITABILITY INDEXES AND HABITAT UNIT VALUES

HSI values for Alternative 2 and cumulative projects were based on the species models used for the baseline assessment (Section 2.2) (USACE 2013c). In April 2013, the USFWS hosted the USACE to coordinate and assist in prediction of the future conditions with the action alternative completed. The *Trinity River Corridor Design Guidelines* (City of Dallas 2009) was used to inform the models in terms of future plant assemblage and habitat anticipated within the Floodway.

6.3.1 Confluence

The HSI and HU values progressions for the Confluence are presented in Table 6-5. The analysis associated with the progressions predicted is the same as that presented for Alternative 1 (refer to Section 3.3.1).

Table 6-5. Estimated Cumulative HSIs, Acreages, and HUs for Habitat Types in the Confluence Group over the Next 50 Years with Alternative 2

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.24	0.24	0.24	0.24	0.24
Acres	966.49	967	967	977	1,016
HUs	231.96	232.08	232.08	234.48	243.84
Emergent Wetland					
HSI	0.30	0.30	0.30	0.30	0.31
Acres	67.95	68	68	68	67
HUs	20.39	20.40	20.40	20.40	20.77
Grassland					
HSI	0.43	0.43	0.43	0.43	0.45
Acres	1,573.16	1,499	1,499	1,469	1,411
HUs	676.46	644.57	644.57	631.67	634.95
Aquatic Riverine					
HSI	0.90	0.90	0.90	0.90	0.93
Acres	132.42	133	133	132	125
HUs	119.18	119.7	119.7	118.8	116.25
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	150.93	151	151	148	136
HUs	107.16	107.21	107.21	105.08	96.56

6.3.2 Mainstem

Table 6-6 presents the Alternative 2 HSIs, acres, and HUs for the Mainstem for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. With the implementation of the BVP Study features, most of the habitat in the Mainstem would be temporarily disturbed. Following the implementation of the BVP Study features (years 0, 1, and 5), the bottomland hardwood, emergent wetland, and urban forest HSIs would be low because the habitats would have just been created and would take time to become established. The bottomland hardwood HSIs are expected to increase over time as the trees mature, and the emergent wetland HSIs are expected to increase over time as the wetlands become more established.

The Mainstem grasslands would consist of native meadow, turf, and urban forest. The native meadow is expected to have a higher HSI than the existing non-native dominated grassland and is expected to increase in value over the next 50 years from increased native species diversity. The turf HSI is not expected to change over time because mowed grass is expected to remain at the same low habitat value over the next 50 years. Urban forest is considered a subset of grassland because the majority of the proposed trees would be non-native ornamental trees and do not provide the same habitat value as a native forest.

Aquatic riverine and open water habitat HSIs are not expected to increase much over time because they would contain water and are expected to be functioning aquatic ecosystems once the BVP Study features are completed. At year 50, the aquatic riverine HSI is expected to increase due to increased regulations and technology for improvements to water quality. The open water HSI was determined by referring to the 2010 fisheries sampling in Crow Lake, Bart Simpson Lake, and Cell D of the Dallas Floodway Extension (USACE 2010).

Table 6-6. Estimated Cumulative HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years with Alternative 2

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	163	163	163	166	171	183
HUs	19.87	14.67	14.67	14.67	21.58	35.91	78.69
Emergent Wetland							
Existing/Continuing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	31	31	31	31	31	31
HUs	57.84	6.82	6.82	6.82	6.82	6.82	6.82
Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	204	204	204	204	204	202
HUs	0	26.52	26.52	69.36	85.68	95.88	105.04
Emergent Wetland HU	**57.84**	**33.34**	**33.34**	**76.18**	**92.5**	**102.7**	**111.86**

Grassland							
Existing/Continuing							
HSI	0.62	0.4	0.4	0.4	0.4	0.4	0.4
Acres	1,752.15	182	182	182	182	182	184
HUs	1,086.33	72.8	72.8	72.8	72.8	72.8	73.6
Landscaping: Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	772	772	772	772	772	772
HUs	-	386.00	463.20	540.40	501.80	540.40	656.20
Landscaping: Turf							
HSI	-	0	0	0.4	0.4	0.4	0.4
Acres	-	157	157	157	157	157	157
HUs	-	0.00	0.00	62.80	62.80	62.80	62.80
Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	5	5	5	5	5	5
HUs	-	2.50	2.50	2.00	2.00	2.00	2.00
Grassland HU	**1,086.33**	**461.30**	**538.50**	**678.00**	**639.40**	**678.00**	**794.60**
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	251	251	251	248	243	231
HUs	102.70	208.33	188.25	208.33	210.80	211.41	207.90
Open Water							
Crow Lake							
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Urban Lake & West Dallas Lake							
HSI	-	0.00	0.00	0.43	0.77	0.77	0.77
Acres	-	207	207	207	207	207	207
HUs	-	0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI	-	0.00	0.00	0.60	0.77	0.77	0.77
Acres	-	50	50	50	50	50	50
HUs	-	0.00	0.00	30.00	38.50	38.50	38.50
Open Water HU	**4.55**	**4.55**	**4.55**	**123.56**	**202.44**	**202.44**	**202.44**

6.3.3 Interior Drainage Systems

Table 6-7 presents the Alternative 2 HSIs, acres, and HUs for the IDS for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years.

The majority of the bottomland hardwoods occur along the drainage channels. Bottomland hardwood areas within the IDS are expected to decrease over time due to development. Bottomland hardwood habitats do not have any special protection from development.

The emergent wetlands are part of the sump pump areas and will remain. As a drying trend is predicted for the region, the quality and quantity of emergent wetlands is expected to decrease in the long term. The primary purpose of the emergent wetland areas are flood control, not to provide habitat.

The majority of the grasslands occur along the drainage channels. The quality (HSI) of the grassland habitat would increase slightly in the long term as trees in the urban forest provide increased foraging opportunities for grassland species. Grassland areas are expected to decrease over time because of development. Grassland habitats do not have any special protection from development.

The aquatic riverine HSI was determined using the Trinity River IBI (USFWS 2004). Reach 1, the lower reach of the Mainstem, had the lowest HSI of the four reaches and was determined to be the most similar of the four reaches to the IDS. The IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal; therefore, it is expected to have a lower HSI than the rest of the River. The HSI is expected to remain at 0.7 from year 0 to 5 because of siltation, erosion, and other temporary impacts from construction. At year 10, the HSI is expected to be back at 0.75 (pre-construction conditions). By year 50, the HSI is expected to increase to 0.80 due to increased regulations and technology for improvements to water quality.

The open water HSI was determined from 2010 fisheries sampling (USACE 2010). Because the IDS is smaller than the Trinity River, has less species diversity, and is not connected to the Trinity River for species dispersal, it is expected to have a lower HSI than the Mainstem or Confluence areas of the Trinity River. Therefore, the average open water HSI score was adjusted to 0.65. The water quality in the open water is not expected to change in the next 50 years; therefore, the HSI would remain the same for the next 50 years.

Table 6-7. Estimated Cumulative HSIs, Acreages, and HUs for Habitat Types in the Interior Drainage Systems Group over the Next 50 Years with Alternative 2

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.39	0.39	0.39	0.39	0.39
Acres	351.50	350	347	339	326
HUs	137.09	136.50	135.33	132.21	127.14
Emergent Wetland					
HSI	0.22	0.23	0.22	0.22	0.19
Acres	87.72	68	68	68	68
HUs	19.3	15.64	14.96	14.96	12.92
Grassland					
Existing Maintenance Levels					
HSI	0.57	0.57	0.57	0.57	0.62
Acres	958.26	928	919	891	829
HUs	546.21	528.96	523.83	507.87	513.98
Landscaping: Urban Forest					
HSI	-	0.50	0.40	0.40	0.40
Acres	-	22	22	22	22
HUs	0	11	8.8	8.8	8.8
Grassland Total HU	**546.21**	**539.96**	**532.63**	**516.67**	**522.78**
Aquatic Riverine					
HSI	0.75	0.70	0.70	0.75	0.80
Acres	165.18	162	162	160	152
HUs	123.89	113.40	113.40	120.00	121.60
Open Water					
HSI	0.65	0.65	0.65	0.65	0.65
Acres	49.30	72	72	71	65
HUs	32.05	46.80	46.80	46.15	42.25

6.4 HABITAT UNITS SUMMARY

As presented in Table 6-8, overall HUs would increase under Alternative 2 and cumulative projects over the next 50 years. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic Riverine habitat would increase from the realignment of the river. The greatest decrease of HUs would be to grassland habitat.

Table 6-8. Cumulative HUs per Habitat Type Within the Study Area with Alternative 2

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	449.67	60.75
Emergent Wetland	97.53	145.55	48.02
Grassland	2,309.00	1,952.33	-356.67
Aquatic Riverine	345.77	445.75	99.98
Open Water	143.76	341.25	197.49
Total	**3,284.98**	**3,334.55**	**49.57**

Table 6-9 presents the existing conditions (baseline) and Alternative 2 and cumulative projects (Year 50) HUs for the five habitat types in the Confluence, IDS, and Mainstem.

Bottomland Hardwood. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 2 and cumulative projects due to bottomland hardwoods being planted as part of the BVP Study features, and grassland, aquatic riverine, and open water habitat converting to bottomland hardwood. However, the bottomland hardwood HUs in the IDS would decrease due to bottomland hardwood habitat being developed.

Emergent Wetland. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 2 and cumulative projects due to the creation and maintenance of more emergent wetlands. Emergent wetland HUs in the IDS would decrease in 50 years under Alternative 2 and cumulative projects due to emergent wetlands converting to grasslands as a result of warmer and drier conditions.

Grassland. HUs in the Confluence, IDS, and Mainstem would decrease in 50 years under Alternative 2 and cumulative projects due to development and grasslands converting to bottomland hardwoods. The majority of the grassland HUs would be lost in the Mainstem due to development.

Aquatic Riverine. HUs in the Mainstem would increase in 50 years under Alternative 2 and cumulative projects due to the realignment of the Trinity River and increased regulations and technological advances to increase water quality. Aquatic riverine HUs in the Confluence and IDS would decrease in 50 years under Alternative 2 due to aquatic riverine habitat converting to bottomland hardwoods from warmer and drier conditions.

Open Water. HUs in the Mainstem would increase in 50 years due to the creation of West, Urban, and Natural Lakes. Open water HUs in the Confluence would decrease in 50 years under Alternative 2 and cumulative projects due to open water habitat converting to bottomland hardwoods in the Confluence as a result of warmer and drier conditions.

Table 6-9. Estimated Change in Cumulative HU Values for Habitats within the Study Area under Alternative 2 (Year 50)

Evaluation Areas	*HUs*		
	Baseline	*Alternative 2 Cumulative*	*Change*
Bottomland Hardwood			
Confluence	231.96	243.84	11.88
IDS	137.09	127.14	-9.95
Mainstem	19.87	78.69	58.82
Total	**388.92**	**449.67**	**60.75**
Emergent Wetland			
Confluence	20.39	20.77	0.38
IDS	19.30	12.92	-6.38
Mainstem	57.84	111.86	54.02
Total	**97.53**	**145.55**	**48.02**
Grassland			
Confluence	676.46	634.95	-41.51
IDS	546.21	522.78	-23.43
Mainstem	1,086.33	794.60	-291.73
Total	**2,309.00**	**1,952.33**	**-356.67**
Aquatic Riverine			
Confluence	119.18	116.25	-2.93
IDS	123.89	121.60	-2.29
Mainstem	102.70	207.90	105.20
Total	**345.77**	**445.75**	**99.98**
Open Water			
Confluence	107.16	96.56	-10.60
IDS	32.05	42.25	10.20
Mainstem	4.55	202.44	197.89
Total	**143.76**	**341.25**	**197.49**

6.5 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

The potential for threatened or endangered species, or birds of conservation concern within the study area under Alternative 2 and cumulative projects is anticipated to be similar to Alternative 2 (refer to Section 4.5).

6.6 RECOMMENDATIONS

The planning recommendations for the implementation of Alternative 2 and cumulative projects are the same as those recommended for Alternative 1, refer to Section 2.4.

CHAPTER 7
CUMULATIVE IMPACT ASSESSMENT ALTERNATIVE 3

7.1 INTRODUCTION

This chapter describes potential impacts to fish and wildlife habitats from the implementation of Alternative 3 and the cumulative projects over the next 50 years. The study area habitat types (bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water) and evaluation groups (Confluence, IDS, and Mainstem) from Chapter 2 are used for the Alternative 3 and cumulative projects evaluation. The impacts to fish and wildlife habitats from the implementation of Alternative 3 and cumulative projects, including the implementation of the BVP Study features, FRM elements, IDP improvements, and FWOP projects described in Chapter 3 are described below and shown in Figure 9. The BVP Study features are still notional in nature. As a result, the impacts of these features cannot be determined with the same precision as the existing conditions. Thus, impacts from DFP implementation are estimated to the nearest whole acre.

7.2 CHANGES TO HABITAT ACREAGES

As presented in Table 7-1, 210 acres of existing habitat would become Urban from the implementation of Alternative 3 and the other cumulative projects. Open water habitat would increase under Alternative 3 and the cumulative projects from the creation of Urban, West, and Natural lakes. Bottomland hardwood acreage would also increase with hardwoods planted along the Trinity River; the largest amount of hardwoods would be planted at the southeastern end of the project area. Aquatic riverine acreage would increase from the realignment of the river. The greatest decrease of habitat would be to grassland habitat.

Table 7-1. Estimated Cumulative Changes to Habitat Acreages with Alternative 3

Habitat Type	*Acres*		
	Existing Conditions	*Alternative 3 Cumulative*	*Change*
Bottomland Hardwood	1,414	1,502	88
Emergent Wetland	419	375	-44
Grassland	4,283	3,624	-659
Aquatic Riverine	421	546	125
Open Water	206	486	280
Habitat Subtotal	*6,743*	*6,533*	*-210*
Urban Area	10,400	10,610	210
Total	**17,143**	**17,143**	**0**

Sources: USACE 2007, 2013b.

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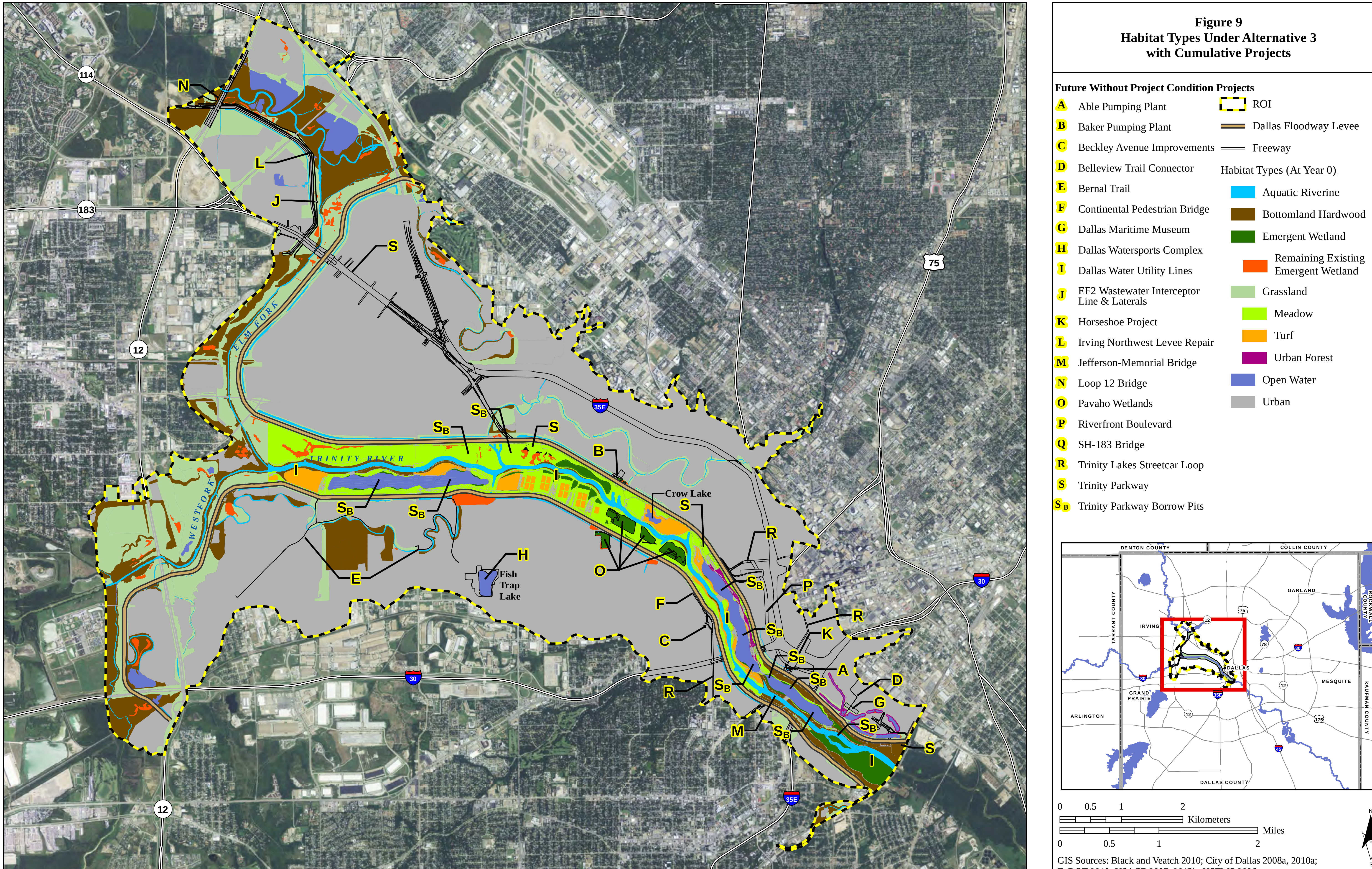
Figure 9
Habitat Types Under Alternative 3
with Cumulative Projects



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7.2.1 Confluence

Alternative 3 and Alternative 2 propose the same activities in the Confluence area with the same impacts. There is no difference in the Confluence under the cumulative condition between Alternative 2 and 3. Therefore, the changes in habitat acreages within the Confluence with cumulative projects would be the same under Alternative 3 as with Alternative 2. Please refer to Section 6.2.1.

7.2.2 Mainstem

The habitat in the Mainstem Group has existed in its current state for the last 50 years. Under Alternative 3 and cumulative projects, most of the habitat in the Mainstem would be temporarily impacted during the implementation of the BVP Study features. After the 10-year construction period for the BVP Study features is complete (2015-2025), most of the habitat would be restored to a higher habitat value than its current state. Three large lakes, re-alignment of the Trinity River, fringe riparian habitat, native grassland meadows, additional bottomland hardwoods, and additional higher quality wetlands would be created with the implementation of the BVP (refer to Figure 9). Alternative 3 FRM elements would improve the levees and have minimal impacts on habitat. Table 7-2 presents the predicted acreages for the habitat types in the Mainstem Group over the next 50 years with the implementation of Alternative 3 and cumulative projects.

Table 7-2. Estimated Cumulative Changes in Habitat Acreages in the Mainstem Group over the Next 50 Years with Alternative 3

Habitat Type	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood	**95**	**186**	**186**	**186**	**189**	**194**	**206**
Emergent Wetland							
Existing	263	32	32	32	32	32	32
Proposed	-	208	208	208	208	208	206
Wetland Subtotal	*263*	*240*	*240*	*240*	*240*	*240*	*238*
Grassland							
Existing Maintenance Levels	1,752	187	187	187	187	187	189
Landscaping: Meadow	-	787	787	787	787	787	787
Landscaping: Urban Forest	-	15	15	15	15	15	15
Landscaping: Turf	-	186	186	186	186	186	186
Grassland Subtotal	*1,752*	*1,175*	*1,175*	*1,175*	*1,175*	*1,175*	*1,177*
Aquatic Riverine[1]	**124**	**251**	**251**	**251**	**248**	**243**	**231**
Open Water							
Existing - Crow Lake	6	6	6	6	6	6	6
Natural Lake	-	50	50	50	50	50	50

Urban and West Dallas Lake	-	207	207	207	207	207	207
Open Water Subtotal	6	*263*	*263*	*263*	*263*	*263*	*263*
Habitat Subtotal	***2,240***	***2,115***	***2,115***	***2,115***	***2,115***	***2,115***	***2,115***
Urban Area	36	161	161	161	161	161	161
Total	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**	**2,276**

Note: [1]Aquatic riverine includes fringe riparian habitat.

Bottomland Hardwood. Under Alternative 3, most of the existing bottomland hardwoods would be removed during the re-alignment of the Trinity River under the BVP Study features. During the implementation of the BVP Study features, 186 acres of bottomland hardwood would be planted in the Mainstem, primarily along the southeastern section of the new Trinity River channel.

The acreage of bottomland hardwoods is not expected to increase because the hardwoods would be planted in an area adjacent to the levee and they would not be allowed to expand next to the levee. Therefore, no change to acreage is expected over the next 50 years. At years 10, 25, and 50, an increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood.

Emergent Wetland. The Mainstem wetlands under Alternative 3 would comprise approximately 240 acres, 32 acres of existing wetlands and 208 acres of wetlands created from the implementation of the BVP Study features. The created wetlands would include Corinth, Cypress, and fringe marsh wetlands along the edge of the lakes.

With the proposed maintenance of the BVP in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 to 25 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland because of siltation and warmer and drier conditions due to climate change.

Grassland. With the implementation of the BVP Study features, the majority of the existing grasslands would be temporarily disturbed and would be replanted and realigned after the completion of the BVP Study features. The grasslands would consist of low quality mowed turf, native meadows, and urban forests.

Due to the proposed maintenance of the grasslands in the Mainstem, no change to BVP grassland acreage is expected over the next 25 years. At year 50, the acreage is expected to increase due to one percent of emergent wetland converting to grassland.

Aquatic Riverine. The aquatic riverine habitat value and acreage in the Mainstem would change significantly under Alternative 3 and cumulative projects. Under the BVP Study features, the Trinity River is proposed to be re-routed to increase sinuosity and increase habitat value. The Mainstem aquatic riverine would include fringe riparian habitat.

The aquatic riverine acreage is expected to remain at 251 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods as a result of less water reaching the Mainstem. This could be from warmer and drier conditions and/or residents and businesses retaining more water on their properties. At year 25, two percent of aquatic riverine is expected to be converted to bottomland hardwoods. By year 50, five percent of the aquatic riverine habitat is expected to be converted to bottomland hardwoods, primarily due to warmer and drier conditions resulting from climate change.

Open Water. Under Alternative 3 and cumulative projects, the Mainstem would comprise 263 acres of open water, including the existing Crow Lake and three BVP Study lakes, Urban, West, and Natural. The lakes would be maintained; therefore, no change to open water acreage is expected over the next 50 years.

7.2.3 Interior Drainage Systems

Alternative 3 and Alternative 2 propose the same activities in the IDS with the same impacts. There is no difference in the IDS under the cumulative condition between Alternative 2 and 3. Therefore, the changes in habitat acreages within the IDS with cumulative projects would be the same under Alternative 3 as with Alternative 2. Please refer to Section 6.2.3.

7.3 Habitat Suitability Indexes and Habitat Unit Values

HSI values for Alternative 3 and cumulative projects were based on the species models used for the baseline assessment (Section 2.2) (USACE 2013c). In April 2013, the USFWS hosted the USACE to coordinate and assist in prediction of the future conditions with the action alternative completed. The *Trinity River Corridor Design Guidelines* (City of Dallas 2009) was used to inform the models in terms of future plant assemblage and habitat anticipated within the Floodway.

7.3.1 Confluence

Alternative 3 and Alternative 2 propose the same activities in the Confluence with the same impacts. There is no difference in the Confluence under the cumulative condition between Alternative 2 and 3. Therefore, the changes in HSI and HU values within the Confluence with cumulative projects would be the same under Alternative 3 as with Alternative 2. Please refer to Section 6.3.1.

7.3.2 Mainstem

Table 7-3 presents the Alternative 3 HSIs, acres, and HUs for the Mainstem for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. With the implementation of the BVP Study features, most of the habitat in the Mainstem would be temporarily disturbed. Following the implementation of the BVP Study features (years 0, 1, and 5), the bottomland hardwood, emergent wetland, and urban forest HSIs would be low because the habitats would have just been created and would take time to become established. The bottomland hardwood HSIs are expected to increase over time as the trees mature, and the emergent wetland HSIs are expected to increase over time as the wetlands become more established.

The Mainstem grasslands would consist of native meadow, turf, and urban forest. The native meadow is expected to have a higher HSI than the existing non-native dominated grassland and is expected to increase in value over the next 50 years from increased native species diversity. The turf HSI is not expected to change over time because mowed grass is expected to remain at the same low habitat value over the next 50 years. Urban forest is considered a subset of grassland because the majority of the proposed trees would be non-native ornamental trees and do not provide the same habitat value as a native forest.

Aquatic riverine and open water habitat HSIs are not expected to increase much over time because they would contain water and are expected to be functioning aquatic ecosystems once the BVP Study features are completed. At year 50, the aquatic riverine HSI is expected to increase due to increased regulations and technology for improvements to water quality. The open water HSI was determined by referring to the 2010 fisheries sampling in Crow Lake, Bart Simpson Lake, and Cell D of the Dallas Floodway Extension (USACE 2010).

Table 7-3. Estimated Cumulative HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years with Alternative 3

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	186	186	186	189	194	206
HUs	19.87	16.74	16.74	16.74	24.57	40.74	88.58
Emergent Wetland							
Existing/Continuing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	32	32	32	32	32	32
HUs	57.84	7.04	7.04	7.04	7.04	7.04	7.04
Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	208	208	208	208	208	206
HUs	0	27.04	27.04	70.72	87.36	97.76	107.12
Emergent Wetland HU	***57.84***	***34.08***	***34.08***	***77.76***	***94.40***	***104.80***	***114.16***
Grassland							
Existing Maintenance Levels							
HSI	0.62	0.4	0.4	0.4	0.4	0.4	0.4
Acres	1,752.15	187	187	187	187	187	189
HUs	1,086.33	74.80	74.80	74.80	74.80	74.80	75.60
Landscaping: Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	787	787	787	787	787	787
HUs	0.00	393.50	472.20	550.90	511.55	550.90	668.95

Landscaping: Turf							
HSI	-	0	0	0.4	0.4	0.4	0.4
Acres	-	186	186	186	186	186	186
HUs	0.00	0.00	0.00	74.40	74.40	74.40	74.40
Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	15	15	15	15	15	15
HUs	0.00	7.50	7.50	6.00	6.00	6.00	6.00
Grassland HU	***1,086.33***	***475.80***	***554.50***	***706.10***	***666.75***	***706.10***	***824.95***
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	251	251	251	248	243	231
HUs	102.70	208.33	188.25	208.33	210.80	211.41	207.90
Open Water							
Crow Lake							
HSI	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Acres	6.41	6.41	6.41	6.41	6.41	6.41	6.41
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Urban Lake & West Dallas Lake							
HSI	-	0.00	0.00	0.43	0.77	0.77	0.77
Acres	-	207	207	207	207	207	207
HUs	-	0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI	-	0.00	0.00	0.60	0.77	0.77	0.77
Acres	-	50	50	50	50	50	50
HUs	-	0.00	0.00	30.00	38.50	38.50	38.50
Open Water HU	***4.55***	***4.55***	***4.55***	***123.56***	***202.44***	***202.44***	***202.44***

7.3.3 Interior Drainage Systems

Alternative 3 and Alternative 2 propose the same activities in the IDS with the same impacts. There is no difference in the IDS under the cumulative condition between Alternative 2 and 3. Therefore, the changes in HSI and HU values within the IDS with cumulative projects would be the same under Alternative 3 as with Alternative 2. Please refer to Section 6.3.3.

7.4 HABITAT UNITS SUMMARY

As presented in Table 7-4, overall HUs would increase under Alternative 3 and cumulative projects over the next 50 years. The greatest increase would be to open water from the creation of the BVP Study lakes. Bottomland hardwood habitat would also increase with the highest quality habitat at the southeastern end of the project area. Aquatic riverine habitat would increase from the realignment of the river. The greatest decrease of HUs would be to grassland habitat.

Table 7-4. Cumulative HUs per Habitat Type Within the Study Area with Alternative 3

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	459.32	70.40
Emergent Wetland	97.53	147.66	50.13
Grassland	2,309.00	1,982.68	-326.32
Aquatic Riverine	345.77	445.75	99.98
Open Water	143.76	341.25	197.49
Total	**3,284.98**	**3,376.66**	**91.68**

Table 7-5 presents the existing conditions (baseline) and Alternative 2 and cumulative projects (Year 50) HUs for the five habitat types in the Confluence, IDS, and Mainstem.

Bottomland Hardwood. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 3 and cumulative projects due to bottomland hardwoods being planted as part of the BVP Study features, and grassland, aquatic riverine, and open water habitat converting to bottomland hardwood. However, the bottomland hardwood HUs in the IDS would decrease due bottomland hardwood habitat being developed.

Emergent Wetland. HUs in the Confluence and Mainstem would increase in 50 years under Alternative 3 and cumulative projects due to the creation and maintenance of more emergent wetlands. Emergent wetland HUs in the IDS would decrease in 50 years under Alternative 3 and cumulative projects due to emergent wetlands converting to grasslands due to warmer and drier conditions.

Grassland. HUs in the Confluence, IDS, and Mainstem would decrease in 50 years under Alternative 3 and cumulative projects due to development and grassland converting to bottomland hardwoods. The majority of the grassland HUs would be lost in the Mainstem due to development.

Aquatic Riverine. HUs in the Mainstem would increase in 50 years under Alternative 3 and cumulative projects due to the realignment of the Trinity River and increased regulations and technological advances to increase water quality. Aquatic riverine HUs in the Confluence and IDS would decrease in 50 years under Alternative 3 due to aquatic riverine habitat converting to bottomland hardwoods from warmer and drier conditions.

Open Water. HUs in the Mainstem would increase in 50 years due to the creation of West, Urban, and Natural Lakes. Open water HUs in the Confluence would decrease in 50 years under the Alternative 3 and cumulative projects due to open water habitat converting to bottomland hardwoods in the Confluence from warmer and drier conditions.

Table 7-5. Estimated Change in Cumulative HU Values for Habitats within the Study Area under Alternative 3 (Year 50)

Evaluation Areas	*HUs*		
	Baseline	*Alternative 3*	*Change*
Bottomland Hardwood			
Confluence	231.96	243.60	11.64
IDS	137.09	127.14	-9.95
Mainstem	19.87	88.15	68.71
Total	**388.92**	**458.89**	**70.40**
Emergent Wetland			
Confluence	20.39	20.77	0.38
IDS	19.30	12.73	-6.57
Mainstem	57.84	114.16	56.32
Total	**97.53**	**147.66**	**50.13**
Grassland			
Confluence	676.46	634.95	-41.51
IDS	546.21	522.78	-23.43
Mainstem	1,086.33	824.95	-261.38
Total	**2,309.00**	**1,982.68**	**-326.32**
Aquatic Riverine			
Confluence	119.18	116.25	-2.93
IDS	123.89	121.60	-2.29
Mainstem	102.70	207.90	105.20
Total	**345.77**	**445.75**	**99.98**
Open Water			
Confluence	107.16	96.56	-10.60
IDS	32.05	42.25	10.20
Mainstem	4.55	202.44	197.89
Total	**143.76**	**341.25**	**197.49**

7.5 THREATENED AND ENDANGERED SPECIES AND BIRDS OF CONSERVATION CONCERN

The potential for threatened or endangered species, or birds of conservation concern within the study area under Alternative 3 and cumulative projects is anticipated to be similar to Alternative 3 (refer to Section 5.5).

7.6 RECOMMENDATIONS

The planning recommendations for the implementation of Alternative 3 and cumulative projects are the same as those recommended for Alternative 1, refer to Section 2.4.

CHAPTER 8
COMPARISON OF ALTERNATIVES

All three of the alternatives evaluated in this report would potentially result in a loss of habitat acreage in the future environment as compared to the baseline existing conditions. As shown in Table 8-1, the implementation of Alternative 3 and cumulative projects would maintain 85 more acres of habitat than the implementation of Alternative 2 and cumulative projects; the FW/OPC would maintain 15 acres more than would Alternative 3. For all three potential future conditions, the majority of potential habitat loss would occur in the grassland habitats. The FW/OPC would also include a loss of aquatic riverine and open water habitats; these habitats would be increased under both Alternative 2 and Alternative 3. The FW/OPC, Alternative 2, and Alternative 3 would all include a loss of emergent wetland acreage (Table 8-1).

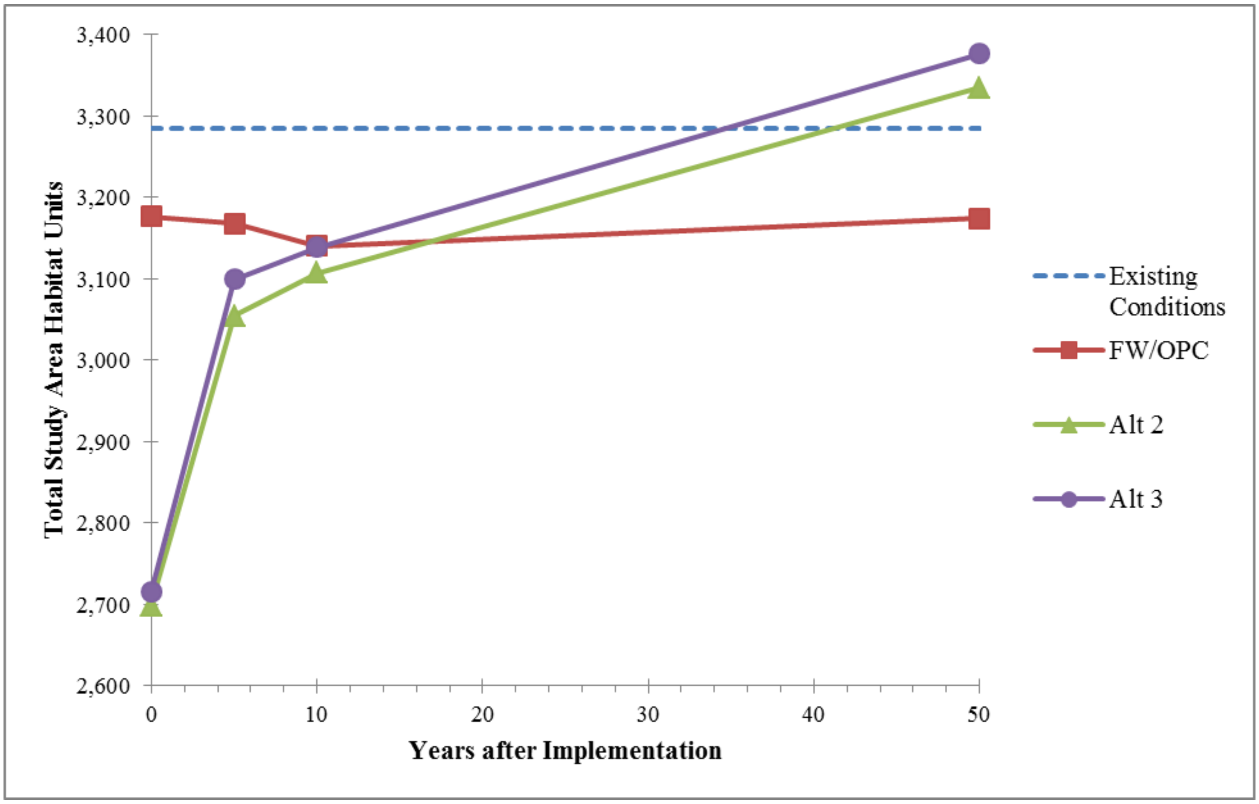
Table 8-1. Comparison of Cumulative Habitat Acres at Year 50 for All Alternatives

Habitat Type	*Existing Conditions*	*FW/OPC*		*Alternative 2 Cumulative*		*Alternative 3 Cumulative*	
	Acres	*Acres*	*Difference*	*Acres*	*Difference*	*Acres*	*Difference*
Bottomland Hardwood	1,414	1,431	17	1,525	111	1,547	133
Emergent Wetland	419	414	-5	368	-51	372	-47
Grassland	4,283	3,926	-357	3,380	-903	3,439	-844
Aquatic Riverine	421	388	-33	508	87	508	87
Open Water	206	186	-20	464	258	464	258
Habitat Subtotal	*6,743*	*6,345*	*-398*	*6,245*	*-498*	*6,330*	*-413*
Urban Area	10,400	10,798	398	10,898	498	10,813	413
Total	**17,143**	**17,143**	**0**	**17,143**	**0**	**17,143**	**0**

Sources: USACE 2007, 2013b.

All three alternatives would have significant short term impacts to habitat and the FW/OPC would result in a long term decrease in HUs. However, habitat improvements would develop over time under Alternatives 2 and 3 (Chart 8-1). While all three alternatives would result in a reduction of HUs within the study area, Alternative 2 and 3 would begin to approach preexisting habitat unit levels around year 34 (Alternative 3) and Year 41 (Alternative 2) and then continue to increase (Chart 8-1).

Chart 8-1. Change in Cumulative HUs for All Alternatives



Furthermore, as shown in Table 8-2, habitat value and associated HUs of sensitive habitat (including aquatic riverine, emergent wetland, bottomland hardwood and open water) would increase to above existing levels under Alternative 2 and 3. Under the FW/OPC, HUs would decrease from existing levels for all habitat types except bottomland hardwood.

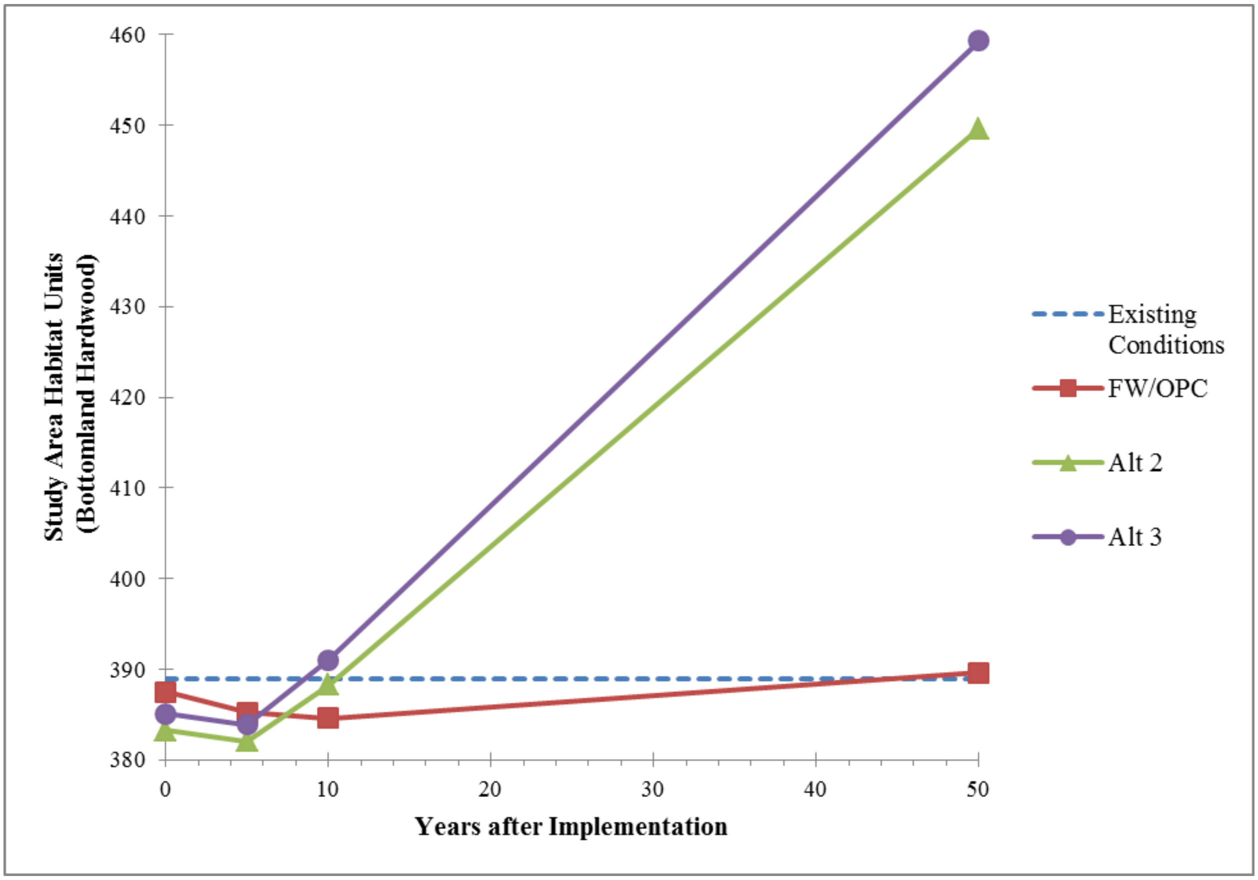
Table 8-2. Comparison of Cumulative HUs at Year 50 for All Alternatives

Habitat Type	*Existing Conditions*	*FW/OPC*		*Alternative 2 Cumulative*		*Alternative 3 Cumulative*	
	HU	*HU*	*Difference*	*HU*	*Difference*	*HU*	*Difference*
Bottomland Hardwood	388.92	389.60	0.68	449.67	60.75	458.89	69.97
Emergent Wetland	97.53	94.48	-3.05	145.55	48.02	147.66	50.13
Grassland	2,309.00	2,227.24	-81.76	1,952.33	-356.67	1,982.68	-326.32
Aquatic Riverine	345.77	332.84	-12.93	445.75	99.98	445.75	99.98
Open Water	143.76	129.90	-13.86	341.25	197.49	341.25	197.49
Total	**3,285.98**	**3,174.06**	**-110.92**	**3,334.55**	**49.57**	**3,376.23**	**91.25**

Charts 8-2 through 8-4 present the HUs over time for each sensitive habitat type, bottomland hardwoods (Chart 8-2), emergent wetlands (Chart 8-3), and open water and aquatic riverine (Chart 8-4). HUs for sensitive vegetation would increase over time.

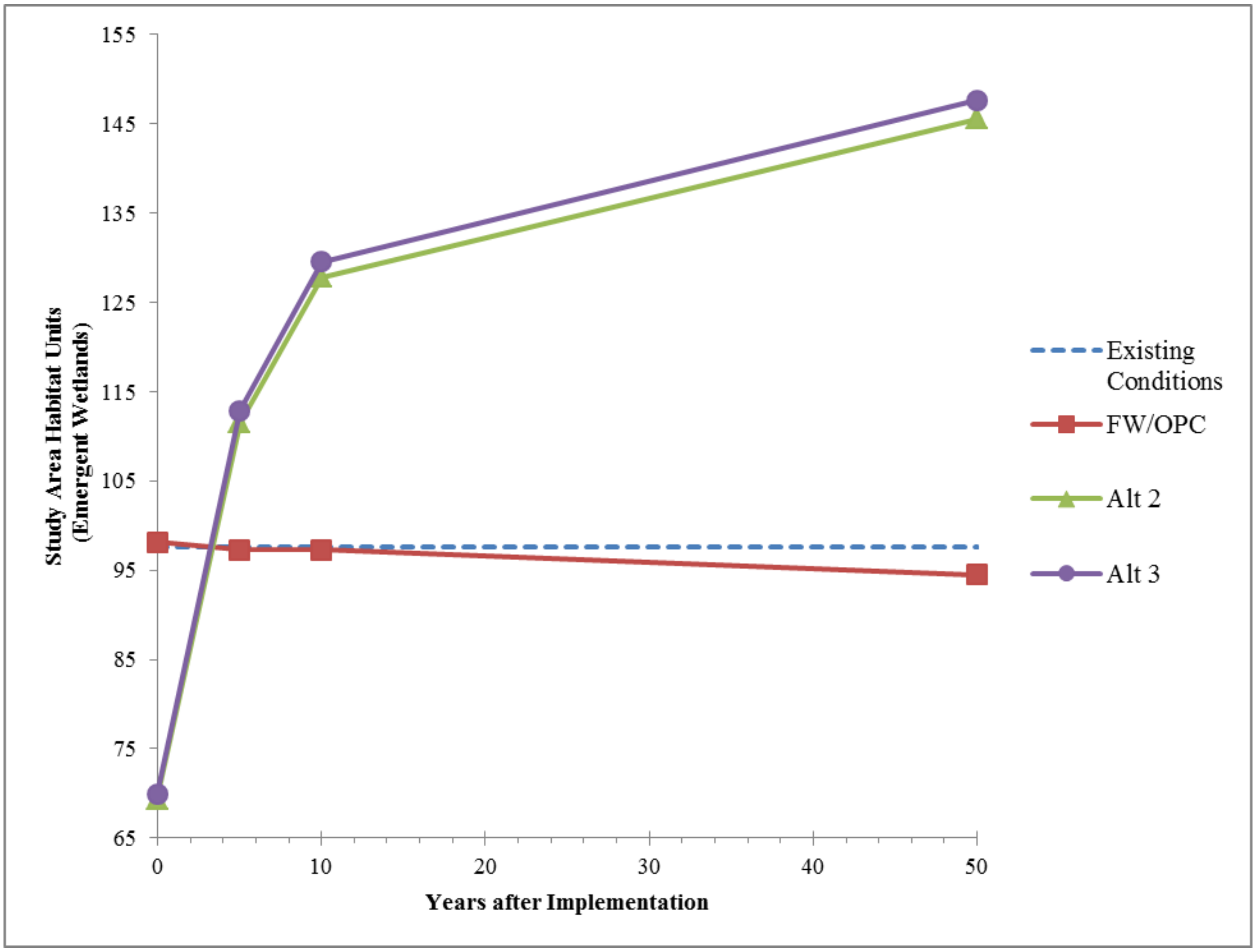
As shown in Chart 8-2, under the FW/OPC, bottomland hardwood habitat quality would decrease from year 0 to year 10. Afterwards, however, bottomland hardwood would recover until it is a slightly improved condition over the baseline condition. While both Alternative 2 and 3 also show a decline in quality below baseline conditions from year 0 to year 5, the active planting and management proposed under both alternatives result in a much more rapid recovery of bottomland hardwood. The increase in acreage and maintenance at high quality habitat would result in substantial gains in HUs of bottomland hardwoods under Alternatives 2 and 3. Alternative 3 would have higher HU values because more acreage of bottomland hardwood habitat is proposed.

Chart 8-2. Change in Cumulative Bottomland Hardwood HUs under All Alternatives



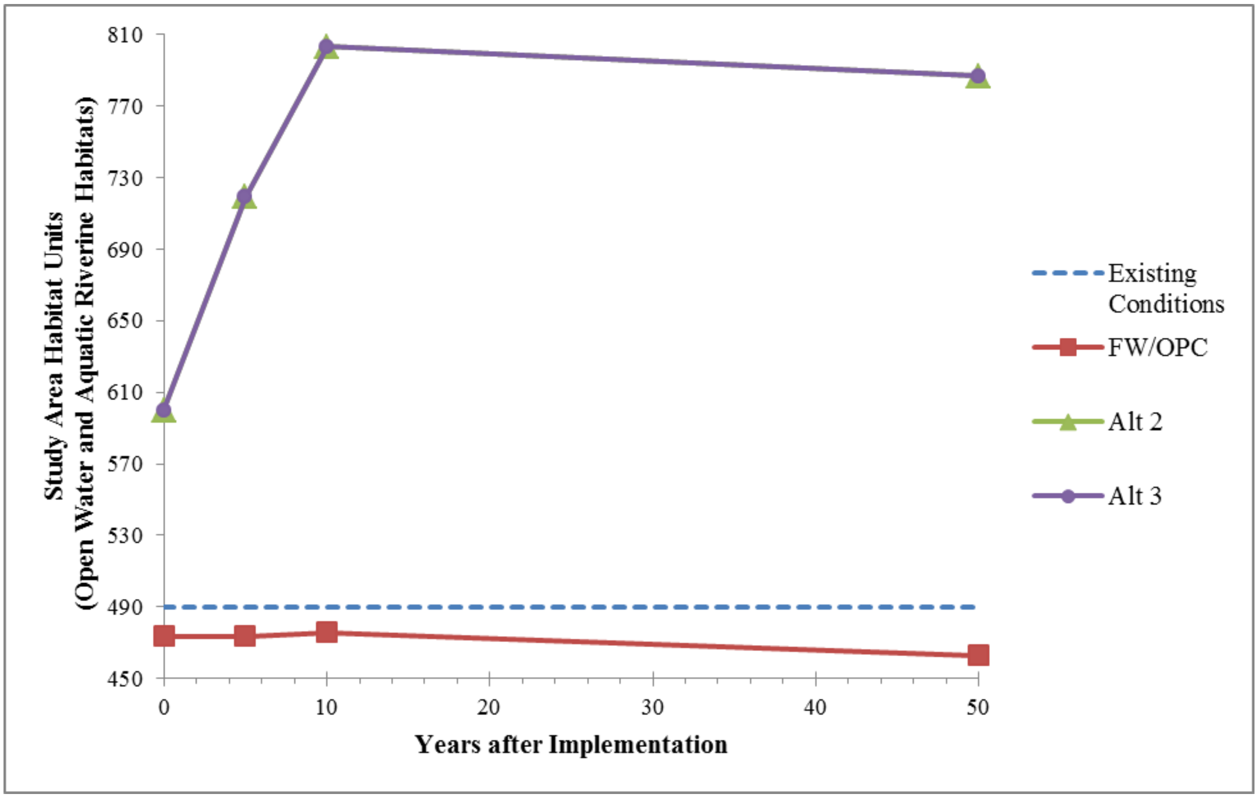
As show in Chart 8-3, under the FW/OPC, emergent wetland habitat quality would decrease steadily from year 0 to year 50. Emergent wetlands are not expected to return to existing quality levels for the next 50 years under the FW/OPC. While both Alternative 2 and 3 show a substantial loss of emergent wetland quality at year 0 (resulting from construction), the plantings would become established by year 5. By year 10 both Alternative 2 and 3 are predicted to surpass the quality of existing conditions. The increase in acreage and maintenance at high quality habitat would result in substantial gains in HUs of emergent wetlands under Alternatives 2 and 3. Alternative 3 would have higher HU values because acreage of emergent wetland would be lost to the Trinity Parkway.

Chart 8-3. Change in Cumulative Emergent Wetlands HUs under All Alternatives



As shown in Chart 8-4, under the FW/OPC, aquatic riverine habitat quality would decrease from year 0 to year 50. Aquatic riverine habitats are not expected to return to existing quality levels for the next 50 years under the FW/OPC. Conversely, the improved habitat structure (i.e. increase meanders and physical complexity) proposed in Alternative 2 and 3 would immediately increase the quality of the aquatic riverine habitat. As plantings become established and maintained, the habitat would continue to improve in quality from years 0 to year 10. The habitat would continue at a high level through year 50, with a slight decrease predicted based on drying trends anticipated through various climate change models.

Chart 8-4. Change in Cumulative Open Water and Aquatic Riverine HUs under All Alternatives

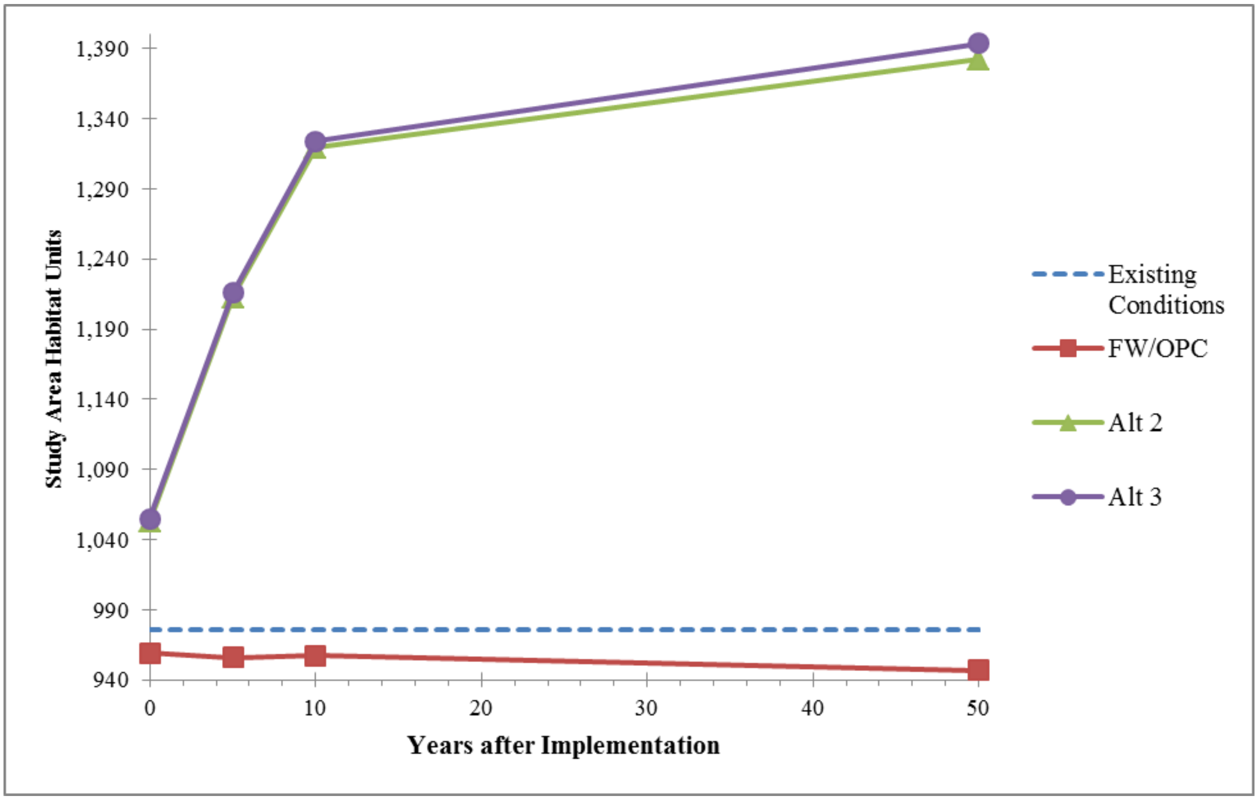


Referring back to project specific impacts for Alternative 2 and Alternative 3 (Sections 4.4 and 5.4, respectively), Alternative 2 generates more HUs than does Alternative 3 (178.82 HU for Alternative 2 and 157.68 HU for Alternative 3). Looking at sensitive habitat alone, the difference is smaller, with Alternative 2 generating 0.61 HU more than Alternative 3.

When the alternatives are considered in a cumulative setting, the impacts of the Trinity Parkway and other large-scale projects are observed. While on a project-only basis Alternative 2 generated the most habitat among alternatives, Alternative 3 generates the most total habitat and sensitive habitat (42.11 HU and 11.76 HU, respectively, more than Alternative 2) among the alternatives.

Chart 8-5 presents all the sensitive habitat HUs combined (bottomland hardwoods, emergent wetland, aquatic riverine, and open water) over time. These HUs would increase the most from year 0 to 10 due to the rapid growth of most wetland and aquatic vegetation. As shown in Chart 8-5, both Alternative 2 and Alternative 3 would result in substantially greater HUs as compared to the FW/OPC, with Alternative 3 predicted to have the greatest increase.

Chart 8-5. Change in Cumulative Bottomland Hardwood, Emergent Wetland, Open Water, and Aquatic Riverine HUs under All Alternatives



CHAPTER 9
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APPENDIX A

PLANT LISTS BY COMMON AND SCIENTIFIC NAMES

Appendix A.
Post Oak Creek Project
Plants by Common Name in Alphabetical Order

Common Name	*Scientific Name*
American beautyberry	***Callicarpa americana***
American elm	***Ulmus americana***
Blackhaw	***Virburnum rufidulum***
Black willow	***Salix nigra***
Boxelder	***Acer negundo***
Bushy bluestem	***Andropogon glomeratus***
Canada wildrye	***Elymus canadensis***
Cedar elm	***Ulmus crassifolia***
Chinaberry	***Melia azedarach***
Coastal Bermudagrass	***Cynodon dactylon***
Common moonseed	***Menispermum canadense***
Cottonwood	***Populus deltoides***
Crapemyrtle	***Lagerstroemia indica***
Croton	***Croton sp.***
Eastern red cedar	***Juniperus virginiana***
Giant ragweed	***Ambrosia trifida***
Green ash	***Fraxinus pennsylvanica***
Gum bumelia	***Bumelia lanuginosa***
Japanese honey-suckle	***Lonicera japonica***
Monkey grass	***Ophiopogon japonicus***
Mustang grape	***Vitis mustangensis* Buckley**
Partridge pea	***Chamaecrista fasciculata***
Pecan	***Carya illinoensis***
Poison ivy	***Toxicodendron radicans***
Post oak	***Quercus stellata***
Privet	***Ligustrum sp.***
Red oak	***Quercus shumardii***
Red mulberry	***Morus rubra***
Rescue grass	***Bromus catharticus***
Saw greenbrier	***Smilax bona-nox***
Soapberry	***Sapindus drummondii***
Southern dewberry	***Rubus enslenii***
Straggler daisy	***Calyptocarpus vialis***
Sugar hackberry	***Celtis laevigata***
Texas redbud	***Cercis Canadensis* var. *texensis***

Trumpet vine	***Campsis radicans***
Water oak	***Quercus nigra***
Western ragweed	***Ambrosia psilostachya***
Wild morning glory	***Ipomoea sp.***
Woodsorrel	***Oxalis sp***
Yaupon holly	***Ilex vomitoria***

Plants by Scientific Name in Alphabetical Order

Scientific Name	Common Name
Acer negundo	**Boxelder**
Ambrosia psilostachya	**Western ragweed**
Ambrosia trifida	**Giant ragweed**
Andropogon glomeratus	**Bushy bluestem**
Bromus catharticus	**Rescue grass**
Bumelia lanuginosa	**Gum bumelia**
Callicarpa americana	**American beautyberry**
Calyptocarpus vialis	**Straggler Daisy**
Campsis radicans	**Trumpet vine**
Carya illinoensis	**Pecan**
Celtis laevigata	**Sugar hackberry**
Cercis Canadensis* var. *texensis	**Texas redbud**
Chamaecrista fasciculata	**Partridge pea**
Croton sp.	**Croton**
Cynodon dactylon	**Bermudagrass**
Elymus canadensis	**Canada wildrye**
Fraxinus pennsylvanica	**Green ash**
Ipomoea sp.	**Wild morning glory**
Juniperus virginiana	**Eastern red cedar**
Lagerstroemia indica	**Crapemyrtle**
Ligustrum sp.	**Privet**
Lonicera japonica	**Japanese honey-suckle**
Melia azedarach	**Chinaberry**
Menispermum canadense	**Common moonseed**
Morus rubra	**Red mulberry**
Ophiopogon japonicus	**Monkey grass**
Oxalis sp	**Woodsorrel**
Paspalum dilatatum	**Dallis grass**
Populus deltoides	**Cottonwood**
Quercus nigra	**Water oak**
Quercus shumardii	**Red oak**
Quercus stellata	**Post oak**
Rubus enslenii	**Southern dewberry**
Salix nigra	**Black willow**
Sapindus saponaria	**Soapberry**
Sideroxylon lanuginosum	**Gum bumelia**

Smilax bona-nox	**Saw greenbrier**
Sorghun halepense	**Johnsongrass**
Toxicodendron radicans	**Poison ivy**
Ulmus crassifolia	**Cedar elm**
Ulmus americana	**American elm**
Virbunum rufidulum	**blackhaw**
***Vitis mustangensis* Buckley**	**Mustang grape**

APPENDIX B

HEP SITES OBSERVATION SHEETS

HEP Site Observations for the Dallas Floodway Project

Site: 001

Date: 8/30/04

GPS #: 001

Photos: Disk #1, 2 - 5

General Description and Observations: Riparian/Shrubland. River bank, silt deposits, willow shrubland on low bank. Recently flooded leaving silt coverage. Between the site and the levee: broad giant ragweed expanse, broken by low areas of smartweed w/ willow, lots of balloonvine and bindweed coverage and johnsongrass fields.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Black willow	Black willow		Smartweed
			Giant ragweed stalks
			bindweed
			Alligatorweed (pink flower)

Wildlife Species Observed:
Dead freshwater drum ~4"

HEP Site Observations for the Dallas Floodway Project

Site: 002

Date: 10/14/05

GPS #: 026

Photos: Disk 13, photos 3 – 6

General Description and Observations: Dry wetland, near golf course, very heavy groundcover nearby, ragweed nearby

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Cedar elm – nearby	Cutgrass	Gerardia
	Honey locust – nearby	Johnsongrass - nearby	sumpweed
	Green ash		Balloon vine
			Dodder
			Daisy fleabane
			Goldenrod
			Sunflower sp.
			Smartweed sp.
			bullrush

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 003

Date: 10/13/05

GPS #: 016

Photos: Disk 8: 6-8 , Disk 9: 1

General Description and Observations: Riparian Woodland bordered by mowed johnson grass field anf West Fork. 90% leaf litter groundcover.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cottonwood	Chinaberry	Johnson grass	Poison ivy
Hackberry		wildrye	Greenbrier
American elm			Giant ragweed
Green ash			Turkey foot leaf
mulberry			

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 004

Date: 08/30/04

GPS #: 005

Photos: Disk 1, 14 – 16

General Description and Observations: Wetland in depression in floodway flats.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Black willow	Signalgrass?	Smartweed sp.
	Buttonbush		Ludwigia peploides
	cottonwood		Spikerush sp.
			5 leaf vine again

Wildlife Species Observed

Crayfish chimneys
Killdeer
Chorus frog
Gulf coast toad
Monarch butterfly

HEP Site Observations for the Dallas Floodway Project

Site: 005

Date: 08/30/04

GPS #: 006

Photos: Disk 2, 1 - 4

General Description and Observations: Emergent wetland near base of levee.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Black willow		Alligatorweed
			Smartweed sp.
			Carex sp. (sample)
			Sumpweed
			Spikerush sp.

Wildlife Species Observed:
Many crayfish chimneys
gambusia

HEP Site Observations for the Dallas Floodway Project

Site: 006

Date: 08/30/04

GPS #: 007

Photos: Disk 2, 5 - 8

General Description and Observations: Grassland floodway flats near base of levee have mostly poison ivy, giant ragweed, and wheat (?).

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Wheat (?)	Sumpweed
			Pigweed
			Poison ivy
			Smartweed sp.
			Morning glory

Wildlife Species Observed:
Crayfish chimneys
Great egret

HEP Site Observations for the Dallas Floodway Project

Site: 007

Date: 08/30/04

GPS #: 008

Photos: Disk 2, 9 - 12

General Description and Observations: Grassland site.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Johnson grass	Sumpweed
	Mulberry	Wheat (?) sample	Giant ragweed
			Bindweed
			Balloonvine
			Purple leather flower
			Goldenrod sp.
			Sensitive briar- like plant (sample)

Wildlife Species Observed:
Giant blue heron
Great egret
Turkey vulture
Mourning dove
Pigeon
(Buteo sp. Redtail)

HEP Site Observations for the Dallas Floodway Project

Site: 008

Date: 08/31/04

GPS #: 009

Photos: Disk 2, 13 - 16

General Description and Observations: Grassland containing Johnson grass and ragweed, with flats on floodplain shelf.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Johnson grass	Balloonvine
		Common bermuda grass	Gaint ragweed
		Wheat-like grass (from sites the day before)	Bindweed
			Sumpweed
			Sensitivebriar-like (from the day before)
			Mexican hat
			Dodder
			Small-leaved aster ?
			Ludwigia sp. ?

Wildlife Species Observed:
Redwing blackbird
Grackle

HEP Site Observations for the Dallas Floodway Project

Site: 009

Date: 08/31/04

GPS #: 011

Photos: Disk 2, 17 - 20

General Description and Observations: Heavily silted riparian site with a very sparse understory and a lot of trash. Rise between channel and wide channel, probably within ~ 1 yr flood zone.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Red mulberry	Box elder	Inland seaoats	Bindweed
Black willow	American elm		Alligatorweed
Cottonwood	Red mulberry		
Green ash	Green ash		

Wildlife Species Observed:
Raccoon traps
Great egret tracks
Sign of beaver
Blue jay feathers

HEP Site Observations for the Dallas Floodway Project

Site: 010

Date: 08/31/04

GPS #: 012

Photos: Disk 3, 1 - 4

General Description and Observations: Grassland. Floodplain flats between levee and channel. Mixed shallow depressions with out water.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Wheat	Pigweed
		Switchgrass	Same small-leaved aster
		Signalgrass-like sample	Bindweed
		Common Bermuda grass	Balloonvine
			Smartweed sp.
			Curly dock
			Sumpweed
			Giant ragweed
			Carex sp.

Wildlife Species Observed:
Many crayfish chimneys
Dead crayfish
Scissortail flycatcher nearby

HEP Site Observations for the Dallas Floodway Project

Site: 011

Date: 08/31/04

GPS #: 010

Photos: Disk 3, 5 - 8

General Description and Observations: Emergent wetland, 2 – 6 inches of water with mostly alligatorweed. Sapling willow shrubland between site and river, followed by a row of large willow on the river bank (green ash, willow, cottonwood, and mulberry).

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Blackwillow		Cattail
	Cottonwood		Ludwigia peploides
			Alligator weed
			Large carex sp.
			Spikerush sp.
			Smartweed sp.

Wildlife Species Observed:
Raccoon tracks
Crayfish chimneys

HEP Site Observations for the Dallas Floodway Project

Site: 012

Date: 10/13/05

GPS #: 019

Photos: Disk 9: 10, Disk 10: 1-3

General Description and Observations: grassland surrounded by the West Fork meanders. Primarily Johnsongrass intermixed with switchgrass and ballonvine. Previously mowed.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cedar elm		Johnsongrass	Sensitive briar
		Switchgrass	Balloonvine
		Dallisgrass	Sumpweed
			Cocklebur
			carex

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 013

Date: 08/31/04

GPS #: 015

Photos: Disk 3, 14 - 17

General Description and Observations: Grassland which appears somewhat wet (cutgrass) with openings full of daisy and bindweed.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Wheat-like grass	Balloonvine
		Johnson grass	Small leaf aster
			Giant ragweed
			Bindweed
			Pigweed
			Sensitive briar-like
			Sawtooth daisy ?

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 014

Date: 08/31/04

GPS #: 014

Photos: Disk 3, 9 – 13 (13, Larry of CDM)

General Description and Observations: Depression wetland amid johnsongrass field.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Buttonbush	Switchgrass	Peppervine
	Black willow		Large carex sp.
	Cottonwood		Spikerush sp.
			Poison ivy
			Curly dock
			s. dewberry

Wildlife Species Observed:
Gambusia
Crayfish chimneys

HEP Site Observations for the Dallas Floodway Project

Site: 015

Date: 08/31/04

GPS #: 016

Photos: Disk 4, 5 - 8

General Description and Observations: Large emergent wetland with a narrow strip of standing water in the center. Algal mats on ~ 50% of water surface and gas line (jet fuel) marked in the center of water.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Willow (small)	Various sedges	Balloon vine
		Smartweed	Dodder
		Spike rush	Maximillian sunflower
		Unknown wheat	Great frogfruit
		Ball sedge	(Little purple aster)
		Cutgrass	Sumpweed
			Cocklebur
			Morning glory

Wildlife Species Observed:
Great egret
Crawfish chimney

HEP Site Observations for the Dallas Floodway Project

Site: 016

Date: 10/12/05

GPS #: 004

Photos: Disk 3: 1-4 (Photos 5 & 6 are of the confluence near railroad tracks)

General Description and Observations: Turtle creek disturbed riparian woodland. Open under canopy, kept mowed with random mature pecan trees. Understory is chinaberry/ hackberry/ and poison ivy. Smartweed on the stream. Water averages 8". Sand and gravel bottom with sporadic aquatic vegetation.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Pecan	Chinaberry	Johnsongrass	Poison ivy
Hackberry			Beggerslice
chinaberry			Prairie cone flower

Wildlife Species Observed:

gambusia
sunfish
damselflies

HEP Site Observations for the Dallas Floodway Project

Site: **017**

Date: **09/01/04**

GPS #: not collected until later

Photos: No photos

General Description and Observations: Riparian site just upstream from Hampton Rd, ~ 20 ft wide woody zone, very steep sandy/silt bank with much sand deposition at the top of it. A lot of large and small woody debris, little ground cover, large old willow snag, and johnsongrass outside woody zone in 1/10 acre plot.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Green ash	Hackberry	Inland seaoats	S. dewberry
Red mulberry	American elm	Johnson grass	Peppervine
Black willow	Boxelder		Snailseed vine
Boxelder	Red mulberry		Poison ivy
	Black willow		Goldenrod sp.
			Large carex-like sp. from 1st sample day

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 018

Date: 08/31/04

GPS #: 019

Photos: Disk 4, 11 - 14

General Description and Observations: Grassland with much poison ivy mixed in near Loop 12.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	American elm	Johnson grass	Poison ivy
	Amorpha fruticosa(?)	Switchgrass	Balloonvine
			Small leaf aster
			Smartweed sp.
			Carex sp. (small)
			Pink evening primrose
			Pigweed
			Tall milkweed (from earlier sample)
			s. dewberry
			Curly dock

Wildlife Species Observed:
Scissortail flycatcher nearby

Site: 019

HEP Site Observations for the Dallas Floodway Project

Date: 08/31/04

GPS #: 020

Photos: Disk 4, 15 – 18 (19 – 21, view of Dallas across wetland/pond near site 9)

General Description and Observations: Wetland. Edge of permanent large pool, shore mostly bare from water fluctuation.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Button bush	Switchgrass	Smartweed sp.
	Green ash	Common Bermuda	Pigweed
			Sesbania sp. (seedlings)
			Sumpweed
			Frogfruit
			Balloonvine
			Bindweed
			Spikerush sp.

Wildlife Species Observed:
Kill deer
Red ear slider
Great blue heron
Large mussel shells
Raccoon tracks

Site: 020

HEP Site Observations for the Dallas Floodway Project

Date: 8/31/04

GPS #: 021

Photos: Disk 4, 22 – 25 (1st photo facing W., 2nd facing E., 3rd facing S. toward river, 4th facing N.)

General Description and Observations: Riverbank riparian zone, approximately 30 ft wide wooded zone, steep bank ~45 degrees (sand/silt), small wooded debris common.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Boxelder	Hackberry	□□□□□□î□□□□	Poison ivy
Green ash	Boxelder	Johnson grass	Smartweed
	Green ash		Giant ragweed
	Red mulberry		Small leaf aster
			Milkweed vine

Wildlife Species Observed:
Red ear slider

HEP Site Observations for the Dallas Floodway Project

Site: 021

Date: 10/13/05

GPS #: 015

Photos: Disk 8: 4&5

General Description and Observations: emergent wetland adjacent to the West Fork. Abundant smartweed, with balloonvine, cocklebur, and willows around the edge.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Black willow	buttonbush	Johnsongrass	Smartweed
cottonwood		switchgrass	Cocklebur
			Balloovine
			Sumpweed
			Aster sp.
			Pigweed
			Curly dock
			Sunflower sp.
			hibiscus

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 022

Date: 09/01/04

GPS #: 023

Photos: Disk 5, 5 - 8

General Description and Observations: Grassland site.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Johnson grass	Giant ragweed
		Wheat-like	Pigweed
		Sedge-like nutgrass (sample)	Sumpweed

Wildlife Species Observed:
Crayfish chimneys

HEP Site Observations for the Dallas Floodway Project

Site: 023

Date: 09/01/04

GPS #: 024

Photos: Disk 5, 9 - 12

General Description and Observations: Grassland with johnson grass. Flat, broad expanse between levee and channel.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Johnson grass	Snow on the prairie
		Wheat-like	Sensitive briar-like w/ long pods
		Nutgrass-like fome earlier	Pink evening primerose
			Balloonvine
			Pigweed
			Giant ragweed
			Sumpweed
			s. dewberry

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 024

Date: 09/01/04

GPS #: 025

Photos: Disk 5, 13 - 16

General Description and Observations: Depression wetland with mostly uniform Eleocharis stand. Open water without emergent vegetation except Eleocharis on margin.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Black willow		Smartweed
	Cottonwood		Tall spikerush sp. (sample)

Wildlife Species Observed:
Chorus frogs
Great egret tracks
Many crayfish holes
Gambusia
Many species of dragonfly and damselfly

Site: 025

HEP Site Observations for the Dallas Floodway Project

Date: 09/01/04

GPS #: 026

Photos: Disk 5, 17 - 20

General Description and Observations: Woodland – part of Greenland park. Dense privet stand with little understory openings with violets, pigeonberry, wildrye, etc. Much down woody debris.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cedar elm	Chinese privet	Canadian wildrye	Giant ragweed
Chinaberry	Hackberry		Pigeonberry
Red mulberry	Green ash		s. dewberry
Bois d'Arc	Western sageberry		Poison ivy
Bur oak			Virginia creeper
			Smilax bona-nox
			Lamiaceae sample
			Balsam gourd

Wildlife Species Observed:

Carolina wren
Blue jay
N. cardinal
Downy woodpecker
Gulf coast toads
White-eyed vireo
Tufted titmouse

Site: 026

HEP Site Observations for the Dallas Floodway Project

Date: 09/01/04

GPS #: 027

Photos: Disk 5, 21 - 24

General Description and Observations: Woodland with much woody debris and wildrye groundcover. Water line ~3 ft high on tree trunks.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Green ash	Chinese privet	Canada wildrye	Pigeonberry
Cedar elm	Red mulberry		Lamiaceae sp (from before)
	Cedar elm		Large carex-like from prior days
	Green ash		Cockerbur
	Hackberry		Poison ivy
	Chinaberry		Smartweed
	Western soapberry		

Wildlife Species Observed:
Carolina chickadee
Grackle
Tufted titmouse
Redtail hawk nearby
Downy woodpecker
Dead water snake just outside of photos

Site: 027

Date: 09/01/04

HEP Site Observations for the Dallas Floodway Project

GPS #: 028

Photos: Disk 6, 1 - 4

General Description and Observations: Woodland which has been cleared, leaving a few scattered trees, mostly invasive (early succession invasives).

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
America elm	Western soapberry	Johnson grass	Sumpweed
Hackberry	Youpon holly		Peppervine
Gum bumelia	Bois 'd' Arc		Smilax bona-nox
	Chinaberry		Annual sunflower
	American elm		Brown eyed susan
	Cedar elm		Poison ivy
	Gum bumelia		Blue flower passion flower vine
	Chinese privet		Beggars lice
			Sumpweed
			Pigweed
			Snailseed vine
			s. dewberry

Wildlife Species Observed:
Warbling vireo
Redbellied woodpecker
mockingbird

Site: 028

Date: 09/01/04

HEP Site Observations for the Dallas Floodway Project

GPS #: 029

Photos: Disk 6, 5 - 8

General Description and Observations: Likely old borrow pit, emergent wetland.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Black willow	Black willow	Johnson grass	Smartweed sp.
Cottonwood	Buttonbush		Spikerush sp.
	Chinese privet		Water clover
	Green ash		Mustang grape
			Poison ivy
			Alligator weed
			Large carex sp. from earlier
			Smilax bona-nox
			Sumpweed
			Giant ragweed
			summergrape

Wildlife Species Observed:
Chorus frogs
Slider sp.
gambusia

Site: 029

Date: 08/31/04

HEP Site Observations for the Dallas Floodway Project

GPS #: 013

Photos: Disk 4, 1 - 4

General Description and Observations: Grassland dominated by johnson grass, with a few large cottonwoods.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Johnsongrass	Balloonvine
	American elm	Wheat-like grass	Purple leatherflower
	Green ash		Annual sunflower
			Frogfruit
			Giant ragweed
			Snailseed vine
			Poison ivy
			s. dewberry
			Milkweed (sample)
			Cocklebur
			Bindweed
			peppervine

Wildlife Species Observed:
Chimney swifts

HEP Site Observations for the Dallas Floodway Project

Site: 030

Date: 10/12/05

GPS #: 008

Photos: Disk 4: 9, Disk 5: 1 - 3

General Description and Observations: barren riparian grassland, primarily bermuda grass. Water flowing through riffles, gravel bottom. Urbanized on both sides of stream.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Bermudagrass	Sesbania
		Johnsongrass	Balloonvine
			Goldenrod
			Duckweed
			Blackberry
			Bullrush
			Smartweed
			peppervine

Wildlife Species Observed:

Sunfish
Carp
Spotted gar
bluejay

HEP Site Observations for the Dallas Floodway Project

Site: 031

Date: 09/01/04

GPS #: 022

Photos: Disk 5, 1 - 4

General Description and Observations: Ragweed/swampweed flat grassland

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Johnson grass	Dodder
		Wheat-like grass	Bindweed
			Balloonvine
			Giant ragweed
			Purple aster-like plant (sample)
			Small leaf aster-like from 1st day
			Large carex-like
			swampweed

Wildlife Species Observed:
Crayfish chimneys

HEP Site Observations for the Dallas Floodway Project

Site: 032

Date: 08/31/04

GPS #: 017

Photos: Disk 4, 9 - 10

General Description and Observations: Riparian site with deposit, flow swept, down woody material, and little ground cover.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Red mulberry	Red mulberry	Inland seaoats	Poison ivy
Green ash	Boxelder		s. dewberry
Cottonwood			
Black willow			

Wildlife Species Observed:
Gulf coast toads

HEP Site Observations for the Dallas Floodway Project

Site: 033

Date: 10/12/05

GPS #: 001

Photos: Disk 1: 1-6

General Description and Observations: Emergent wetland. Sump between railroad and Corinth St. Shallow drainage area (approximately 10 acres), water currently present. Random trees. Surrounded by mowed bermudagrass and johnsongrass.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cottonwood	Sesbania	Switchgrass	cattail
Dogwood		(tall alternate head – collected)	Ludwigia
		Knotroot bristlegrass	Spikerush
		Meadow dropseed	Unknown sedge
			Smartweed sp.
			Griet ragweed
			Duckweed
			Prairie coneflower
			Goldenrod
			bullrush

Wildlife Species Observed:

White ibis
Snowy egret
Great blue heron
Great egret
Yellowlegs
Killdeer
Red-tail hawk

mallard
monarch butterfly
multible turtles (sliders)
gambusia
sunfish
dragonflies

HEP Site Observations for the Dallas Floodway Project

Site: 034

Date: 8/30/04

GPS #: 004

Photos: Disk 1, 10 - 13

General Description and Observations: Grassland, east side of river flat inside levees, abundant sumpweed and giant ragweed

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Johnsongrass	balloonvine
	American elm	Wheatgrass	bindweed
	Cedar elm		Curley dock
			Sumpweed
			Gient ragweed
			Milkweed vine
			Poison ivy
			Purple leatherflower
			Bermuda grass
			cocklebur
			5 leaflet pinnate vine (sample)

Wildlife Species Observed:
Redtailed hawk
Few crawfish chimneys

HEP Site Observations for the Dallas Floodway Project

Site: 035

Date: 10/14/05

GPS #: 020

Photos: Disk 11: 1- 4

General Description and Observations: Riparian woodland. Dense privit understory (approximately 80% closure) Overstory: cedar elm dominant. Ground cover: Moderate amount of down limbs and leaves

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cedar elm	privit		greenbrier
Green ash			
Bois d'arc			

Wildlife Species Observed:

Carolina wren
Crow
Bluejay
Carolina chickadee
Cardinal
Northern flicker
N. Mockingbird

HEP Site Observations for the Dallas Floodway Project

Site: 036

Date: 8/30/04

GPS #: 002

Photos: Disk #: 1, 6 - 9

General Description and Observations: Wetland with open water areas, flood channel flats with levees.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	buttonbush	Switchweed	sumpweed
	Black willow		smartweed
	Cottonwood		Hibiscus moscheuts
			Carex sp.
			Spikerush sp.

Wildlife Species Observed:

Many crawfish chimneys
Great blue heron
Great egret

HEP Site Observations for the Dallas Floodway Project

Site: 037

Date: 10/13/05

GPS #: 018

Photos: Disk 9: 6 - 9

General Description and Observations: Emergent wetland. Surrounded by cattails with the West Fork meander as the source of water.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Creeping lovegrass	Cattail
		Switchgrass	Bullrush
			Smartweed
			Balloonvine

Wildlife Species Observed:

Great egret
Red-winged blackbird

HEP Site Observations for the Dallas Floodway Project

Site: 038

Date: 10/14/05

GPS #: 023

Photos: Disk 12: 3 - 6

General Description and Observations: Riparian woodland.Wood ducks in nearby West Fork meander. American elm and hackberry dominant overstory. Occasional dense stands of large leaved privit. Some bare soil visible. Much shade.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
American elm	(large leaved privit)		Greenbrier 1
Hackberry	Small leaved privit		Greenbrier 2
Chinaberry			

Wildlife Species Observed:

Northern flicker
Fox squirrel
Kestral
Wood duck
Great blue heron
Bluejay
Mockingbird
Starling
Crow
Red-tailed hawk
Killdeer
Carolina Chickadee

HEP Site Observations for the Dallas Floodway Project

Site: **039**

Date: **10/12/05**

GPS #: **009**

Photos: Disk 5: 4 - 7

General Description and Observations: Riparian woodland surrounded by urban development in the Elm Fork meander area.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
American elm		wildrye	Beggerslice
Mulberry			Smartweed
Bois d'arc			Bullrush
			Poison ivy
			Spikerush
			Greenbrier
			Plantain
			Sagiterious
			Sedge sp.
			Crow's poison?
			Passion flower?
			peppervine

Wildlife Species Observed:

Spotted gar
Mockingbird
Wood ducks
Downey woodpecker
Frop sp.
bluejay

HEP Site Observations for the Dallas Floodway Project

Site: 040

Date: 0/12/05

GPS #: 006

Photos: Disk 4: 1 - 4

General Description and Observations: Narrow riparian woodland along the Elm Fork meander, urbanized on both sides. Open with scattered mature trees. Slow moving stained water. Very little ground cover on slopes due to mowing. Two large American elm trees (43.5” and 44” dbh)

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
American elm		Wildrye	Cattail
Green ash		Johnsongrass	Begger’s tick
Hackberry		Sporabolis sp.	Duckweed
Mulberry			Balloonvine
			Poison ivy
			Greenbrier
			Peppervine

Wildlife Species Observed:

Gambusia
turtles
fox squirrel
grackle
european starling

HEP Site Observations for the Dallas Floodway Project

Site: 041

Date: 10/13/05

GPS #: 013

Photos: Disk 7: 3 - 6

General Description and Observations: Open savannah with scattered bur oak. Mowed. Along the Elm Fork meanders.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Pecan	mesquite	johnsongrass	Croton
Cottonwood			Sensitive brier
Bur oak			Western ragweed
Hackberry			Beebalm
			Morning glory
			Passion flower?

Wildlife Species Observed:

Bluejay

HEP Site Observations for the Dallas Floodway Project

Site: 042

Date: 10/13/05

GPS #: 012

Photos: Disk 6: 9 - 10

General Description and Observations: Wetland approximately 4 ac in size. Willows on fringe, abundant smartweed, with numerous cattail patches, and abundant crawfish holes.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Black willow			Caryx
Pecan			Smartweed
Hackberry			Cattail
Green ash			Bullrush
			Balloonvine

Wildlife Species Observed:

Great egret
killdeer
kingfisher

HEP Site Observations for the Dallas Floodway Project

Site: 043

Date: 10/12/05

GPS #: 005

Photos: Disk 3: 7 & 8

General Description and Observations: Wetland, shallow water site with breeched dam, approximately 0.5 acres. Woody debris present.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cottonwood		switchgrass	Ballonvine
Black willow			Bullrush
American elm			Smartweed
			Caryx
			Gourd
			Curly clemetis

Wildlife Species Observed:

cottontail
bluejay
eastern kingbird
carolina wren

HEP Site Observations for the Dallas Floodway Project

Site: 044

Date: 10/12/05

GPS #: 007

Photos: Disk 4: 5 - 8

General Description and Observations: Narrow riparian corridor near the Elm Fork meander. Urbanized on both sides. Slow moving stained water. Large American elm present with 35.5" dbh.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
American elm		Johnsongrass	Balloonvine
Cottonwood		Wildrye	Beggerstick
Hackberry		bermudagrass	Virginia Creeper
Mulberry			Poison ivy
Pecan (just outside)			greenbrier
			Giant ragweed
			Bullrush
			Smartweed
			Duckweed
			pigweed
			Prairie coneflower
			Crow's poison
			Peppervine

Wildlife Species Observed:

Fox squirrel
gambusia

HEP Site Observations for the Dallas Floodway Project

Site: 045

Date: 10/12/05

GPS #: 003

Photos: Disk 2: 2 - 5

General Description and Observations: riparian woodland near West Fork. Narrow mixed willow/cottonwood corridor bordered by the river and mowed field. Giant ragweed in understory and 80% leaf litter.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cottonwood	Chinaberry	Johnsongrass	Giant ragweed
Black willow	Box elder	wildrye	Goldenrod
American elm	greenash		Balloonvine
Milberry			Blackberry?
			Poison ivy

Wildlife Species Observed:

bluejay
carolina wren
kingfisher

HEP Site Observations for the Dallas Floodway Project

Site: 046

Date: 10/13/05

GPS #: 014

Photos: Disk 8: 1 - 3

General Description and Observations: Emergent wetland adjacent to the levees of the Elm Fork. The other side has an abundant smartweed.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Green ash	Buttonbush	wildrye	Smartweed
Black willow	sesbania		Sumpweed
			Peppervine
			Caryx
			Cattail
			Giant ragweed
			Poison ivy
			Aster sp.
			gerardia
			Alligatorweed?

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 047

Date: 10/14/05

GPS #: 022

Photos: Disk 11: 9 – 10, Disk 12: 1 - 2

General Description and Observations: Mowed grassland west of the West Fork.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
		Bermudagrass	Frogfruit
		Clumping grass?	Unidentified ground cover with white flowers

Wildlife Species Observed:

Kestral
Wood duck
Great blue heron
Northern flicker
Bluejay
mockingbird
european starling
crow
red-tailed hawk
killdeer
Carolina chickadee

HEP Site Observations for the Dallas Floodway Project

Site: 048

Date: 10/12/05

GPS #: 002

Photos: Disk 1: 7 - 10

General Description and Observations: Riparian woodland. Narrow willow corridor bordered by river and mowed area perched, with 75% leaf litter, giant ragweed understory.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Black willow	Box elder	Johnsongrass	Giant ragweed
Mulberry		Wildrye	Western ragweed
Cottonwood			Poison ivy
			Balloonvine
			Goldenrod

Wildlife Species Observed:

Red-tailed hawk
killdeer
northern flicker
downey woodpecker
eastern kingbird

HEP Site Observations for the Dallas Floodway Project

Site: **0**49

Date: **10/13/05**

GPS #: 010

Photos: Disk 6: 1 - 4

General Description and Observations: Wetland corridor through urban area. Stream widens to create aquatics flat of smartweed, peppervine. Water slow moving. Grassy slopes on shoreline with scattered old trees.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Green ash (2.5" dbh)	chinaberry	Wildrye	Balloonvine
American elm		Johnsongrass	Peppervine
		bermudagrass	Smartweed
			Passion flower?
			Bullrush
			Duckweed
			Prairie coneflower
			Greenbrier
			Alligatorweed
			Poison ivy
			bramble

Wildlife Species Observed:

frog
turtles
bluejay
mockingbird
great egrets flying over

HEP Site Observations for the Dallas Floodway Project

Site: **050**

Date: **10/13/05**

GPS #: 011

Photos: Disk 6: 5 - 8

General Description and Observations: Grassland adjacent to narrow stream along Elm Fork meander, corridor bordered by urban areas, primarily bermudagrass, and Johnsongrass

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Hackberry	Johnsongrass	Balloonvine
	Cedar elm	bermundagrass	Like sensitive brier
			Curly dock
			Beggerstick

Wildlife Species Observed:

Great egret
pigeons
mourning dove
starlings

HEP Site Observations for the Dallas Floodway Project

Site: 051

Date: 10/13/05

GPS #: 017

Photos: Disk 9: 2 - 5

General Description and Observations: Mowed grassland bordered by riparian woodlands on the West Fork and the levees. Predominantly johnsongrass, with random cedar elm saplings.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Cedar elm	sesbania	johnsongrass	Western ragweed
			Blackberry?

Wildlife Species Observed:

HEP Site Observations for the Dallas Floodway Project

Site: 052

Date: 10/14/05

GPS #: 025

Photos: Disk 13: 1 - 4

General Description and Observations: Dry wetland, 98% groundcover, some small black willows recolonizing.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Black willow	Johnsongrass	Cocklebur
		Bermudagrass	Daisy fleabane
		Creeping lovegrass	Frogfruit
			Balloonvine
			Sumpweed
			Morning glory
			Goldenrod
			Smartweed

Wildlife Species Observed:

Red-tail hawk

HEP Site Observations for the Dallas Floodway Project

Site: 53

Date: 10/14/05

GPS #: 021

Photos: Disk 11: 5 - 8

General Description and Observations: Grassland with West Fork meander nearby.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
	Chinaberry	Johnsongrass	Bindweed
	Mulberry	Bermudagrass	Morning glory
		Canada rye	Bullrush
			Saggitaria
			Balloonvile
			Curly Clemetis
			Yellow nighshade
			Sedge??
			Milkweed

Wildlife Species Observed:

mockingbird
bluejay
starling

HEP Site Observations for the Dallas Floodway Project

Site: 54

Date: 10/14/05

GPS #: 024

Photos: Disk 12: 7 & 8

General Description and Observations: Riparian woodland with large amount of chinaberry 1' – 25' tall, 30% canopy cover, hackberry overstory, heavy shrub groundcover 70%.

Plant Species:

Tree:	Shrub:	Grass:	Vine or Forb:
Hackberry	Privit	Wild rye	Greenbrier
Chinaberry	Chinaberry		Begger's tick
Green ash	Bur oak		Day flower
American elm			
Water's edge:			Bullrush
			Balloonvine
			Day flower
			Hibiscus

Wildlife Species Observed:

Many grackles
cardinal

HEP Site Observations for the Dallas Floodway Project

HEP Site Observation sheets for sites 55 through 68 are unavailable

APPENDIX C

HEP STRUCTURAL HABITAT COMPOSITION PARAMETERS

Dallas Floodway HEP Field Data Summary

Cover Type: **Bottomland Hardwood**

Species: **Carolina Chickadee** **Raccoon** **Fox Squirrel**

Wood Duck **Barred Owl**

Variable	HEP Site #																						
	3	9	16	17	20	25	26	27	32	35	38	39	40	44	45	48	54	55	57	58	59	60	66
% canopy closure of trees that produce hard mast >6 in dbh	0	0	25	70	0	15	0	0	12	8	0	0	0	2	10	0	0	80	35	60	60	75	4.5
Distance to available grain (yards)	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
Average dbh of overstory trees	14.5	7	11	7.5	8	12	6.5	7.7	18	5.7	9.6	30.5	43	20	13	12	12.8	16	10	9.5	9	8	14
Percent tree (>16.5 ft height) canopy closure	65	75	40	70	60	80	55	15	95	70	60	90	85	45	80	40	30	90	35	80	60	75	4.5
Percent shrub (<16.5 ft height) crown cover	50	10	15	5	40	50	40	15	45	80	85	5	0	2	40	25	70	50	70	15	60	50	0
Water regime (permanence of surface water)	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1
% canopy cover of overstory trees	65	15	40	70	60	80	55	15	95	70	60	90	85	45	80	40	30	80	55	80	60	50	15
Number of trees >20" dbh/acre	20	1	2	1	0	10	0	0	20	0	1	10	20	1	20	0	0	2	2	3	2	0	3
% water area <6 feet deep	0	40	100	5	10	100	100	20	15	20	100	100	100	100	50	20	100	100	100	100	100	100	40

Variable	3	9	16	17	20	25	26	27	32	35	38	39	40	44	45	48	54	55	57	58	59	60	66
% emergent herbaceous canopy cover in littoral zone	5	2	5	0	5	0	15	0	4	2	90	10	10	20	1	0	100	0	2	40	40	40	10
Water current (average summer conditions)	2	2	1	2	2	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1
Number of nest boxes/acre	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of potential nest sites per acre	10	0	0	40	0	30	40	0	10	0	20	10	10	0	1	1	20	0	0	2	0	0	1
% of water surface covered by potential winter cover	0	20	2	5	0	5	35	0	0	5	0	30	1	0	10	5	80	0	0	10	10	0	0
% of water surface covered by potential brood cover	0	40	2	5	0	10	75	0	0	5	0	30	1	0	10	5	80	0	0	20	20	0	0
Number of snags < 10 inches dbh/ acre	30	2	10	56	20	90	260	70	40	70	30	30	10	10	40	30	20	20	20	25	45	40	5
% canopy closure of deciduous trees in stand	65	75	40	70	60	80	55	15	95	70	60	90	85	45	80	40	30	100	100	100	100	100	100
Average height of overstory trees	70	40	35	35	35	50	35	30	50	40	50	50	65	62	50	40.3 2	55	55	45	60	50	40	35
Distance to water	50	100	40	40	30	200	100	642	50	100	100	0	0	0	60	50	100	199	99	299	99	199	45
Overstory forest size class	3	2	3	2	2	3	2	2	3	1	2	4	4	3	3	3	3	3	3	2	2	2	3
Number of refuge sites/acre	0	2	0	20	0	20	40	1	20	0	40	10	0	10	20	10	30	10	15	10	10	10	5

Table C-2

Dallas Floodway Sections HEP Field Data Summary

Cover Type: Grassland

Species: Eastern Meadowlark, Kestrel, Eastern Cottontail

Variable	Area/Site Number																					
	6	7	8	10	12	13	18	22	23	29	30	31	34	41	47	50	51	53	56	62	64	65
% tree (>16.5 ft height) canopy closure	0	0	0	0	0	0	0	0	0	5	0	0	0	10	0	0	0	0	0	5	0	2
% shrub (<16.5 ft height) crown cover	2	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	2	10	0.5	2.5	1	30
% canopy closure of persistent herbaceous vegetation	70	90	98	100	0	40	85	5	90	75	100	89	10	20	80	100	3	10	40	2	5	10
Diversity Index; ratio of cover type edge to total area	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average height of herbaceous canopy (feet)	0.66	2.50	1.50	0.66	3.00	1.50	1.00	3.00	2.00	1.50	1.20	2.50	2.00	1.00	0.25	0.50	3.00	1.50	2.0	2.0	1.5	1.5
% herbaceous canopy cover	79	98	98	70	90	85	98	30	100	100	100	89	100	50	80	100	40	95	95	100	95	80
Portion of herbaceous canopy cover that is grass (%)	64	85	55	80	85	60	95	92	95	75	91	20	75	30	100	95	35	90	20	25	60	70
Distance to perch site (m)	61	152	30.5	22.88	30.4	250.0	30.5	15.25	396.2	27.4	13.7	137.2	45.8	9.8	30.4	14	46	12	10	10	100	20
% herbaceous canopy cover ≤12" tall (30 cm)	50	5	15	80	30	15	4	80	25	3	85	25	10	95	100	60	15	85	45	40	90	100
Number of trees ≥ 12" dbh within 1 mi. **1**)Abundant, ≥ 10; **2**) Moderate, 4 to 9; **3**) Scarce to none, 0 to 3.	1	3	3	3	2	1	2	1	2	1	1	1	2	1	1	1	2	2	3	3	3	3
Availability of cliff ledges, earth banks, or old abandoned buildings within 1 mi. **1**) Abundant; **2**) Moderate to few; **3**) Scarce to none	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

Table C-3

Dallas Floodway HEP Wetland Field Data Summary

Cover Type: Emergent Wetland

Species: Raccoon Green Heron Wood Duck

Variable	Area/Site Number																					
	2	4	5	11	14	15	19	21	24	28	33	36	37	42	43	46	49	52	61	63	67	68	Ave
% water area <6 feet deep	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	90.91
Aquatic Substrate Composition (1=Muddy, 2=Sandy,3=Rocky)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.00
% herbaceous canopy cover in littorial zone	100.0	75.0	80.0	80.0	80.0	75.0	15.0	80.0	80.0	50.0	10.0	85.0	85.0	20.0	25.0	30.0	65.0	80.0	90.0	60.0	70.0	90.0	64.77
Distance to water (feet)	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	50.00	100.00	0.00	0.00	0.00	0.00	200.00	0.00	0.00	0.00	0.00	15.92
Water Current (1=still/slow, 2=Mod. slow, 3=Mod. fast, 4=Fast	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.00
% water area <10 in. deep (Summer conditions)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	30.0	40.0	100.0	100.0	75.0	50.0	70.0	90.0	100.0	80.0	100.0	90.0	100.0	87.50
# of refuge sites/acre	10.0	0.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0	40.0	1.0	0.0	3.0	3.0	20.0	3.0	3.0	0.0	1.0	1.0	0.0	2.0	4.14
Water regime (average summer conditions)	3.0	2.0	1.0	2.0	2.0	1.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	1.0	1.0	1.0	1.0	3.0	1.0	2.0	1.0	2.0	1.82
Density of potential nest cavities per acre	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.90	0.18	0.00	0.36	0.18	0.36	2.00	1.00	1.00	0.00	0.38
# of nest boxes/acre	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
# of potential nest sites per acre	30.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	5.0	1.0	0.0	2.0	1.0	2.0	2.0	1.0	1.0	0.0	2.09
% of water surface covered by potential winter cover	0.0	2.5	1.5	5.0	2.5	0.0	0.0	0.5	0.0	12.5	0.5	2.5	0.0	1.0	3.0	0.0	7.0	0.0	3.0	3.0	3.0	3.0	2.30
% of water surface covered by potential brood cover	0.0	5.0	3.0	10.0	5.0	0.0	0.0	1.0	0.0	25.0	1.0	5.0	0.0	2.0	6.0	0.0	15.0	80.0	3.0	3.0	3.0	3.0	7.73
Distance to deciduous forested or deciduous shrub wetland (miles)	0.04	0.04	0.50	0.06	0.31	0.25	0.12	0.02	0.12	0.00	0.10	0.09	0.04	0.02	0.01	0.00	0.00	0.30	50.00	200.00	200.0	200.0	29.64

APPENDIX D

HEP SITE PHOTOGRAPHS


Site 001, east view.


Site 001, west view.


Site 001, north view.


Site 001, south view.


Site 002, east view.


Site 002, north view.


Site 002, west view.


Site 002, south view.


Site 003, east view.


Site 003, north view.


Site 003, west view.


Site 003, south view.


Site 004, north view.


Site 004, west view.


Site 004, south view.


Site 005, east view.


Site 005, north view.


Site 005, west view.


Site 005, south view.


Site 006, east view.


Site 006, north view.


Site 006, west view.


Site 006, south view.


Site 007, east view.


Site 007, north view.


Site 007, west view.


Site 007, south view.


Site 008, east view.


Site 8, north view.


Site 008, west view.


Site 008, south view.


Site 009, east view.


Site 009, north view.


Site 009, west view.


Site 009, south view.


Site 010, east view.


Site 010, north view.


Site 010, west view.


Site 010, south view.


Site 011, east view.


Site 011, north view.


Site 011, west view.


Site 011, south view.


Site 012, east view.


Site 012, north view.


Site 012, west view.


Site 012, south view.


Site 013, east view.


Site 013, north view.


Site 013, west view.


Site 013, south view.


Site 014, east view.


Site 014, north view.


Site 014, west view.


Site 014, south view.


Site 015, east view.


Site 015, north view.


Site 015, west view.


Site 015, south view.


Site 016, east view.


Site 016, north view.


Site 016, west view.


Site 016, south view.


Site 018, east view.


Site 018, north view.


Site 018, west view.


Site 018, south view.


Site 019, east view.


Site 019, north view.


Site 019, west view.


Site 019, south view.


Site 020, east view.


Site 020, north view.


Site 020, west view.


Site 020, south view.


Site 021, west view.


Site 021, east view.


Site 022, east view.


Site 022, north view.


Site 022, west view.


Site 022, south view.


Site 023, east view.


Site 023, north view.


Site 023, west view.


Site 023, south view.


Site 024, east view.


Site 024, north view.


Site 024, west view.


Site 024, south view.


Site 025, east view.


Site 025, north view.


Site 025, west view.


Site 025, south view.


Site 026, east view.


Site 026, north view.


Site 026, west view.


Site 026, south view.


Site 027, east view.


Site 027, north view.


Site 027, west view.


Site 027, south view.


Site 028, east view.


Site 028, north view.


Site 028, west view.


Site 028, south view.


Site 029, east view.


Site 029, north view.


Site 029, west view.


Site 029, south view.


Site 030, east view.


Site 030, north view.


Site 030, west view.


Site 030, south view.


Site 031, east view.


Site 031, north view.


Site 031, west view.


Site 031, south view.


Site 032, north view.


Site 032, west view.


Site 033, #1.


Site 033, #2.


Site 033, #3


Site 033, #4.


Site 033, #5.


Site 033, #6.


Site 034, east view.


Site 034, north view.


Site 034, west view.


Site 034, south view.


Site 035, east view.


Site 035, north view.


Site 035, west view.


Site 035, south view.


Site 036, east view.


Site 036, north view.


Site 036, west view.


Site 036, south view.


Site 037, east view.


Site 037, north view.


Site 037, west view.


Site 037, south view.


Site 038, east view.


Site 038, north view.


Site 038, west view.


Site 038, south view.


Site 039. east view.


Site 039, north view.


Site 039, west view.


Site 039, south view.


Site 040, east view.


Site 040, north view.


Site 040, west view.


Site 040, south view.


Site 041, east view.


Site 041, north view.


Site 041, west view.


Site 041, south view.


Site 042, #1.


Site 042, #2.


Site 1042, #3.


Site 043, #1.


Site 043, #2.


Site 044, east view.


Site 044, north view.


Site 044, west view.


Site 044, south view.


Site 045, east view.


Site 045, north view.


Site 045, west view.


Site 045, south view.


Site 046, #1.


Site 046, #2.


Site 046, #3.


Site 047, east view.


Site 047, south view.


Site 047, north view.


Site 047, west view.


Site 048, east view.


Site 048, north view.


Site 048, west view.


Site 048, south view.


Site 049, east.


Site 049, north view.

Site 049, west view.

Site 049, south view.

Site 050, east view.

Site 050, north view.

Site 050, west view.

Site 050, south view.


Site 051, east view.


Site 051, north view.


Site 051, west view.

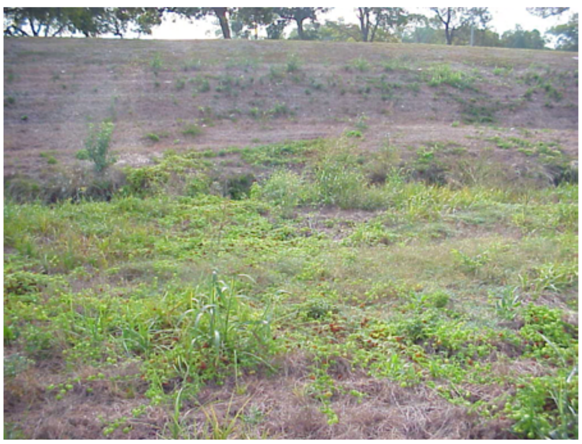

Site 051, south view.


Site 052, east view.


Site 052, north view.


Site 052, east view.


Site 052, north view.


Site 052, west view.


Site 052, south view.


Site 053, east view.


Site 053, north view.


Site 053, west view.


Site 053, south view.

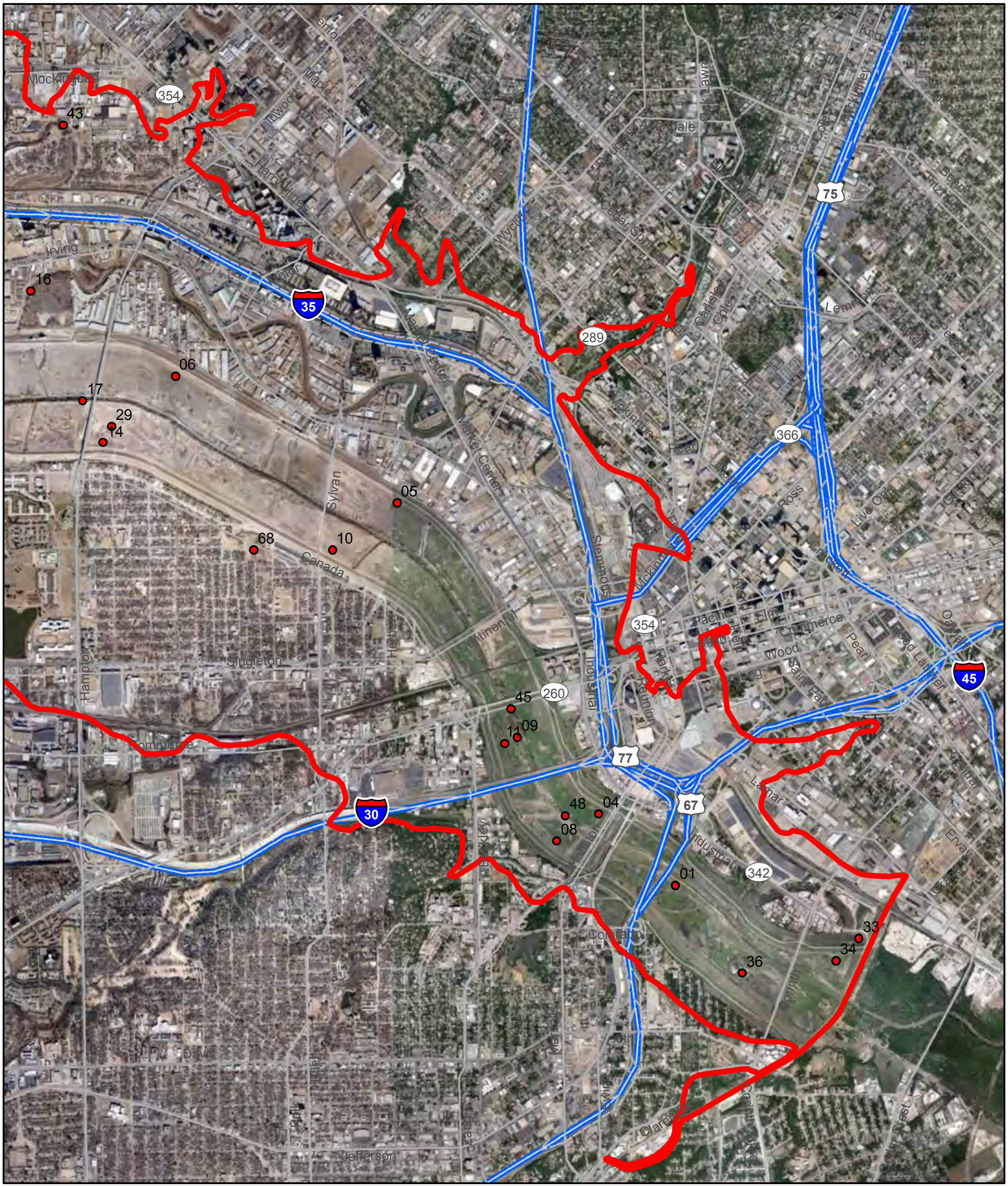

Site 054, north view.


Site 054, west view.

Photographs for sites 55 through 68 are unavailable.

APPENDIX E

STUDY AREA AERIAL PHOTOGRAPHS



U.S. Fish & Wildlife Service

Arlington, Texas, Ecological Services Field Office

Projection: UTM Zone 14N, NAD 1983, GRS 1980

Production Date: 5/12/2010

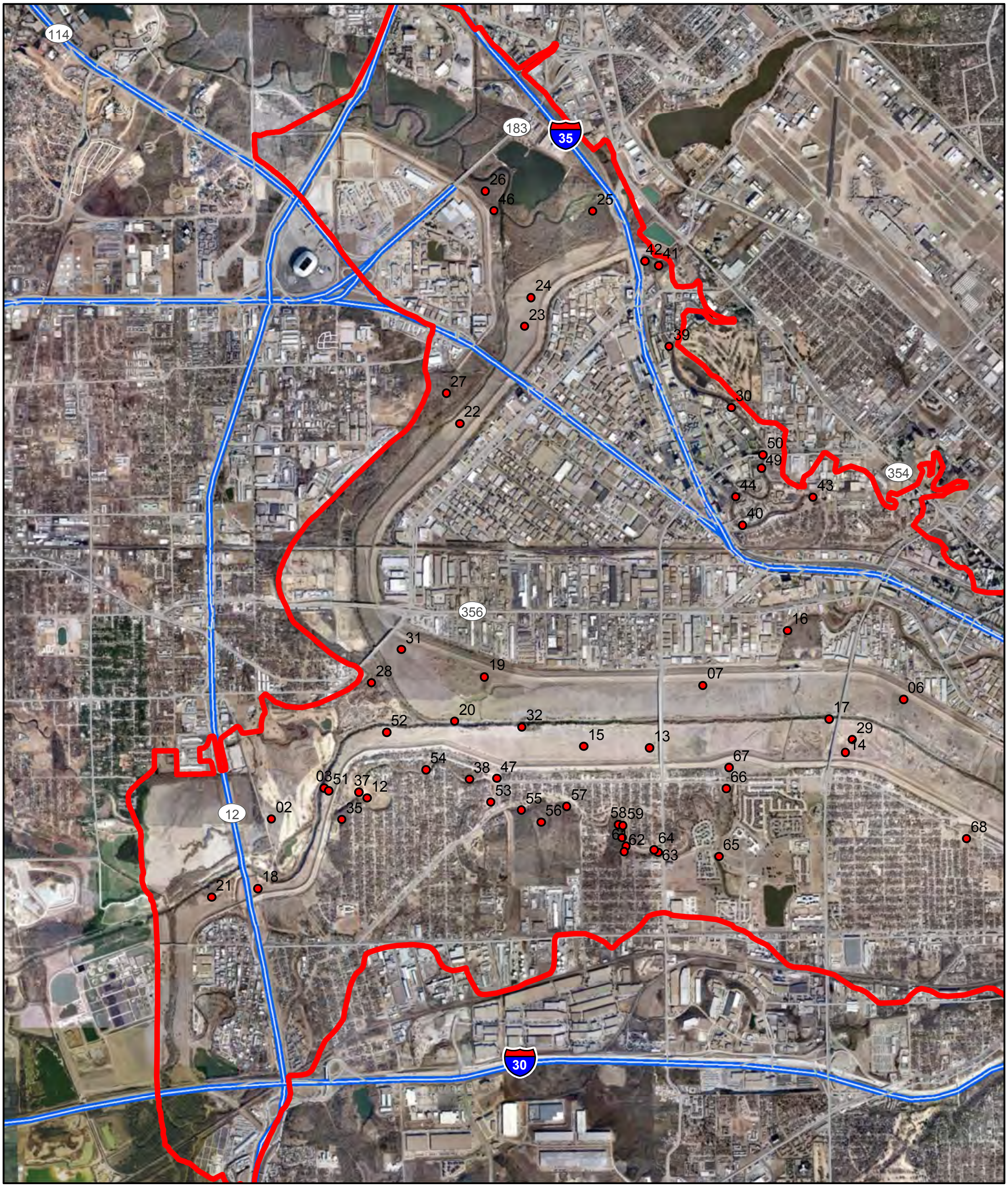
0 0.15 0.3 0.6 Miles

0 0.2 0.4 0.8 Kilometers

● HEP Sites

Study Area

Appendix E: Dallas Floodway aerial photo - eastern half



U.S. Fish & Wildlife Service

Arlington, Texas, Ecological Services Field Office

Projection: UTM Zone 14N, NAD 1983, GRS 1980

Production Date: 5/12/2010

Appendix E: Dallas Floodway aerial photo - western half

APPENDIX F

HEP SITES GEOGRAPHICAL POSITIONS

Appendix F. HEP Data Point GPS Coordinates

Point	Cover-type	Longitude	Latitude
1	Emergent Wetland	-96.79005020320	32.75768083710
2	Bottomland Hardwood	-96.81502648750	32.76702404200
3	Bottomland Hardwood	-96.81950576850	32.77486680900
4	Bottomland Hardwood	-96.86006076360	32.80591069790
5	Emergent Wetland	-96.85701378290	32.81788944340
6	Bottomland Hardwood	-96.86462052920	32.81550229790
7	Bottomland Hardwood	-96.86528571920	32.81806648240
8	Grassland	-96.86557002720	32.82610774380
9	Bottomland Hardwood	-96.87208964210	32.83175342590
10	Emergent Wetland	-96.86250015550	32.82060752950
11	Grassland	-96.86229773510	32.82180010030
12	Emergent Wetland	-96.87449642160	32.83951343170
13	Grassland	-96.87303193390	32.83907882840
14	Emergent Wetland	-96.89050244760	32.84431857640
15	Emergent Wetland	-96.92211100620	32.78287588240
16	Bottomland Hardwood	-96.90988011660	32.79255331630
17	Grassland	-96.90938659790	32.79227971560
18	Emergent Wetland	-96.90617330310	32.79209733110
19	Grassland	-96.90533646820	32.79156087600
20	Bottomland Hardwood	-96.90805085100	32.78967261050
21	Grassland	-96.89208633760	32.79097615480
22	Grassland	-96.89143725370	32.79309511570
23	Bottomland Hardwood	-96.89435012860	32.79307365180
24	Bottomland Hardwood	-96.89895280310	32.79400168900
25	Emergent Wetland	-96.90307268580	32.79746710490
26	Emergent Wetland	-96.91554674910	32.78983841100
27	Bottomland Hardwood	-96.80568777450	32.76181037040
28	Emergent Wetland	-96.80010805100	32.75532424200
29	Grassland	-96.79206140980	32.75608599240
30	Emergent Wetland	-96.81217262170	32.76708842340
31	Emergent Wetland	-96.82895789010	32.78998375050
32	Grassland	-96.84778698800	32.79950021610
33	Grassland	-96.86920711630	32.80110955640
34	Grassland	-96.81584188090	32.76520012760
35	Emergent Wetland	-96.82011732320	32.77235627760
36	Bottomland Hardwood	-96.81902297020	32.77279615880

37	Grassland	-96.83457978010	32.78667389550
38	Emergent Wetland	-96.85412625480	32.79481169250
39	Grassland	-96.85335627210	32.79595305740
40	Grassland	-96.87504894610	32.79557348220
41	Emergent Wetland	-96.88206560930	32.79582561390
42	Bottomland Hardwood	-96.88863167430	32.79769240880
43	Bottomland Hardwood	-96.85577617400	32.79786441680
44	Grassland	-96.91715964170	32.78361081270
45	Emergent Wetland	-96.89252624440	32.80228973480
46	Bottomland Hardwood	-96.89579852920	32.79833079580
47	Grassland	-96.90133998000	32.80488610290
48	Grassland	-96.89460761720	32.82517433410
49	Grassland	-96.88747831600	32.83382712430
50	Emergent Wetland	-96.88671657240	32.83642350900
51	Bottomland Hardwood	-96.87993596030	32.84410000770
52	Bottomland Hardwood	-96.89139433830	32.84610629090
53	Bottomland Hardwood	-96.89598627780	32.82794772940
54	Emergent Wetland	-96.90456935050	32.80194103150
55	Bottomland Hardwood	-96.88885286920	32.79022046040
56	Grassland	-96.88675589670	32.78906712570
57	Bottomland Hardwood	-96.88402102180	32.79046041300
58	Bottomland Hardwood	-96.87851454810	32.78873641870
59	Bottomland Hardwood	-96.87805188720	32.78862735070
60	Bottomland Hardwood	-96.87816214550	32.78750950920
61	Emergent Wetland	-96.87775173960	32.78675176610
62	Grassland	-96.87795774420	32.78626066720
63	Emergent Wetland	-96.87436359390	32.78612936690
64	Grassland	-96.87475985060	32.78638033980
65	Grassland	-96.86785621000	32.78563372280
66	Bottomland Hardwood	-96.86695029910	32.79176626170
67	Emergent Wetland	-96.86659251290	32.79367026490
68	Emergent Wetland	-96.84136062360	32.78679206610

APPENDIX G

IBI REPORT

ASSESSMENT OF TRINITY RIVER FISHERIES
WITHIN THE PROPOSED
DALLAS FLOOD CONTROL PROJECT AREA, DALLAS COUNTY, TEXAS
2004

Abstract

A fisheries survey was conducted on the Trinity River in Dallas County, Texas, by the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, with technical assistance provided by Texas Parks and Wildlife Department. The purpose of this survey was to determine baseline fish-community structure within the area of the Trinity River that could be potentially impacted by stream modifications, development, and/or construction activities associated with the proposed Dallas Flood Control Project. Data resulting from this survey were also qualitatively compared to previous fisheries studies conducted within this portion of the Trinity to evaluate fish community trends within the proposed project area. In addition, 25 fish collected during this survey were retained for chemical analyses to qualitatively assess current contaminant levels in fish within the proposed project area.

Results of the baseline fisheries survey characterized the fish assemblages within reaches of the proposed Dallas Flood Control Project area as intermediate to exceptional. Overall, community degradation was low and aquatic life use values were high to exceptional within the entire study area. In comparing these results with previous studies conducted in the area, fish community indices demonstrated a shift to higher aquatic life use values while a greater number of total species including more species considered intolerant to poor water quality conditions as well as a greater number of individual game fish were encountered during this assessment then had been observed in the past. Even though the fish assemblages were characterized as high to exceptional and appear to be recovering in comparison to previous studies, all of the fish sampled for chemical analyses contained detectable amounts of organochlorine contaminants.

Acknowledgments: The authors wish to express their deepest gratitude to Mr. Brent Bristow, Dr. Barry Forsythe, Mr. Jacob Lewis, Mr. Michael Merida, Mr. Tom Cloud, Mr. Billy Colbert, Mr. Brandon Mobley, Mr. Michael Votaw, Dr. Marina Giggleman, and Mr. Ron Shindoll without whom this project could never have been completed. In addition, the authors wish to express their sincere gratitude to Mr. Gordon Linam whose patience in assisting with sampling and providing guidance for evaluating the data was greatly appreciated.

ASSESSMENT OF TRINITY RIVER FISHERIES
WITHIN THE PROPOSED
DALLAS FLOOD CONTROL PROJECT AREA, DALLAS COUNTY, TEXAS
2004

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Introduction

A fisheries survey was conducted on the Trinity River in Dallas County, Texas, from August 30 - September 1, 2004, by the U.S. Fish and Wildlife Service (USFWS) and the U.S. Army Corps of Engineers (USACE), with technical assistance provided by Texas Parks and Wildlife Department (TPWD). The purpose of this survey was to determine baseline fish-community structure within the area of the Trinity River that could be potentially impacted by stream modifications, development, and/or construction activities associated with the proposed Dallas Flood Control Project. Data resulting from this survey were also qualitatively compared to previous fisheries studies conducted within this portion of the Trinity to evaluate fish community trends within the proposed project area. In addition, 25 fish collected during this survey were retained for chemical analyses to qualitatively assess current contaminant levels in fish within the proposed project area.

Methods and Materials

Four reaches were selected on the Trinity River to conduct this survey (Table 1 and Figure 1). All

Table 1. Fisheries survey sample sites with general descriptions for the Dallas Flood Control Project.

Sample Site	General Description
Reach 1	Trinity River, between Sylvan Avenue and Corinth Street bridges, Dallas (Dallas County), Texas.
Reach 2	Trinity River, between Sylvan Avenue and the confluence of the West and Elm Forks of the Trinity River, Dallas (Dallas County), Texas.
Reach 3	Elm Fork Trinity River, between confluence with West Fork Trinity River and SH 183, Dallas (Dallas County), Texas.
Reach 4	West Fork Trinity River, between confluence with Elm Fork Trinity River and Loop 12, Dallas (Dallas County), Texas.

reaches were located within an area of the river that could be potentially impacted by the proposed project.

Reaches 3 and 4 were located in portions of the Trinity River classified as fifth order streams, while the remaining two reaches were situated in a section of the Trinity classified as a sixth order stream. The drainage basin for Reaches 1 and 2 encompasses approximately 15,752 square kilometers (km^2) [6,082 square miles ($miles^2$)], while the basin area for Reach 3 is approximately 6,709 km^2 (2,590 $miles^2$) and the drainage basin for Reach 4 is approximately 9,043 km^2 (3,491 $miles^2$). Reaches 1, 2, and 4 were located within the portion of the Trinity River that has been placed on the State of Texas 303(d) List as being an impaired water body (TCEQ, 2002). This section of the Trinity River is not meeting the designated fish consumption use due to elevated organochlorines in fish tissues (TCEQ, 2002). A fish consumption advisory was issued for this portion of the Trinity River in 1990 and modified in 2002 (TDSHS, 2003a). The premise of this advisory is that persons are prohibited from possessing any species of fish from this area because of elevated polychlorinated biphenyls (PCBs) and the pesticides chlordane and dichloro-diphenyl-dichloroethylene (DDE) (TDSHS, 2003a).

Fish were collected from the four reaches in 2004 using a direct-current-boom electro-fishing boat and a 4 feet by 10 feet (1.2 by 3 meters) seine with c inch (0.32 centimeters) mesh. Sampling at each reach consisted of electro-shocking for a period of 60 minutes supported by eight seine hauls per site, with the exception of Reach 3 where 11 seine hauls were conducted. This sampling was performed under less than optimum physical conditions. Seining was confined to narrow bands along the margins of the reaches due to strong currents and deep water. Electro-shocking produced limited results due to high flow rates and turbid water conditions. Once collected, fish were identified to species, counted, and any observed anomalies were recorded. All fish were then released back into the reach where collected with the exception of fish kept for voucher specimens and/or chemical analyses. Data resulting from this sampling were used to calculate aquatic life use values for each reach as well as the entire area sampled using the state regional index of biotic integrity, an index of biotic integrity developed specifically for the Trinity River, and a fish-community degradation index. Fish community trends were assessed using similarity indices.

An index of biotic integrity (IBI) provides a means to assess aquatic life use within a given water body using multiple metrics. Accounting for the high variability in fish assemblages in aquatic systems between various ecological regions (eco-regions) in Texas, Linam *et al.* (2002) developed regionalized IBIs. The portion of the Trinity River sampled in 2004 is located in the region designated by Linam *et al.* (2002) as the Subhumid Agricultural Plains which incorporates the variability of fish species inhabiting aquatic systems in Ecoregions 27 (Central Great Plains), 29 (Central Oklahoma/Texas Plains), and 32 (Texas Blackland Prairies). The regionalized IBI for this area consists of 11 metrics that define species richness, trophic composition, and abundance (Table 2). Each one of these metrics is scored with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric score for a total score.

Regionalized IBIs were developed for wadeable streams and should be used with prudence when assessing larger streams such as the Trinity River (Linam, pers. comm., 2004). To compensate for this and to account for the differences of fish communities within the Trinity River basin in comparison to other basins in Texas, Kleinsasser and Linam (1989) developed an IBI specifically for the Trinity River (Table 3). This IBI is composed of 12 metrics and is similar to the regionalized IBI with the exception that Metrics 3 (the number of benthic invertivore species) and 10 (the proportion of non-native species) in the regionalized IBI are not evaluated as separate metrics. In addition, the number of catfish species, the number of intolerant species, and the proportion of hybrid fish are considered as independent metrics in the Trinity River IBI but not in the regionalized IBI.

Still, another method of evaluating the fish assemblage within a given water body is by determining the fish-community degradation index. Four metrics are considered in calculating this index (Land *et al.*, 1998). These are the percent of tolerant individual fish species at the site; the percent of omnivorous fish at the site; the percent of non-native fish at the site; and the percent of fish with anomalies (disease) at the site (Moring, pers. comm., 2003). As with the IBIs, each one of these metrics is scored with values ranging from low (1) to moderate (3) to high (5) (Table 4). A low

Table 2. Regional index of biotic integrity scoring criteria for stream fish assemblages in the Subhumid Agricultural Plains (Ecoregions 27, 29, and 32) (Note - total score for aquatic life use subcategories: ∃49 = Exceptional; 41-48 = High; 35-40 = Intermediate; and <35 = Limited) (Linam *et al.*, 2002).			
Metric	**Scoring Criteria**		
	5	**3**	**1**
1. Total number of fish species	ι	ι	ι
2. Number of native cyprinid species	>3	2-3	<2
3. Number of benthic invertivore species	>1	1	0
4. Number of sunfish species	>3	2-3	<2
5. % of individuals as tolerant species (excluding western mosquitofish)	<26%	26-50%	>50%
6. % of individuals as omnivores	<9%	9-16%	>16%
7. % of individuals as invertivores	>65%	33-65%	<33%
8. % of individuals as piscivores	>9%	5-9%	<5%
9. (a) Number of individuals/seine haul	>87	36-87	<36
9. (b) Number of individuals/minute of electrofishing	>7.1	3.3-7.1	<3.3
10. % of individuals as non-native species	<1.4%	1.4-2.7%	>2.7%
11. % of individuals with disease or other anomaly	<0.6%	0.6-1%	>1%

ιRefer to Figure 2 to obtain scoring criteria for Metric No.1.

Figure 2. Fish species richness versus drainage basin size for the Subhumid Agricultural Plains (Ecoregions 27, 29, and 32) (Linam *et al.*, 2002).

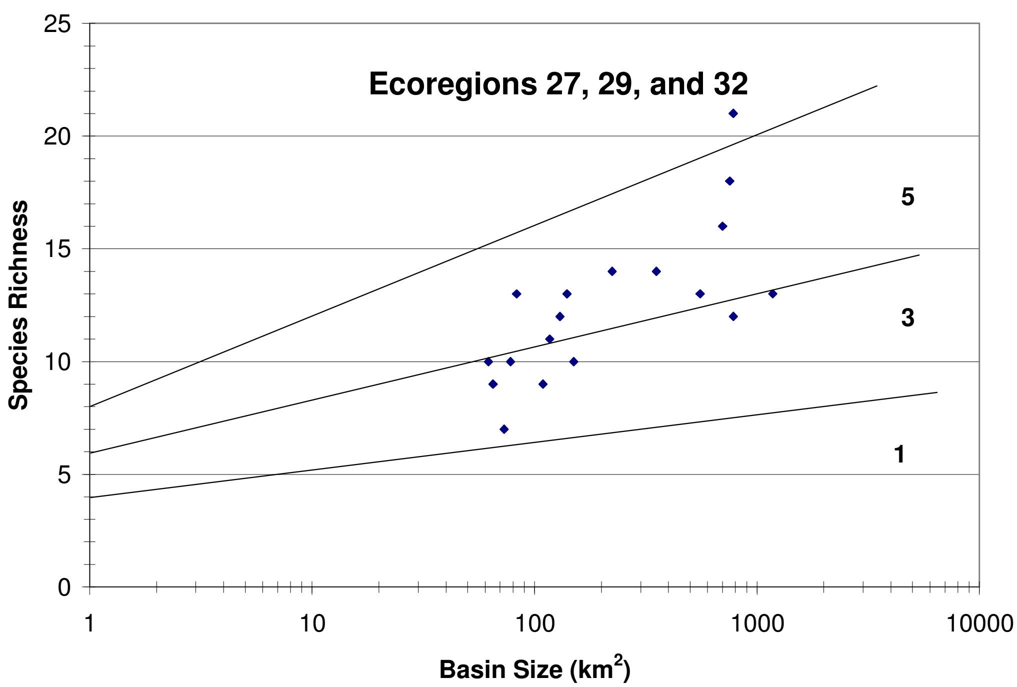


Table 3. Index of biotic integrity developed by Kleinsasser and Linam (1989) to specifically assess fish assemblages in the Trinity River Basin (Note - total score for aquatic life use subcategories: 58-60 = Exceptional; 48-52 = High; 40-44 = Intermediate; and <34 = Limited).

Metric	Scoring Criteria		
	5	**3**	**1**
1. Total number of fish species	>13	7-13	<7
2. Number of cyprinid species (excluding common carp)	>3	2-3	0-1
3. Number of catfish species	>1	1	0
4. Number of *Lepomis* (sunfish) species	>3	2-3	0-1
5. Number of intolerant species	2	1	0
6. Proportion of individuals as tolerants	<20%	20-50%	>50%
7. Proportion of individuals as omnivores	<20%	20-45%	>45%
8. Proportion of individuals as invertebrate feeders	>80%	41-80%	#40%
9. Proportion of individuals as piscivores	>5%	1-5%	<1%
10. (a) Number of individuals collected electro-fishing*	>50	21-50	#20
10. (b) Number of individuals collected seining*	>200	51-200	#50
11. Proportion of individuals as hybrids	0	0-1%	>1%
12. Proportion of individuals with disease or other anomalies	0-2%	>2-5%	>5%

*Scoring of Metric No. 10 is average of 10a and 10b combined.

Table 4. Fish-community degradation index metrics and scoring criteria where low = 1; moderate = 3; and high = 5. Overall ratings are 4 - 8 = low degradation; 10 - 14 = moderate degradation; and 16 - 20 = high degradation (Moring pers. comm., 2003).

Metric	Scoring Criteria		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site.	0 – 25	25 - 50	>50
2. Percent omnivores at site.	0 – 20	20 - 45	>45
3. Percent non-native individuals at site.	0 – 2	2 - 8	>8
4. Percent anomalies of individuals at site.	0 – 2	2 - 5	>5

degradation rating is indicative of a fish community that is comprised of species that are intolerant to physical and chemical disturbances and represent a balanced trophic structure (Moring, pers. comm., 2003). Moderate degradation indicates community degradation associated with the loss of intolerant species in conjunction with the increase of tolerant, omnivorous, and/or non-native species, whereas high degradation is indicative of an assemblage that is comprised primarily of species that are omnivorous and tolerant to physical and chemical disturbances (Moring, pers. comm., 2003).

Similarity indices were also employed to further evaluate fish assemblages within the Trinity River. According to Lydy *et al.* (2000), similarity indices can be used to compare the community structures at the same site for different periods of time to assess trends. Jaccard's Index is a similarity index that can be used to express the percentage of species shared in common between sampling periods (Washington, 1984). According to the U.S. Environmental Protection Agency (1972), Cairns (1977), and Lydy *et al.* (2000), this index is most commonly used to express species overlap between sampling periods. It can be calculated by the following equation:

$$J = 100 x \frac{T_c}{T_1 + T_2}$$

where: J = Jaccard's Index;

T_1= total number of species in first sampling period;

T_2 = total number of species in second sampling period;

T_c = total number of species in common between sampling periods.

Still another similarity index that can be used to assess community structure over time is the Percentage Similarity Index. Where Jaccard's Index is based entirely on the presence or absence of a given species, the Percentage Similarity Index factors in the relative abundance of the species sampled. It can be calculated by the following equation:

$$PSC = 100 - 0.5 \sum_{i=1}^{T} \left| 100 \left(\frac{n_{1i}}{n_1} - \frac{n_{2i}}{n_2} \right) \right|$$

where: PSC = Percentage Similarity Index;

n_1= the number of individuals in first sampling period;

n_2 = the number of individuals in second sampling period;

n_{1i} = the number of individuals of *i*th species in first sampling period;

n_{2i} = the number of individuals of *i*th species in second sampling period.

Like Jaccard's Index, results of the Percentage Similarity Index are expressed in percentages, ranging from 0 to 100, with 100 representing identical species composition and 0 reflecting two completely dissimilar communities (Lydy *et al.*, 2000).

In addition to evaluating fish community structure within the proposed project area, a total of 25 fish representing different trophic levels were collected from the four reaches and retained for chemical analyses (Table 5). After collection, these fish were placed on ice in coolers and transported to the U.S. Fish and Wildlife Service Arlington, Texas Ecological Services Field Office where each fish was measured and weighed. Edible muscle tissue (skinless fillet) samples were collected from 13 of these fish, while the remaining 12 fish were prepared as whole body samples (Table 5). The fillet samples were prepared using a Rapala stainless steel fillet knife. This knife was decontaminated after each sample using Liqui-Nox detergent and de-ionized water. After preparation, all samples were individually vacuum sealed in plastic bags using a Food Saver VacLoc Deluxe II Vacuum Sealer (Model No. 99-21-F-01-5226) and frozen. The samples were then submitted to the Geochemical and Environmental Research Group, College of Geosciences, Texas A&M University

Table 5. 25 Twenty-five fish collected for chemical analyses from four Trinity River sampling reaches, Dallas County, Texas, August 30-September 1, 2004 (Note – Reach 1 is the Trinity River downstream of Sylvan Avenue; Reach 2 is the Trinity River upstream of Sylvan Avenue; Reach 3 is the Elm Fork; Reach 4 is the West Fork; g is grams; lb is pounds; mm is millimeters; and in is inches).

Reach No.	Species	Weight (g)	Weight (lb)	Length (mm)	Length (in)	Sample Type	Sample ID
1	Smallmouth Buffalo (*Ictiobus bubalus*)	2,645	5.83	520	20.47	fillet	TRSMB1
1	Smallmouth Buffalo (*Ictiobus bubalus*)	1,334	2.94	450	17.72	whole body	TRSMB2
1	Largemouth Bass (*Micropterus salmoides*)	1,709	3.77	495	19.49	fillet	TRLMB1
1	Largemouth Bass (*Micropterus salmoides*)	609	1.34	342	13.46	whole body	TRLMB2
1	Common Carp (*Cyprinus carpio*)	5,485	12.09	705	27.76	fillet	TRC1
1	Common Carp (*Cyprinus carpio*)	1,185	2.61	452	17.80	whole body	TRC2
2	Smallmouth Buffalo (*Ictiobus bubalus*)	2,961	6.53	553	21.77	fillet	TR2SMB1
2	Smallmouth Buffalo (*Ictiobus bubalus*)	2,424	5.34	530	20.87	whole body	TR2SMB2
2	Largemouth Bass (*Micropterus salmoides*)	499	1.10	323	12.72	fillet	TR2LMB1
2	Largemouth Bass (*Micropterus salmoides*)	273	0.60	260	10.24	whole body	TR2LMB2
2	Common Carp (*Cyprinus carpio*)	1,528	3.37	442	17.40	fillet	TR2C1
2	Channel Catfish (*Ictalurus punctatus*)	526	1.16	376	14.80	whole body	TR2CC1
2	Flathead Catfish (*Pylodictis olivaris*)	2,654	5.85	595	23.43	fillet	TR2FHC1
3	Smallmouth Buffalo (*Ictiobus bubalus*)	5,862	12.93	695	27.36	fillet	TREFSMB1
3	Smallmouth Buffalo (*Ictiobus bubalus*)	2,137	4.71	500	19.69	whole body	TREFSMB2
3	Largemouth Bass (*Micropterus salmoides*)	701	1.55	395	15.55	fillet	TREFLMB1
3	Channel Catfish (*Ictalurus punctatus*)	137	0.30	240	9.45	whole body	TREFCC1
3	Longnose Gar (*Lepisosteus osseus*)	1,966	4.34	775	30.51	whole body	TREFLNG1
4	Smallmouth Buffalo (*Ictiobus bubalus*)	2,062	4.55	490	19.29	fillet	TRWFSMB1
4	Smallmouth Buffalo (*Ictiobus bubalus*)	2,027	4.47	474	18.66	whole body	TRWFSMB2
4	Largemouth Bass (*Micropterus salmoides*)	545	1.20	333	13.11	fillet	TRWFLMB1
4	Common Carp (*Cyprinus carpio*)	5,041	11.12	700	27.56	fillet	TRWFC1
4	Channel Catfish (*Ictalurus punctatus*)	467	1.03	365	14.37	fillet	TRWFCC1
4	Flathead Catfish (*Pylodictis olivaris*)	182	0.40	245	9.65	whole body	TRWFFHC1
4	Spotted Gar (*Lepisosteus oculatus*)	1,188	2.62	633	24.92	whole body	TRWFSG1

(833 Graham Road, College Station, Texas 77845-9668) for analyses of (1) 27 residual organochlorine pesticides, including 1,2,3,4-terachlorobenzene, 1,2,4,5-tetrachlorobenzene, aldrin, alpha-hexachlorocyclohexane (αBHC), beta-hexachlorocyclohexane (βBHC), delta-hexachlorocyclohexane (δBHC), gamma-hexachlorocyclohexane (γBHC), alpha (α) chlordane, gamma (γ) chlordane, *cis*- nonachlor, *trans*-nonachlor, oxychlordane, heptachlor, heptachlor epoxide, 2,4=-dichloro-diphenyl-dichloroethane (2,4=-DDD), 2,4=-dichloro-diphenyl-dichloroethylene (2,4=-DDE), 2,4=-dichloro- diphenyl-trichloroethane (2,4=-DDT), 4,4=-dichloro-diphenyl-dichloroethane (4,4=-DDD), 4,4=-dichloro-diphenyl-dichloroethylene (4,4=-DDE), p,p=-dichloro-diphenyl-trichloroethane (4,4=-DDT), dieldrin, endosulfan II, endrin, hexachlorobenzene (HCB), mirex, pentachloro-anisole, and toxaphene; (2) an organophosphate pesticide (chlorpyrifos); and (3) total polychlorinated biphenyls (total PCBs) in milligrams per kilogram (mg/kg) wet weight. Analyses of these constituents followed U.S. Environmental Protection Agency methodologies. Data resulting from these analyses were qualitatively compared with available human health and ecological screening criteria and data from previous studies within the Trinity River watershed to assess contaminant levels of fish within the proposed project area.

Results and Discussion

Fish Community Assessment

A total of 1,826 fish comprising 34 species from12 families were collected during the combined seining and electro-fishing sampling conducted at the four reaches (Tables 6, 7, and Appendix B). The greatest number of species collected at any reach was 27 (Reach 3), while Reach 4 yielded the fewest species (23) (Table 7). The highest number of individual fish collected was 558 from Reach 3, while the fewest were collected at Reach 4 (270) (Table 7). Seventeen species from nine families were collected at all four reaches (Table 7). Bullhead minnow (*Pimephales vigilax*) represented 32% of the total number of fish collected from the four reaches, followed by gizzard shad (*Dorosoma cepedianum*) (25%), red shiner (*Cyprinella lutrensis*) (9%), smallmouth buffalo (*Ictiobus bubalus*) (6%), bluegill (*Lepomis macrochirus*) (4%), and inland silverside (*Menidia beryllina*) (4%) (Table 6).

Designated tolerance levels and associated trophic guilds for the species collected were obtained from Linam and Kleinsasser (1998) and are presented in Table 8. Results of the state regionalized IBI calculations for the four reaches, as well as the entire area sampled are included in Tables 9A through 14A, while results of the Trinity River basin specific IBIs are included in Tables 9B through 14B. Results of the fish-community degradation evaluations are presented in Tables 9C through 14C.

Results of the state regional IBI assessments demonstrated high aquatic life use values for Reaches 2 and 3 (scores of 42 at both reaches), while fish assemblages at Reaches 1 and 4 were characterized as intermediate with scores of 36 and 35, respectively. The fish community within the overall study

Table 6. Species and total number of fish collected during Dallas Flood Control - Trinity River Fishery Survey, August 30 - September 1, 2004.		
Family	**Species**	**Total**
Atherinidae (silversides)	*Labidesthes sicculus* - Brook Silverside	14
	Menidia beryllina - Inland Silverside	71
Catostomidae (suckers)	*Carpiodes carpio* – River Carpsucker	4
	Ictiobus bubalus - Smallmouth Buffalo	113
Centrarchidae (sunfishes)	*Lepomis cyanellus* - Green Sunfish	8
	Lepomis gulosus – Warmouth	4
	Lepomis humilis – Orangespotted Sunfish	23
	Lepomis macrochirus - Bluegill	75
	Lepomis megalotis - Longear Sunfish	12
	Lepomis microlophus - Redear Sunfish	1
	Micropterus punctulatus - Spotted Bass	22
	Micropterus salmoides - Largemouth Bass	21
	Pomoxis annularis - White Crappie	22
Clupeidae (herrings)	*Dorosoma cepedianum* - Gizzard Shad	464
	Dorosoma petenense - Threadfin Shad	40
Cyprinidae (minnows)	*Cyprinella lutrensis* - Red Shiner	159
	Cyprinella venusta – Blacktail Shiner	6
	Cyprinus carpio - Common Carp	4
	Notropis buchanani - Ghost Shiner	4
	Pimephales promelas - Fathead Minnow	1
	Pimephales vigilax – Bullhead Minnow	591
Cyprinodontidae (killifishes)	*Fundulus notatus* - Blackstripe Topminnow	5
Ictaluridae (catfishes)	*Ameiurus natalis* - Yellow Bullhead	1
	Ictalurus furcatus - Blue Catfish	2
	Ictalurus punctatus – Channel Catfish	30
	Pylodictis olivaris - Flathead Catfish	33
Lepisosteidae (gars)	*Atractosteus spatula* - Alligator Gar	1
	Lepisosteus oculatus – Spotted Gar	7
	Lepisosteus osseus - Longnose Gar	19
Percichthyidae (temperate basses)	*Morone chrysops* – White Bass	32
Percidae (perches)	*Percina macrolepida* - Bigscale Logperch	11
	Percina sciera - Dusky Darter	6
Poeciliidae (live bearers)	*Gambusia affinis* - Western Mosquitofish	16
Sciaenidae (drums)	*Aplodinotus grunniens* - Freshwater Drum	4
Note – A total of 34 species from 12 families collected.		1826

Table 7. Species list by reach of fish collected during Dallas Flood Control - Trinity River Fishery Survey, August 30 - September 1, 2004.					
Species	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Total**
Brook Silverside	-	2	12	-	14
Inland Silverside*	6	2	58	5	71
River Carpsucker	2	-	2	-	4
Smallmouth Buffalo*	38	33	20	22	113
Green Sunfish*	1	2	1	4	8
Warmouth	2	2	-	-	4
Orangespotted Sunfish	20	-	3	-	23
Bluegill*	21	32	18	4	75
Longear Sunfish*	2	1	8	1	12
Redear Sunfish	1	-	-	-	1
Spotted Bass	-	4	13	5	22
Largemouth Bass*	7	5	8	1	21
White Crappie*	5	3	4	10	22
Gizzard Shad*	281	97	62	24	464
Threadfin Shad*	18	2	10	10	40
Red Shiner*	26	10	66	57	159
Blacktail Shiner	1	-	-	5	6
Common Carp	2	1	-	1	4
Ghost Shiner	-	1	3	-	4
Fathead Minnow	-	-	-	1	1
Bullhead Minnow*	50	229	219	93	591
Blackstripe Topminnow	-	2	3	-	5
Yellow Bullhead	-	-	1	-	1
Blue Catfish	2	-	-	-	2
Channel Catfish*	10	4	11	5	30
Flathead Catfish*	4	16	8	5	33
Alligator Gar	-	-	-	1	1
Spotted Gar*	2	2	2	1	7
Longnose Gar*	6	4	3	6	19
White Bass*	8	8	9	7	32
Bigscale Logperch	1	5	5	-	11
Dusky Darter	2	2	2	-	6
Western Mosquitofish*	4	6	5	1	16
Freshwater Drum	-	1	2	1	4
Total	**522**	**476**	**558**	**270**	**1826**

*17 species from 9 families collected at all four reaches; In total, 1,125 fish were collected using seines and 701 fish were collected while electro-shocking.

Table 8. Associated tolerance levels and trophic guilds of fish species collected from four reaches on the Trinity River, Dallas County, Texas, August 30 - September 1, 2004 (Note - I = intermediate; N = intolerant; and T = tolerant) (Linam and Kleinsasser, 1998).			
Family	**Species**	**Tolerance Level**	**Trophic Guild**
Atherinidae (silversides)	Brook Silverside	N	invertivore
	Inland Silverside	I	invertivore
Catostomidae (suckers)	River Carpsucker	T	omnivore
	Smallmouth Buffalo	I	omnivore
Centrarchidae (sunfishes)	Green Sunfish	T	piscivore
	Warmouth	T	piscivore
	Orangespotted Sunfish	I	invertivore
	Bluegill	T	invertivore
	Longear Sunfish	I	invertivore
	Redear Sunfish	I	invertivore
	Spotted Bass	I	piscivore
	Largemouth Bass	I	piscivore
	White Crappie	I	piscivore
Clupeidae (herrings)	Gizzard Shad	T	omnivore
	Threadfin Shad	I	omnivore
Cyprinidae (minnows)	Red Shiner	T	invertivore
	Blacktail Shiner	I	invertivore
	Common Carp*	T	omnivore
	Ghost Shiner	I	invertivore
	Fathead Minnow	T	omnivore
	Bullhead Minnow	I	invertivore
Cyprinodontidae (killifishes)	Blackstripe Topminnow	I	invertivore
Ictaluridae (catfishes)	Yellow Bullhead	I	omnivore
	Blue Catfish	I	piscivore
	Channel Catfish	T	omnivore
	Flathead Catfish	I	piscivore
Lepisosteidae (gars)	Alligator Gar	T	piscivore
	Spotted Gar	T	piscivore
	Longnose Gar	T	piscivore
Percichthyidae (temperate basses)	White Bass	I	piscivore
Percidae (perches)	Bigscale Logperch	N	benthic invertivore
	Dusky Darter	N	benthic invertivore
Poeciliidae (live bearers)	Western Mosquitofish	T	invertivore
Sciaenidae (drums)	Freshwater Drum	T	invertivore

*Non-native species.

Table 9A. State Regional IBI Metric Calculations (IBI Score) for Reach 1.			
1. Total # of fish species:	26(5)	**7. % of individuals as invertivores:**	26(1)
2. # of native cyprinid species:	3(3)	**8. % of individuals as piscivores:**	7.1(3)
3. # of benthic invertivore species:	2(5)	**9a. # of individuals/seine haul:**	22.8(1)
4. # of sunfish species:	7(5)	**9b. # of individuals/minute of electro-fishing:**	5.7(3)
5. % of individuals as tolerant species:	68(1)	**10. % of individuals as non-native species:**	0.38(5)
6. % of individuals as omnivores:	67(1)	**11. % of individuals with disease or other anomaly:**	0(5)
IBI Total Score: 36 (Intermediate)			

Note - overall score for Metric No. 9 is average between 9a (1) and 9b (3) which equals 2.

Table 9B. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for Reach 1.			
1. Total # of species:	26(5)	**8. % of individuals as invertivores:**	26(1)
2. Total # of cyprinid species:	3(3)	**9. % of individuals as piscivores:**	7.1(5)
3. Total # of catfish species:	3(5)	**10a. # of individuals collected electro-fishing:**	340(5)
4. Total # of sunfish species:	7(5)	**10b. # of individuals collected seining:**	182(3)
5. Total # of intolerant species:	2(5)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	68(1)	**12. % of individuals with disease or other anomaly:**	0(5)
7. % of individuals as omnivores:	67(1)	**IBI Total Score: 45 (Intermediate to High)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (3) which equals 4.

Table 9C. Fish-Community Degradation Index Metric Calculations (FDI Score) for Reach 1.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	68(5)
2. Percent omnivores at site:	-	-	67(5)
3. Percent non-native individuals at site:	0.38(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 12 (Moderate Degradation)			

Table 10A. State Regional IBI Metric Calculations (IBI Score) for Reach 2.			
1. Total # of fish species:	26(5)	7. % of individuals as invertivores:	62(3)
2. # of native cyprinid species:	3(3)	8. % of individuals as piscivores:	9.7(5)
3. # of benthic invertivore species:	2(5)	9a. # of individuals/seine haul:	37.3(3)
4. # of sunfish species:	5(5)	9b. # of individuals/minute of electro-fishing:	3(1)
5. % of individuals as tolerant species:	33(3)	10. % of individuals as non-native species:	0.21(5)
6. % of individuals as omnivores:	29(1)	11. % of individuals with disease or other anomaly:	0(5)
IBI Total Score: 42 (High)			

Note - overall score for Metric No. 9 is average between 9a (3) and 9b (1) which equals 2.

Table 10B. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for Reach 2.			
1. Total # of species:	26(5)	8. % of individuals as invertivores:	62(3)
2. Total # of cyprinid species:	3(3)	9. % of individuals as piscivores:	9.7(5)
3. Total # of catfish species:	2(5)	10a. # of individuals collected electro-fishing:	178(5)
4. Total # of sunfish species:	5(5)	10b. # of individuals collected seining:	298(5)
5. Total # of intolerant species:	2(5)	11. % of individuals as hybrids:	0(5)
6. % of individuals as tolerants:	33(3)	12. % of individuals with disease or other anomaly:	0(5)
7. % of individuals as omnivores:	29(3)	IBI Total Score: 52 (High)	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (5) which equals 5.

Table 10C. Fish-Community Degradation Index Metric Calculations (FDI Score) for Reach 2.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	-	34(3)	-
2. Percent omnivores at site:	-	29(3)	-
3. Percent non-native individuals at site:	0.21(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table 11A. State Regional IBI Metric Calculations (IBI Score) for Reach 3.			
1. Total # of fish species:	27(5)	**7. % of individuals as invertivores:**	72(5)
2. # of native cyprinid species:	3(3)	**8. % of individuals as piscivores:**	8.6(3)
3. # of benthic invertivore species:	2(5)	**9a. # of individuals/seine haul:**	40.7(3)
4. # of sunfish species:	5(5)	**9b. # of individuals/minute of electro-fishing:**	1.8(1)
5. % of individuals as tolerant species:	30(3)	**10. % of individuals as non-native species:**	0(5)
6. % of individuals as omnivores:	19(1)	**11. % of individuals with disease or other anomaly:**	0.18(5)
IBI Total Score: 42 (High)			

Note - overall score for Metric No. 9 is average between 9a (3) and 9b (1) which equals 2.

Table 11B. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for Reach 3.			
1. Total # of species:	27(5)	**8. % of individuals as invertivores:**	72(3)
2. Total # of cyprinid species:	3(3)	**9. % of individuals as piscivores:**	8.6(5)
3. Total # of catfish species:	3(5)	**10a. # of individuals collected electro-fishing:**	110(5)
4. Total # of sunfish species:	5(5)	**10b. # of individuals collected seining:**	448(5)
5. Total # of intolerant species:	3(5)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	30(3)	**12. % of individuals with disease or other anomaly:**	0.18(5)
7. % of individuals as omnivores:	19(5)	**IBI Total Score: 54 (High to Exceptional)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (5) which equals 5.

Table 11C. Fish-Community Degradation Index Metric Calculations (FDI Score) for Reach 3.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	31(3)	-
2. Percent omnivores at site:	19(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0.18(1)	-	-
FDI Total Score: 6 (Low Degradation)			

Table 12A. State Regional IBI Metric Calculations (IBI Score) for Reach 4.			
1. Total # of fish species:	23(5)	**7. % of individuals as invertivores:**	62(3)
2. # of native cyprinid species:	4(5)	**8. % of individuals as piscivores:**	14.8(5)
3. # of benthic invertivore species:	0(1)	**9a. # of individuals/seine haul:**	24.6(1)
4. # of sunfish species:	4(5)	**9b. # of individuals/minute of electro-fishing:**	1.2(1)
5. % of individuals as tolerant species:	39(3)	**10. % of individuals as non-native species:**	0.37(5)
6. % of individuals as omnivores:	23(1)	**11. % of individuals with disease or other anomaly:**	1.5(1)
IBI Total Score: 35 (Intermediate)			

Note - overall score for Metric No. 9 is average between 9a (1) and 9b (1) which equals 1.

Table 12B. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for Reach 4.			
1. Total # of species:	23(5)	**8. % of individuals as invertivores:**	62(3)
2. Total # of cyprinid species:	4(5)	**9. % of individuals as piscivores:**	14.8(5)
3. Total # of catfish species:	2(5)	**10a. # of individuals collected electro-fishing:**	73(5)
4. Total # of sunfish species:	4(5)	**10b. # of individuals collected seining:**	197(3)
5. Total # of intolerant species:	0(1)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	39(3)	**12. % of individuals with disease or other anomaly:**	1.5(5)
7. % of individuals as omnivores:	23(3)	**IBI Total Score: 49 (High)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (3) which equals 4.

Table 12C. Fish-Community Degradation Index Metric Calculations (FDI Score) for Reach 4.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	39(3)	-
2. Percent omnivores at site:	-	23(3)	-
3. Percent non-native individuals at site:	0.37(1)	-	-
4. Percent anomalies of individuals at site:	1.5(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table 13A. State Regional IBI Metric Calculations (IBI Score) for Overall Study Area.			
1. Total # of fish species:	34(5)	**7. % of individuals as invertivores:**	55(3)
2. # of native cyprinid species:	5(5)	**8. % of individuals as piscivores:**	9.4(5)
3. # of benthic invertivore species:	2(5)	**9a. # of individuals/seine haul:**	32.1(1)
4. # of sunfish species:	7(5)	**9b. # of individuals/minute of electro-fishing:**	2.9(1)
5. % of individuals as tolerant species:	43(3)	**10. % of individuals as non-native species:**	0.22(5)
6. % of individuals as omnivores:	36(1)	**11. % of individuals with disease or other anomaly:**	0.27(5)
IBI Total Score: 43 (High)			

Note - overall score for Metric No. 9 is average between 9a (1) and 9b (1) which equals 1.

Table 13B. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for Overall Study Area.			
1. Total # of species:	34(5)	**8. % of individuals as invertivores:**	55(3)
2. Total # of cyprinid species:	5(5)	**9. % of individuals as piscivores:**	9.4(5)
3. Total # of catfish species:	4(5)	**10a. # of individuals collected electro-fishing:**	701(5)
4. Total # of sunfish species:	7(5)	**10b. # of individuals collected seining:**	1125(5)
5. Total # of intolerant species:	3(5)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	43(3)	**12. % of individuals with disease or other anomaly:**	0.27(5)
7. % of individuals as omnivores:	36(3)	**IBI Total Score: 54 (High to Exceptional)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (5) which equals 5.

Table 13C. Fish-Community Degradation Index Metric Calculations (FDI Score) for Overall Study Area.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	44(3)	-
2. Percent omnivores at site:	-	36(3)	-
3. Percent non-native individuals at site:	0.22(1)	-	-
4. Percent anomalies of individuals at site:	0.27(1)	-	-
FDI Total Score: 8 (Low Degradation)			

area was classified as high with a score of 43. Scoring of the Trinity River basin specific IBIs yielded slightly different results. The basin specific aquatic life use value calculated for Reach 1 (score of 45) was intermediate to high, while aquatic life use values were high at Reaches 2 and 4 (scores of 52 at Reach 2 and 49 at Reach 4). At Reach 3 and within the overall study area, the fish communities were characterized as high to exceptional (both scored 54). Fish assemblages observed at Reaches 2, 3, 4, and within the overall study area exhibited low community degradation (scores ranged from 6 at Reach 3 to 8 at the remaining two sites and the overall study area), whereas the community at Reach 1 demonstrated moderate degradation with a score of 12. The moderate degradation characterization and intermediate aquatic life use classification at Reach 1 can be attributed to the large number of individual tolerant, omnivorous fish collected from this reach. The regional intermediate classification of Reach 4 can be attributed to the lack of darter and intolerant species collected within this area.

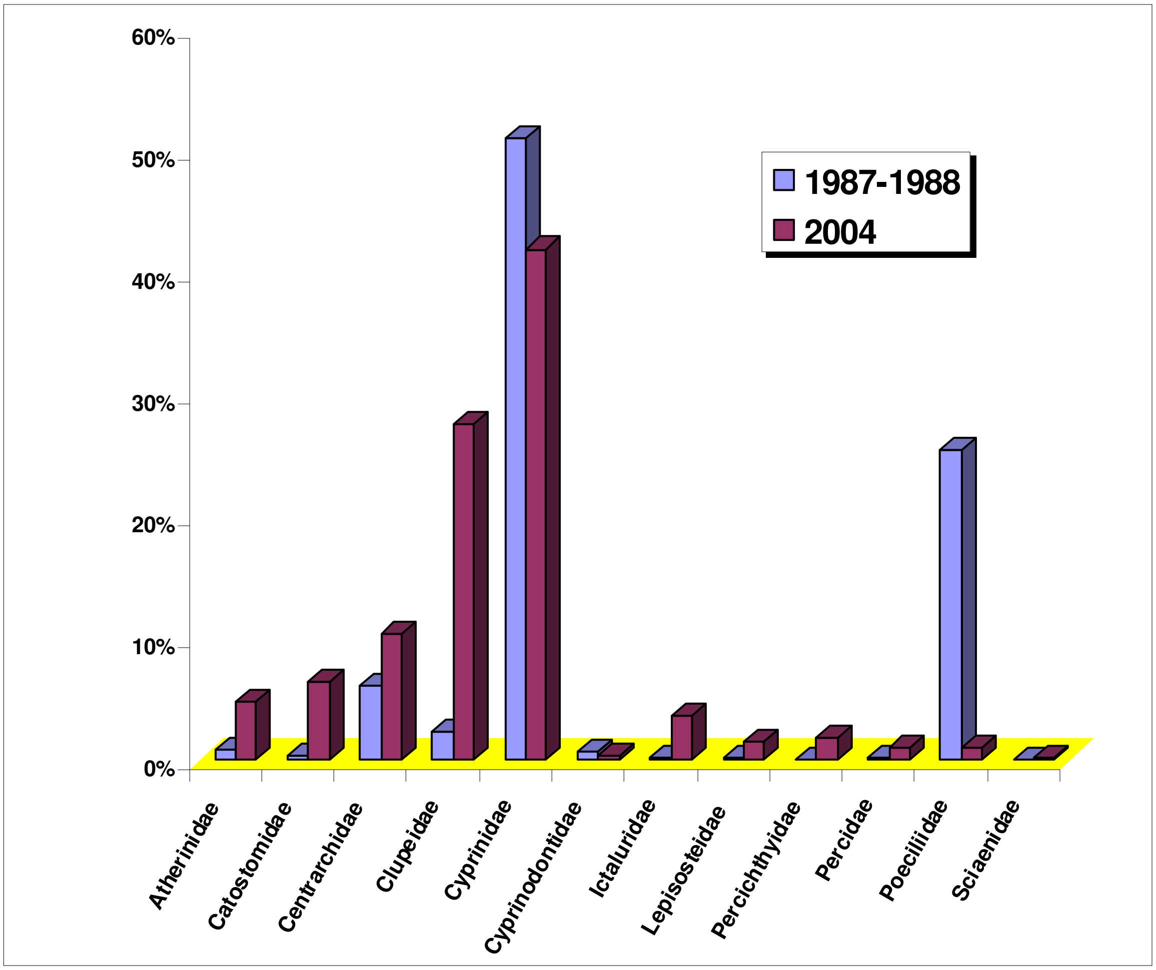
Employing similar sampling techniques, TPWD conducted surveys of the fish assemblages within the Trinity River off Sylvan Avenue in August 1987 and again in August 1988 (Kleinsasser and Linam, 1989). They also sampled the West Fork near Belt Line Road in Dallas County [approximately 6.5 miles (10.5 kilometers) upstream of the confluence with the Elm Fork] and the Elm Fork above SH 183 in Dallas County during the same time periods (Kleinsasser and Linam, 1989). In August 1987, a combined total of 2,481 fish, representing 22 species from 11 families were collected from the three reaches by TPWD (Appendix C, Table C16). A combined total of 2,320 fish, consisting of 25 species from 9 families were collected from the same three reaches by TPWD in August 1988 (Appendix C, Table C16). The West Fork yielded the lowest number of species collected during 1987 (11 species), whereas the least number of species encountered in 1988 (11 species) were from the Elm Fork (Appendix C, Tables C6 and C11). During both sampling periods, the Sylvan Avenue Reach yielded the greatest number of species (14 species in 1987 and 19 species in 1988) and the greatest number of fish (1,176 in 1987 and 1,726 in 1988) (Appendix C, Table C1). The lowest number of fish collected in 1987 (188 fish) and 1988 (197 fish) were from the Elm Fork (Appendix C, Tables C11 and C16). In 1987, western mosquitofish (*Gambusia affinis*) represented 52% of the total number of fish collected from the three reaches, followed by bullhead minnow (26%), red shiner (15%), longear sunfish (*Lepomis megalotis*) (2%), and gizzard shad (2%). In 1988, red shiner (72% of the total), bullhead minnow (10%), western mosquitofish (8%), gizzard shad (4%), redfin shiner (*Lythrurus umbratilis*) (2%), and longear sunfish (2%) represented the species with the greatest number of individuals encountered within the three reaches. Using the Trinity River basin specific IBI (Table 3), Kleinsasser and Linam (1989) determined from the 1987 sampling data intermediate aquatic life use values for the fish assemblages within the Sylvan Avenue Reach (score of 38) and the West Fork Reach (score of 39), while the Elm Fork Reach ranked high (score of 44). Aquatic life use values calculated from the 1988 data remained fundamentally unchanged at the Elm Fork Reach (high score of 43) and West Fork Reach (intermediate score of 40); however, the fish community was characterized as high (score of 48) within the Sylvan Avenue Reach (Kleinsasser and Linam, 1989).

Applying the regional IBI used to evaluate the 2004 data to the 1987-1988 data yielded different aquatic life use values for the fish assemblage observed in 1987 in the West Fork Reach (IBI score shift from intermediate to limited) (Appendix C, Tables C6, C7, and C9) and the community encountered in 1988 at the Elm Fork Reach (IBI score shift from high to limited) (Appendix C, Tables C11, C12, and C14). Regional aquatic life use values calculated for the remaining reaches sampled in 1987-1988 mirrored the basin specific scores (Appendix C, Tables C1, C2, C4, C6, C7, C9, C11, C12, and C14). Using the degradation index developed by Land *et al.* (1998), fish assemblages observed by TPWD within the three reaches exhibited low degradation in both 1987 and 1988 (scores ranged from 6 to 8), with the exception that the community from the West Fork Reach in 1987 demonstrated moderate degradation (score of 10) (Appendix C, Tables C1, C3, C5, C6, C8, C10, C11, C13, and C15). The fish assemblages observed in 1987 within the combined reaches exhibited a high regional aquatic life use value (score of 42), an intermediate basin specific aquatic life value (score of 44), and low degradation (score of 8) (Appendix C, Tables C16-C22). The 1988 fish communities within the combined reaches demonstrated high aquatic life use values using both the regional and basin specific IBIs (scores of 42 and 50, respectively) and low degradation (score of 8) (Appendix C, Tables C16-C22).

The University of North Texas (UNT) in conjunction with the University of Texas at Dallas, conducted fish sampling on the West Fork of the Trinity River in Dallas County near Loop 12 and on the Elm Fork upstream of SH 183 in Dallas County in August 1987 and September 1988 (Dickson *et al.*, 1989). In August 1987, a combined total of 294 fish consisting of 15 species from eight families were collected from these two reaches, while 760 fish representing 20 species from 11 families were collected from the same area in September 1988 (Appendix D, Table D1). Based on the number of individuals collected, red shiner was the most abundant fish encountered during both sampling periods (31% of the total in 1987 and 76% in 1988). In 1987, the species with the greatest number of individuals collected after red shiner were bullhead minnow (17% of the total) and longear sunfish (14%), whereas in 1988, red shiner followed by longear sunfish (4% of the total), green sunfish (*Lepomis cyanellus*) (4%), and bullhead minnow (3%) represented the species with the greatest number of individuals encountered within the two reaches. Using the IBI developed by Karr and Dudley, Dickson *et al.* (1989) calculated high aquatic life use values for the West Fork Reach in 1987 and 1988 (both scored 44), while the fish assemblage in the Elm Fork Reach was characterized as high in 1987 (score of 44) and exceptional in 1988 (score of 52). Employing the degradation index developed by Land *et al.* (1998), fish assemblages observed in 1987-1988 within the West Fork, the Elm Fork, and combined reaches exhibited low degradation (scores ranged from 4 to 8) (Appendix D, notes and Tables D1-D7).

In comparing the 2004 data with the TPWD and UNT results, there was an increase in silversides (atherinids), suckers (catostomids), sunfishes (centrarchids), herrings (clupeids), catfishes (ictalurids), gars (lepisosteids), temperate basses (percichthyids), perches (percids), and drums (sciaenids) and a decrease in minnows (cyprinids), killifishes (cyprinodontids), and live bearers (poeciliids) as percentages of the total populations sampled within the entire study area between the combined 1987-1988 studies and the 2004 study (Figure 3). A higher percentage of sunfishes, killifishes, and live bearers were collected from the Elm Fork Reach in 1987-1988 then in 2004 (Figure 4) and a greater percentage of minnows and live bearers were sampled from the West Fork and the Main-Stem Reaches in 1987-1988 then in 2004 (Figures 5 and 6). All other fish families

Figure 3. Comparison of individual composition, as percentages of total population sampled, of fish families identified within the Trinity River by Texas Parks and Wildlife Department and University of North Texas in 1987-1988 with fish families observed by U.S. Fish and Wildlife Service in 2004.



encountered exhibited greater representation within the three reaches in 2004 then in 1987-1988 with the exception that no killifishes or perches were collected from the West Fork Reach during either the 1987-1988 or 2004 sampling periods (Figure 5). Similar to the TPWD 1987-1988 results, bullhead minnow and red shiner found in 2004 represented two of the three most abundant fish collected. Western mosquitofish, which was the other most common fish sampled by TPWD in 1987-1988, was collected in notably lower numbers within the area in 2004 (16 verses 1,278 in 1987 and 174 in 1988). Gizzard shad was the second most common fish observed in 2004 and this species was collected in far greater numbers then in either the TPWD or UNT 1987-1988 studies [464 verses 36 (TPWD) and 4 (UNT) in 1987 and 85 (TPWD) and 4 (UNT) in 1988]. Greater numbers of bluegill, spotted bass (*Micropterus punctulatus*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), channel catfish (*Ictalurus punctatus*), and flathead catfish (*Pylodictis olivaris*), all considered game fish (Bristow, pers. comm., 2004), were collected in 2004 then in either of the 1987-1988 studies. In addition, greater numbers of inland silverside (*Menidia*

Figure 4. Comparison of individual composition, as percentages of total population sampled, of fish families identified within the Elm Fork by Texas Parks and Wildlife Department and University of North Texas in 1987-1988 with fish families observed by U.S. Fish and Wildlife Service in 2004.

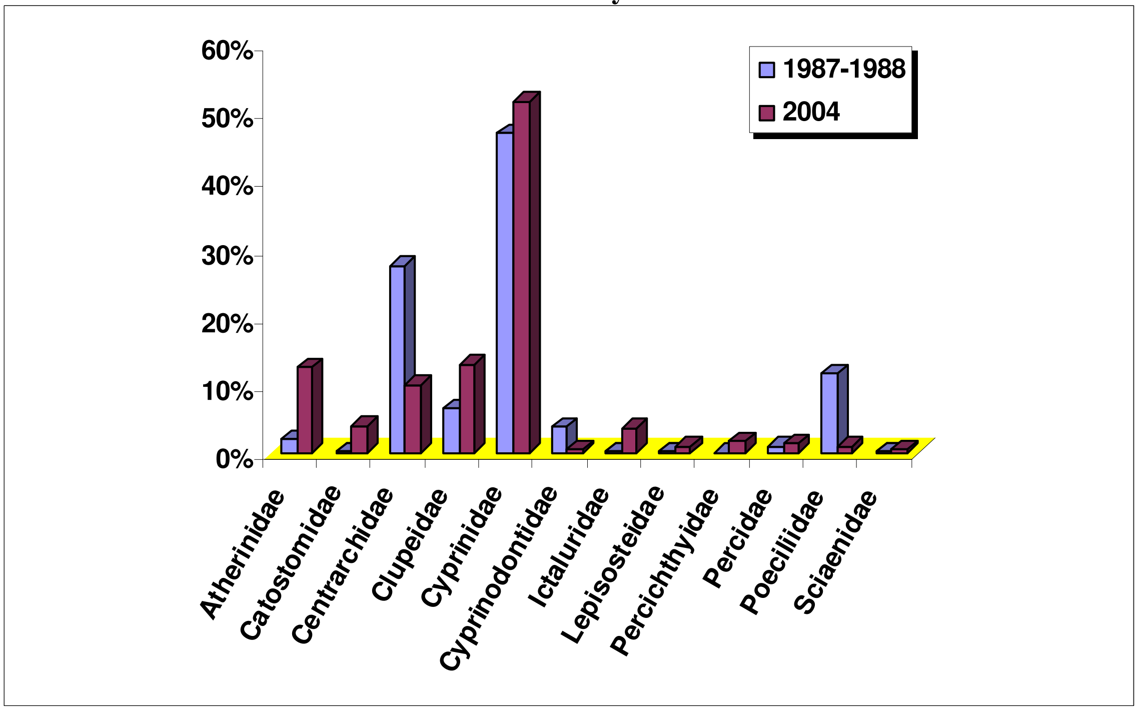


Figure 5. Comparison of individual composition, as percentages of total population sampled, of fish families identified within the West Fork by Texas Parks and Wildlife Department and University of North Texas in 1987-1988 with fish families observed by U.S. Fish and Wildlife Service in 2004.

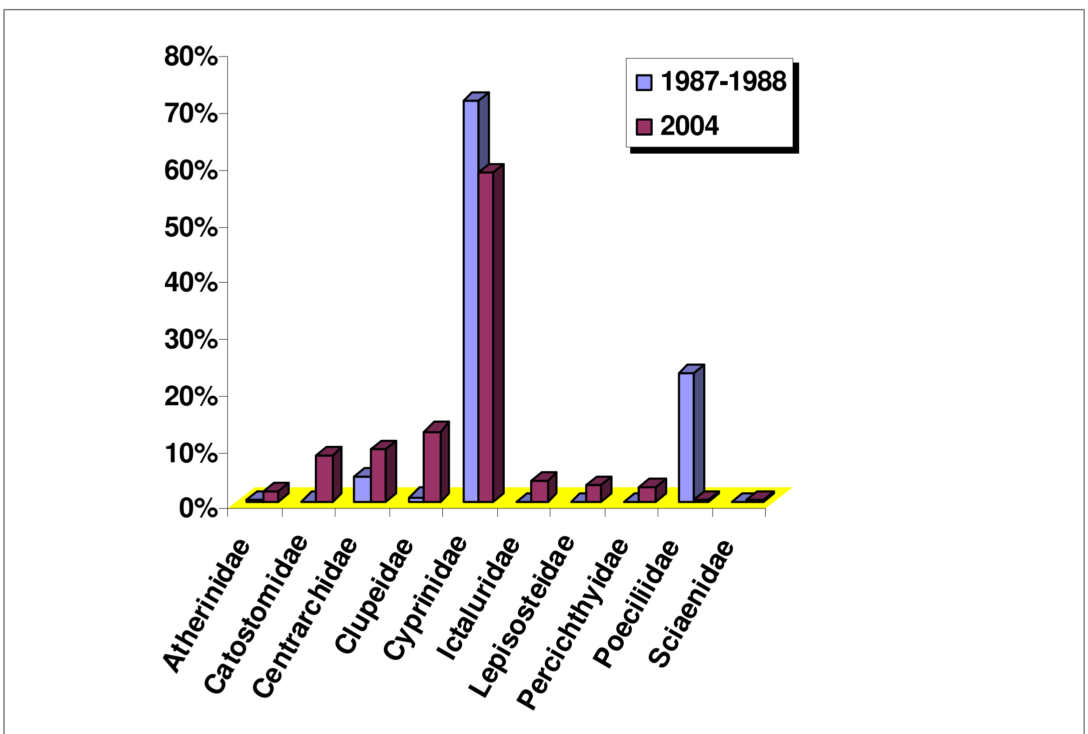
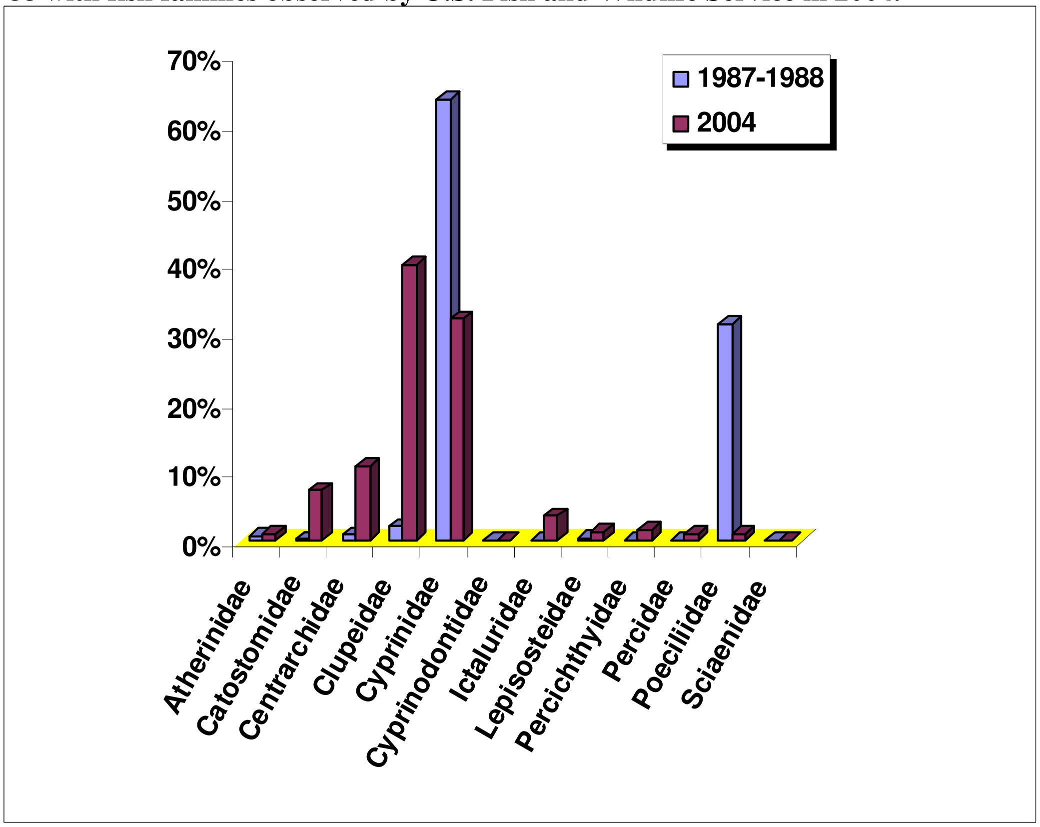


Figure 6. Comparison of individual composition, as percentages of total population sampled, of fish families identified within the Main-Stem of the Trinity River by Texas Parks and Wildlife Department in 1987-1988 with fish families observed by U.S. Fish and Wildlife Service in 2004.



beryllina), smallmouth buffalo, and longnose gar (*Lepisosteus osseus*) were encountered in 2004 then in the 1987-1988 studies, but lower numbers of green sunfish [8 verses 15 (TPWD) and 18 (UNT) in 1987 and 11 (TPWD) and 28 (UNT) in 1988] and longear sunfish [12 verses 45 (TPWD) and 41 (UNT) in 1987 and 36 (TPWD) and 31 (UNT) in 1988] were collected in 2004 then in the 1987-1988 studies. Five fish species [redfin shiner, golden shiner (*Notemigonus crysoleucas*), pugnose minnow (*Opsopoeodus emiliae*), bluntnose darter (*Etheostoma chlorosomum*), and slough darter (*Etheostoma gracile*)] were collected in 1987 and/or 1988 that were not encountered in 2004 (Appendix C, Table C4 and Appendix D, Table D1); however, seven species [brook silverside (*Labidesthes sicculus*), redear sunfish (*Lepomis microlophus*), fathead minnow (*Pimephales promelas*), yellow bullhead (*Ameiurus natalis*), alligator gar (*Atractosteus spatula*), white bass (*Morone chrysops*), and bigscale logperch (*Percina macrolepida*)], including two species considered by Linam and Kleinsasser (1998) intolerant to poor water quality (brook silverside and bigscale logperch) were observed in 2004 that were not collected during either study in 1987 or in 1988. Overall, a greater number of species were collected at each reach and within the entire study area in 2004 then in the 1987-1988 studies.

In comparing the scores of the indices, dependent on the index used, overall aquatic life use scores demonstrated a shift towards higher values between the 1987-1988 and 2004 sampling periods. As previously stated, the fish community within the overall study area exhibited low degradation in 1987, 1988, and 2004 and was characterized as intermediate to high in 1987-1988 and as high to exceptional in 2004. The fish assemblage at the Elm Fork Reach demonstrated low degradation in 1987, 1988, and 2004, and was characterized as high in1987 in both the TPWD and UNT studies, as limited to high to exceptional in the 1988 studies, and as high to exceptional in the 2004 study. The fish community from the West Fork Reach exhibited moderate degradation in the TPWD 1987 study and low degradation in the remaining studies and was classified as limited to intermediate in the TPWD 1987-1988 study, as high in the UNT 1987-1988 study, and as intermediate to high in the 2004 study. The Sylvan Avenue Reach demonstrated low degradation in 1987-1988 and moderate to low degradation in 2004, and was characterized as intermediate in 1987, as high in 1988, as intermediate to high downstream of Sylvan Avenue and high upstream of Sylvan Avenue in 2004.

Applying Jaccard's Index to the collective data for the entire study area resulted in a species overlap value of 42% between the combined 1987-1988 and 2004 sampling periods. Of the three reaches, the West Fork Reach demonstrated the lowest species overlap (34%), while both the Elm Fork and Main-Stem Reaches exhibited species overlap values of 40%. Using the Percentage Similarity Index, species composition from the combined 1987-1988 and 2004 sampling periods was determined to be 33% similar within the overall study area. The Sylvan Avenue Reach demonstrated the lowest species similarity between the sampling periods (22%), while the West Fork Reach exhibited the highest (49%). The Elm Fork Reach fish assemblage demonstrated moderate similarity (41%) between the two sampling periods.

Chemical Analyses

Results of the residual pesticide and PCB analyses in mg/kg wet weight for the 25 fish samples collected from the Trinity River in 2004 are presented in Tables 14 and 15. Each sample was analyzed for 29 separate compounds. Of these compounds, only toxaphene was not detected above the analytical detection limits in any of the samples collected and is not discussed further in this report. The remaining detected organochlorine contaminants were qualitatively compared to analytical results from previous studies, ecological screening criteria, and/or human health screening criteria to evaluate contaminant levels in fish within the proposed project area.

[1,2,3,4-Tetrachlorobenzene] Used as an ingredient in dielectric fluids and pesticides, 1,2,3,4-tetrachlorobenzene is highly toxic to aquatic organisms and is considered a suspected teratogen (Sax and Lewis, 1987). Currently, screening criteria are not available for this compound, but detected concentrations in fish tissues collected from upstream of the Dallas area by the USFWS/USACE in 2003 from Lake Worth, an impoundment of the West Fork of the Trinity River in Tarrant County, Texas, ranged from 0.0005 mg/kg wet weight in one largemouth bass and two channel catfish to 0.0013 mg/kg wet weight in a smallmouth buffalo (Giggleman and Lewis, 2004).

Eight of the 12 whole body fish samples and 11 of the 13 fish tissue samples collected in 2004 contained detectable amounts of 1,2,3,4-tetrachlorobenzene. In the whole body samples, detected concentrations ranged from 0.00024 mg/kg wet weight in a flathead catfish collected from the West

Table 14. Analytical results in mg/kg wet weight of whole body fish collected in 2004 from four reaches on the Trinity River, Dallas County, Texas (Note – SMB is smallmouth buffalo, LMB is largemouth bass, C is common carp, CC is channel catfish, FHC is flathead catfish, LNG is longnose gar, SG is spotted gar, J is concentration measured below analytical detection limit, D is diluted sample results, and bdl is below the analytical detection limit).

Analyte	Sylvan Avenue, downstream			Sylvan Avenue, upstream			Elm Fork			West Fork		
	SMB	LMB	C	SMB	LMB	CC	SMB	CC	LNG	SMB	FHC	SG
1,2,3,4-tetrachlorobenzene	0.00076J	0.00058J	0.00051J	0.00075J	bdl	bdl	0.00066J	bdl	0.00095J	bdl	0.00024J	0.00140
1,2,4,5-tetrachlorobenzene	0.00375	0.00038J	0.00067J	0.00245	0.00043J	0.00640	0.00147J	0.00137	0.00284	0.01552	0.00282	0.00583
Aldrin	0.00069J	0.00031J	0.00018J	0.00061	0.00014J	0.00016J	0.00023J	0.00015J	0.00036J	0.00050J	0.00008J	0.00016J
αBHC	0.00052J	0.00024J	0.00018J	0.00040J	0.00010J	0.00031J	0.00055J	0.00022J	0.00216	0.00030J	0.00010J	0.00024J
βBHC	0.00087J	0.00100J	0.00267	0.00019J	0.00047J	0.00042J	0.00023J	0.00041J	0.00032J	0.00011J	0.00007J	0.00019J
δBHC	0.00045J	0.00013J	0.00023J	bdl	bdl	bdl	bdl	0.00017J	bdl	bdl	0.00026J	0.00048J
γBHC	0.00021J	0.00021J	0.00046J	0.00063J	0.00010J	0.00127	0.00032J	0.00015J	0.00089J	0.00220	0.00052J	0.00114
αchlordane	0.03538D	0.03702D	0.05612D	0.03367	0.02043D	0.00769	0.01693	0.01199	0.08337D	0.00906	0.01003	0.01204
γchlordane	0.02133	0.01534	0.04000D	0.02595	0.00791	0.00529	0.00973	0.00801	0.03567	0.00604	0.00721	0.00760
cis-nonachlor	0.01535	0.02645D	0.01815	0.01545	0.01749	0.00626	0.01401	0.00932	0.06229D	0.00400	0.00635	0.01115
trans-nonachlor	0.03950D	0.07163D	0.04342D	0.03978	0.03713D	0.00208	0.03465	0.03021D	0.16186D	0.00744	0.01655	0.03600
Oxychlordane	0.00398	0.00852	0.00508	0.00545	0.00595	0.00293	0.00504	0.00377	0.01077	0.00206	0.00246	0.00518
Heptachlor	0.00055J	0.00044J	0.00057J	0.00050J	0.00018J	0.00046J	0.00018J	0.00011J	bdl	bdl	0.00014J	0.00016J
Heptachlor epoxide	0.00492	0.00815	0.01372	0.00430D	0.00169	0.00288	0.00139J	0.00085J	0.00411	0.00530	0.00279	0.00256
2,4'-DDD	0.00274	0.00188	0.00443	0.00124J	0.00131	0.00076J	0.00113J	0.00060J	0.00387	0.00111	0.00107	0.00221
2,4'-DDE	0.00179J	0.00038J	0.00072J	0.00260	0.00021J	0.00019J	0.00132J	0.00005J	0.00432	0.00031J	0.00033J	0.00072J
2,4'-DDT	0.00675	0.00161	0.00100	0.00579	0.00364	0.00264	0.00411	0.00259	0.01566	0.00424	0.00435	0.00901
4,4'-DDD	0.01818	0.01418	0.01992D	0.00894	0.00603	0.00348	0.00462	0.00353	0.02480	0.00382	0.00400	0.00952
4,4'-DDE	0.06808D	0.05667D	0.02931D	0.03336	0.02065D	0.01345	0.06001D	0.03500D	0.22418D	0.01422	0.01662D	0.07676
4,4'-DDT	0.00412	0.00863	0.00410	0.00126J	0.00130	0.00132	0.00143J	0.00107	0.00345	0.00066J	0.00042J	0.00142
Dieldrin	0.05154D	0.09207D	0.13608D	0.05133D	0.02185D	0.00089J	0.01163	0.00608	0.03301	0.02678	0.01283	0.01935
Endosulfan II	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.00054J	bdl	bdl
Endrin	0.00107J	0.00259	0.00418	0.05380D	0.00133	0.00345	bdl	0.00032J	0.00179J	0.00128	bdl	0.00043J
HCB	0.00050J	0.00053J	0.00080J	0.00101J	0.00033J	0.00102	0.00063J	0.00048J	0.00327	0.00148	0.00078J	0.00207
Mirex	0.00216	0.00231	0.00105	0.00389	0.00229	0.00104	0.00773	0.00377	0.01043	0.00023J	0.00093	0.00301
Pentachloro-anisole	0.00655	0.00408	0.03231D	0.00496	0.00069J	0.01031	0.00351	0.00241	0.00489	bdl	0.00426	0.00419
Toxaphene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chlorpyrifos	bdl	0.00286	0.00206	bdl	bdl	0.00251	bdl	0.00122	bdl	0.00230	0.00160	0.00137
Total PCBs	0.5222	0.6319	0.4262	0.8167	0.5355	0.2944	0.7465	0.3130	2.2664	0.2878	0.3918	1.5655
Detection limit	0.00186	0.00093	0.00097	0.00170	0.00093	0.00098	0.00190	0.00094	0.00189	0.00095	0.00083	0.00079

Table 15. Analytical results in mg/kg wet weight of skinless fillets from fish collected in 2004 from four reaches on the Trinity River, Dallas County, Texas (Note – SMB is smallmouth buffalo, LMB is largemouth bass, C is common carp, CC is channel catfish, FHC is flathead catfish, J is concentration measured below analytical detection limit, D is diluted sample results, and bdl is below the analytical detection limit).

Analyte	Sylvan Avenue, downstream			Sylvan Avenue, upstream				Elm Fork		West Fork			
	SMB	LMB	C	SMB	LMB	C	FHC	SMB	LMB	SMB	LMB	C	CC
1,2,3,4-tetrachlorobenzene	0.00069J	0.00005J	0.00031J	0.00036J	bdl	0.00006J	0.00022J	0.00028J	bdl	0.00020J	0.00009J	0.00019J	0.00021J
1,2,4,5-tetrachlorobenzene	0.00435	0.00023J	0.00062J	0.00103	0.00005J	0.00025J	0.00046J	0.00117	0.00069J	0.00151	0.00355	0.00451	0.00255
Aldrin	0.00021J	0.00007J	0.00017J	0.00019J	bdl	0.00001J	0.00005J	0.00014J	bdl	0.00007J	0.00002J	0.00002J	0.00008J
αBHC	0.00026J	0.00007J	0.00017J	0.00007J	0.00006J	0.00005J	0.00008J	0.00015J	0.00004J	0.00006J	0.00011J	0.00010J	0.00009J
βBHC	0.00030J	0.00013J	0.00053J	0.00004J	0.00001J	0.00010J	0.00008J	0.00004J	bdl	0.00001J	0.00001J	0.00008J	0.00011J
δBHC	0.00022J	bdl	bdl	0.00005J	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
γBHC	0.00010J	0.00003J	0.00014J	0.00015J	0.00001J	0.00002J	0.00011J	0.00019J	0.00006J	0.00011J	0.00013J	0.00016J	0.00040J
αchlordane	0.01003	0.00884	0.01335	0.00992	0.00119	0.00175	0.00263	0.00998	0.00035J	0.00107	0.00057J	0.00196	0.00331
γchlordane	0.00575	0.00263	0.00896	0.00672	0.00050J	0.00121	0.00165	0.00671	0.00007J	0.00061J	0.00026J	0.00127	0.00235
cis-nonachlor	0.00387	0.00733	0.00515	0.00376	0.00100	0.00090	0.00240	0.01009	0.00032J	0.00075J	0.00052J	0.00107	0.00174
trans-nonachlor	0.01051	0.02092	0.01353	0.01110	0.00237	0.00209	0.00615	0.03660D	0.00073J	0.00165	0.00127	0.00256	0.00406
Oxychlordane	0.00115J	0.00383	0.00119	0.00167	0.00046J	0.00026J	0.00097	0.00413	0.00028J	0.00030J	0.00045J	0.00031J	0.00067J
Heptachlor	0.00009J	0.00009J	0.00026J	0.00016J	bdl	bdl	0.00006J	0.00023J	bdl	bdl	bdl	bdl	bdl
Heptachlor epoxide	0.00176J	0.00127	0.00312	0.00100	0.00015J	0.00020J	0.00045J	0.00122	0.00013J	0.00031J	0.00039J	0.00040J	0.00118
2,4'-DDD	0.00050J	0.00042J	0.00087J	0.00074J	0.00019J	0.00013J	0.00023J	0.00063J	0.00003J	0.00024J	0.00018J	0.00024J	0.00037J
2,4'-DDE	0.00023J	0.00018J	0.00015J	0.00069J	0.00003J	0.00007J	0.00007J	0.00022J	0.00004J	0.00009J	0.00003J	0.00004J	0.00015J
2,4'-DDT	0.00129J	0.00190	0.00043J	0.00024J	0.00025J	0.00020J	0.00080J	0.00451	0.00032J	0.00095	0.00077J	0.00048J	0.00177
4,4'-DDD	0.00435	0.00384	0.00592	0.00528	0.00046J	0.00048J	0.00085J	0.00335	0.00013J	0.00056J	0.00026J	0.00142	0.00108
4,4'-DDE	0.01489	0.01881	0.01940D	0.06205D	0.00191	0.00101	0.00606	0.04947D	0.00060J	0.00769	0.00127	0.01695	0.00478
4,4'-DDT	0.00034J	0.00124	0.00081J	0.00079	0.00100J	0.00003J	0.00014J	0.00119	0.00003J	0.00014J	0.00006J	0.00004J	0.00028J
Dieldrin	0.02147	0.02101	0.03192D	0.01012	0.00255	0.00207	0.00218	0.00932	0.00079J	0.00137	0.00187	0.00200	0.00465
Endosulfan II	bdl	0.00011J	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Endrin	0.00034J	0.00071J	0.00083J	0.00120	0.00032J	0.00028J	bdl	0.00085	bdl	bdl	bdl	bdl	bdl
HCB	0.00016J	0.00012J	0.00054J	0.00066J	0.00004J	0.00006J	0.00022J	0.00108	0.00007J	0.00020J	0.00016J	0.00016J	0.00039J
Mirex	0.00047J	0.00019J	0.00047J	0.00061J	0.00019J	0.00020J	0.00048J	0.00426	0.00007J	0.00021J	0.00014J	0.00038J	0.00035J
Pentachloro-anisole	0.00442	0.00057J	0.00876	0.00132	0.00008J	0.00020J	0.00064J	0.00256	0.00005J	0.00068J	0.00022J	0.00075J	0.00300
Toxaphene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chlorpyrifos	bdl	0.00045J	0.00130	bdl	bdl	bdl	0.00028J	0.00094	0.00001J	0.00017J	0.00021J	0.00010J	0.00200
Total PCBs	0.0884	0.0779	0.1260	0.1746	0.0409	0.0431	0.0969	0.4876	0.0193	0.1146	0.0571	0.0554	0.1033
Detection limit	0.00195	0.00084	0.00088	0.00078	0.00095	0.00085	0.00091	0.00070	0.00094	0.00084	0.00095	0.00096	0.00089

Fork Reach to 0.0014 mg/kg wet weight in a spotted gar also collected from the West Fork Reach. Measured concentrations in the tissue samples ranged from 0.00005 mg/kg wet weight in a largemouth bass collected from the Trinity River downstream of Sylvan Avenue to 0.00069 mg/kg wet weight in a smallmouth buffalo collected from the same location. All of the tissue samples and all of the whole body samples, with the exception of the spotted gar from the West Fork Reach, contained 1,2,3,4-tetrachlorobenzene levels less then the highest concentration observed in fish tissues collected from Lake Worth in 2003 (Giggleman and Lewis, 2004).

[1,2,4,5-Tetrachlorobenzene] Listed by the U.S. Environmental Protection Agency (USEPA) as a persistent, bio-accumulative, and toxic chemical (PBT), 1,2,4,5-tetrachlorobenzene is a common component of many herbicides, insecticides, defoliants, and electrical insulation fluids (Sax and Lewis, 1987; NDDH, 2002). Sub-chronic exposure to 1,2,4,5-tetrachlorobenzene has resulted in renal non-carcinogenic toxicological effects to exposed mammals (USEPA, 2004). Currently, there are no ecological screening criteria available for this compound, but in fish tissues from freshwater systems, the Texas Commission on Environmental Quality (TCEQ) (2003) recommends a human-health screening level of 5.85 mg/kg wet weight.

All of the fish samples collected in 2004 contained detectable amounts of 1,2,4,5-tetrachlorobenzene. Concentrations in the whole body fish samples ranged from 0.00038 mg/kg wet weight in a largemouth bass collected from the Trinity River downstream of Sylvan Avenue to 0.01552 mg/kg wet weight in a smallmouth buffalo collected from the West Fork Reach. In the tissue samples, 1,2,4,5-tetrachlorobenzene concentrations ranged from 00005 mg/kg wet weight in a largemouth bass collected from the Trinity River upstream of Sylvan Avenue to 0.00451 mg/kg wet weight in a common carp collected from the West Fork Reach. All of the measured concentrations were well below the human-health screening criterion reported by the TCEQ (2003).

[Aldrin] Considered by the USEPA as a probable human carcinogen, aldrin was used as a pesticide in the United States from 1950 through 1970 (ATSDR, 1993). In 1974, the USEPA banned all uses of aldrin except for subterranean termite control (ATSDR, 1993). In 1987, the USEPA banned all commercial uses of this compound in the United States (ATSDR, 1993). When released into the environment, aldrin readily breaks down to the epoxide dieldrin through microbial and photic degradation (ATSDR, 1993; Cornell, 1998). Chronic exposure to aldrin has resulted in hepatic non-carcinogenic toxicological effects in mammals (USEPA, 2004). Newell *et al.* (1987), recommend an aldrin concentration of 0.12 mg/kg in fish to be protective of piscivorous wildlife. A composite whole body sample of three green sunfish and one bluegill collected from the West Fork in August, 1987 by UNT within the current project area contained an aldrin concentration of 0.0032 mg/kg wet weight (Appendix E, Table E1), whereas no detectable amounts of aldrin were measured in a composite sample of whole body blue catfish collected in 1992 by the U.S. Geological Survey (USGS) from the Trinity River off South Loop 12 in Dallas County, Texas downstream of the current project area (Appendix E, Table E3).

In edible fish tissue, the USEPA recommends an aldrin concentration of 0.0007 mg/kg wet weight as a conservative human health screening value (Nowell and Resek, 1994), while the TCEQ (2003) recommends an aldrin concentration of 0.136 mg/kg wet weight as a screening level protective of human health. The USEPA value is based on an acceptable carcinogenicity risk level of 1 x 10^{-6} (1 in 1,000,000) and negligible non-cancer health risks (Nowell and Resek, 1994), whereas the screening value reported by the TCEQ (2003) is based on a carcinogenicity risk level of 1 x 10^{-5} (1 in 100,000). The U.S. Food and Drug Administration (USFDA) (2000) action level for aldrin in edible fish tissue is 0.3 mg/kg wet weight. This action level is applicable only for interstate commerce, but does represent a regulatory limit that when equaled or exceeded could result in legal action being taken by the USFDA to prevent the consumption of a given contaminant (USFDA, 2000). In fish tissue samples [sample size (n) = 13] collected in 2003 by the USFWS/USACE from the Trinity River in Tarrant County, Texas upstream of the current project area no detectable amounts of aldrin were measured (Appendix E, Table E4).

In 2004, a largemouth bass tissue sample collected from the Trinity River upstream of Sylvan Avenue and a largemouth bass tissue sample collected from the Elm Fork Reach contained no detectable amounts of aldrin (Tables 14 and 15). All other fish samples analyzed in 2004 contained aldrin levels that exceeded the analytical detection limits. Aldrin concentrations in whole body fish samples ranged from 0.00008 mg/kg wet weight in a flathead catfish collected from the West Fork Reach to 0.00069 mg/kg wet weight in a smallmouth buffalo taken from the Trinity River downstream of Sylvan Avenue (Table 14). Detected aldrin concentrations in the fish tissue samples ranged from 0.00001 mg/kg wet weight in a common carp collected from the Trinity River upstream of Sylvan Avenue to 0.00021 mg/kg wet weight in a smallmouth buffalo taken from the Trinity River downstream of Sylvan Avenue (Table 15). All of the whole body samples contained aldrin concentrations that were below the concentration observed in 1987 by UNT in fish from the West Fork (Appendix E, Table E1) and well below the predator protection limit recommended by Newell *et al.* (1987), while detected tissue-aldrin concentrations were less then even the most conservative human-health screening value cited above.

[Hexachlorocyclohexane (BHC)] Hexachlorocyclohexane (BHC) represents a group of manufactured chemicals used in pesticides that do not occur naturally in the environment (ATSDR, 1999). Eight isomers are formed from BHC of which the four most common are alpha (α)-, beta (β), delta (δ)-, and gamma (γ)-BHC (ATSDR, 1999). In the United States, the commercial production of γBHC, also known as lindane, began in 1945 (EHP, 2002). This compound was used extensively in the 1950s as an insecticide in the timber industry but is no longer produced commercially in the United States (ATSDR, 1999; EHP, 2002). The commercial production of all BHC pesticides ceased after 1983 in the United States (EHP, 2002).

In a terrestrial environment, BHC can degrade rapidly under anaerobic conditions (Damborsky *et al.*, 2002). Under aerobic conditions, bio-degradation mineralizes αBHC and γBHC, whereas βBHC persists (Middeldorp and McLeish, 2002). Anaerobically, βBHC can biodegrade to benzene and chlorobenzene (Middeldorp and McLeish, 2002). In aquatic systems, BHC can be absorbed and adsorbed to sediments and broken down biologically by microflora and fauna (ETN, 1993). It can accumulate in the fatty tissue of fish, birds, and mammals (ETN, 1993; ATSDR, 1999). The isomer γBHC is highly toxic to fish and aquatic invertebrates and may cause birth defects in amphibians

(ETN, 1993). Sub-chronic exposure to γBHC has resulted in hepatic non-carcinogenic toxicological effects to exposed organisms (USEPA, 2004). In whole body fish, Newell *et al.* (1987), recommend a BHC concentration of 0.1 mg/kg to be protective of piscivorous wildlife. A composite whole body sample of three longear sunfish collected upstream of the current project area from the Elm Fork in September, 1988 by UNT contained an αBHC concentration of 0.0244 mg/kg wet weight (Appendix E, Table E1), while a composite whole body blue catfish sample collected by the USGS in 1992 from the Trinity River off South Loop 12 downstream of the current project area contained a γBHC of 0.01 mg/kg wet weight (Appendix E, Table E3). No other detectable BHC isomers were reported from either the UNT 1987-1988 study or the USGS 1992 data (Appendix E, Tables E1 and E3).

Hexachlorocyclohexane and its isomers are reasonably anticipated to be human carcinogens (EHP, 2002). In edible fish tissue, the USEPA recommends αBHC, βBHC, and γBHC concentrations of 0.0017, 0.006, and 0.0081 mg/kg wet weight, respectively, as conservative human health screening criteria (Nowell and Resek, 1994). These concentrations are based on carcinogenicity risk levels of 1×10^{-6} and negligible non-cancer health risks (Nowell and Resek, 1994). In contrast, the TCEQ (2003) recommends concentrations of 0.366, 1.281, and 5.852 mg/kg wet weight as screening values for αBHC, βBHC, and γBHC, respectively. These values are based on an acceptable carcinogenicity risk level of 1×10^{-5} (TCEQ, 2003). In fish tissue samples (n = 13) collected in 2003 by the USFWS/USACE from the Trinity River in Tarrant County upstream of the current project area no detectable amounts of BHC isomers were measured (Appendix E, Table E4).

In 2004, the isomers αBHC, βBHC, and γBHC were measured above the analytical detection limits in all of the fish samples analyzed, while detectable amounts of the isomer δBHC were measured in six of the 12 whole body samples and only two of the 13 tissue samples (Tables 14 and 15). In the whole body fish samples, detected αBHC concentrations ranged from 0.0001 mg/kg wet weight in a largemouth bass collected from the Trinity River upstream of Sylvan Avenue and a flathead catfish from the West Fork Reach to 0.00216 mg/kg wet weight in a longnose gar taken from the Elm Fork Reach. The measured βBHC concentrations in whole body fish ranged from 0.00007 mg/kg wet weight in a flathead catfish collected from the West Fork Reach to 0.00267 mg/kg wet weight in a common carp collected from the Trinity River downstream of Sylvan Avenue, while the whole body γBHC concentrations ranged from 0.0001 mg/kg wet weight in a largemouth bass collected from the Trinity River upstream of Sylvan Avenue to 0.0022 mg/kg wet weight in a smallmouth buffalo taken from the West Fork Reach. Detected whole body δBHC concentrations ranged from 0.00013 mg/kg wet weight in a largemouth bass sample collected from the Trinity River downstream of Sylvan Avenue to 0.00048 mg/kg in a spotted gar collected from the West Fork Reach. In fish tissue samples, αBHC concentrations ranged from 0.00004 mg/kg wet weight in a largemouth bass collected from the Elm Fork Reach to 0.00026 mg/kg wet weight in a smallmouth buffalo taken from the Trinity River downstream of Sylvan Avenue, while measured βBHC concentrations ranged from 0.00001 mg/kg wet weight in a largemouth bass collected from the Trinity River upstream of Sylvan Avenue and a smallmouth buffalo and largemouth bass collected from the West Fork Reach to 0.00053 mg/kg wet weight in a common carp taken from the Trinity River downstream of Sylvan Avenue. Detected tissue-γBHC concentrations ranged from 0.00001 mg/kg wet weight in a largemouth bass collected from the Trinity River upstream of Sylvan Avenue to 0.0004 mg/kg wet weight in a channel catfish collected from the West Fork Reach. The smallmouth buffalo collected from the Trinity River upstream and downstream of Sylvan Avenue were the only tissue samples that contained detectable δBHC and these concentrations were 0.00022 mg/kg and 0.00005 mg/kg wet weight, respectively.

All of the whole body samples contained BHC isomer concentrations that were below the respective concentrations reported by UNT and the USGS (Appendix E, Tables E1 and E3) and well below the predator protection limit suggested by Newell *et al.* (1987). Detected BHC isomer tissue concentrations were less then the respective human health screening values reported by the USEPA (Nowell and Resek, 1994) and the TCEQ (2003).

[Chlordane, technical] Listed by the USEPA as a probable carcinogen, technical chlordane consists of the stereoisomers alpha (α) and gamma (γ) or *cis* and *trans*-chlordane, heptachlor, *cis*- and *trans*-nonachlor, and the metabolites oxychlordane and heptachlor epoxide (ATSDR, 1994; USEPA, 2004). First developed in 1946, chlordane was used as a general pesticide until 1983 (LMF, 2002). Between 1983 and 1988, use of chlordane in the United States was restricted by the USEPA to subterranean termite control (ATSDR, 1994). All commercial use of chlordane as a pesticide was banned by the USEPA in the United States in 1988 (ATSDR, 1994).

Once released into the environment, chlordane binds tightly with soil and sediment particles and can remain in the soil for more than 20 years (LMF, 2002). It can bio-accumulate in the tissues of fish, birds, and mammals and can adversely affect the nervous, digestive, and hepatic systems in both humans and animals (ATSDR, 1994; LMF, 2002). Irwin (1988) recommends a chlordane concentration of 0.01 mg/kg in whole body fish as a predator alert level for piscivorous avian species. Newell *et al.* (1987) recommend a chlordane concentration of 0.5 mg/kg in fish to be protective of piscivorous wildlife. A composite whole body sample of three green sunfish and one bluegill collected from the West Fork in August, 1987 by UNT within the current project area contained a chlordane concentration of 0.3164 mg/kg wet weight (Appendix E, Table E1), while a composite whole body blue catfish sample collected by the USGS in 1992 from the Trinity River off South Loop 12 downstream of the current project area contained a technical chlordane concentration of 0.313 mg/kg wet weight (Appendix E, Table E3).

In edible fish tissue, the USEPA (2000) recommends a technical chlordane (the summation of α and γchlordane, *cis*- and *trans*-nonachlor, and oxychlordane) concentration of 0.014 mg/kg wet weight as a screening value for subsistence fishermen, whereas the Texas Department of State Health Services (TDSHS) (2001) reports a non-cancer risk health based assessment comparison (HAC) value of 1.2 mg/kg wet weight and a cancer risk HAC value of 1.6 mg/kg wet weight. The USFDA (2000) action level for technical chlordane in edible fish tissue is 0.3 mg/kg wet weight. Smallmouth buffalo and gizzard shad tissue samples (n = 6) collected by TPWD in 1987 from the Trinity River in the vicinity of the current project area contained detectable chlordane levels that ranged from 0.032 to 0.84 mg/kg wet weight (Appendix E, Table E2). Detected chlordane concentrations in fish tissue samples (n = 6) collected from the Trinity River upstream of the current project area in Tarrant County by the USFWS/USACE in 2003 ranged from 0.084 to 0.61 mg/kg wet weight (Appendix E, Table E4).

All of the fish submitted for analyses in 2004 contained detectable amounts of chlordane isomers and/or metabolites (Tables 14 and 15). Technical chlordane values were determined from these data following Munn and Gruber (1997), by calculating the sum of ∀- and (chlordane, *cis*- and *trans*-nonachlor, oxychlordane, heptachlor, and heptachlor epoxide for each sample (Table 16). In the

Table 16. Technical chlordane values in mg/kg wet weight for whole body fish and skinless muscle tissue (fillet) samples collected in 2004 from four reaches on the Trinity River, Dallas County, Texas, calculated using the sum of ∀- and (chlordane, *cis*- and *trans*-nonachlor, oxychlordane, heptachlor, and heptachlor epoxide concentrations (Note – TR is downstream of Sylvan Avenue; TR2 is upstream of Sylvan Avenue; EF is Elm Fork; WF is West Fork; SMB is smallmouth buffalo; LMB is largemouth bass; C is common carp; CC is channel catfish; FHC is flathead catfish; LNG is longnose gar; SG is spotted gar; and bdl is below the analytical detection limit).

Sample ID	∀ chlordane	(chlordane	*cis*-nonachlor	*trans*-nonachlor	oxy-chlordane	heptachlor	heptachlor epoxide	Technical Chlordane
TRSMB2	0.03538	0.02133	0.01535	0.03950	0.00398	0.00055	0.00492	0.12101
TRLMB2	0.03070	0.01539	0.02645	0.07163	0.00852	0.00044	0.00815	0.16128
TRC2	0.05612	0.04000	0.01815	0.04342	0.00508	0.00057	0.01372	0.17706
TR2SMB2	0.03367	0.02596	0.01545	0.03978	0.00545	0.00050	0.00430	0.12511
TR2LMB2	0.02043	0.00791	0.01749	0.03713	0.00595	0.00018	0.00169	0.09078
TR2CC1	0.00769	0.00529	0.00626	0.00208	0.00293	0.00046	0.00288	0.02759
TREFSMB2	0.01693	0.00973	0.01401	0.03465	0.00504	0.00018	0.00139	0.08193
TREFCC1	0.01199	0.00801	0.00932	0.03021	0.00377	0.00011	0.00085	0.06426
TREFLNG1	0.08337	0.03567	0.06229	0.16186	0.01077	bdl	0.00411	0.35807
TRWFSMB2	0.00906	0.00604	0.00400	0.00744	0.00206	bdl	0.00530	0.03390
TRWFFHC1	0.01003	0.00721	0.00635	0.01654	0.00246	0.00014	0.00279	0.04552
TRWFSG1	0.01204	0.00760	0.01115	0.03600	0.00518	0.00016	0.00256	0.07469
TRSMB1*	0.01003	0.00575	0.00387	0.01051	0.00115	0.00009	0.00176	0.03316
TRLMB1*	0.00884	0.00263	0.00733	0.02092	0.00383	0.00009	0.00127	0.04491
TRC1*	0.01335	0.00896	0.00515	0.01354	0.00119	0.00026	0.00312	0.04557
TR2SMB1*	0.00992	0.00672	0.00376	0.01110	0.00167	0.00016	0.00100	0.03433
TR2LMB1*	0.00119	0.00050	0.00100	0.00237	0.00046	bdl	0.00015	0.00567
TR2C1*	0.00175	0.00121	0.00090	0.00209	0.00026	bdl	0.00020	0.00641
TR2FHC1*	0.00263	0.00165	0.00240	0.00615	0.00097	0.00006	0.00045	0.01431
TREFSMB1*	0.00998	0.00671	0.01009	0.03660	0.00413	0.00023	0.00122	0.06896
TREFLMB1*	0.00035	0.00007	0.00032	0.00073	0.00028	bdl	0.00013	0.00188
TRWFSMB1*	0.00107	0.00061	0.00075	0.00165	0.00030	bdl	0.00031	0.00469
TRWFLMB1*	0.00057	0.00026	0.00052	0.00127	0.00045	bdl	0.00039	0.00346
TRWFC1*	0.00196	0.00127	0.00107	0.00256	0.00031	bdl	0.00040	0.00757
TRWFCC1*	0.00331	0.00234	0.00174	0.00406	0.00067	bdl	0.00118	0.01330

*Fillet.

whole body fish samples, calculated technical chlordane levels ranged from 0.0276 mg/kg wet weight in a channel catfish collected from the trinity River upstream of Sylvan Avenue to 0.3581 mg/kg wet weight in a longnose gar taken from the Elm Fork Reach. All of these whole body samples contained technical chlordane levels less then the concentrations reported by UNT for fish taken from the West Fork in 1987 and in fish collected by the USGS in 1992 downstream of the current project area (Appendix E, Tables E1 and E3), with the exception of the concentration calculated for the longnose gar from the Elm Fork Reach. All of the 2004 whole body samples also contained technical chlordane levels that exceeded the predator alert level recommended by Irwin (1988), however none of these fish contained chlordane concentrations that equaled or exceeded the predator protection value suggested by Newell *et al.* (1987).

In fish tissues sampled in 2004, technical chlordane concentrations ranged from 0.00188 mg/kg wet weight in a largemouth bass collected from the Elm Fork Reach to 0.06896 mg/kg wet weight in a smallmouth buffalo also collected from the Elm Fork Reach. Four of these 13 tissue samples (the smallmouth buffalo, largemouth bass, and common carp collected from the Trinity River downstream of Sylvan Avenue and the smallmouth buffalo collected from upstream of Sylvan Avenue) contained calculated chlordane levels that were greater then the lowest concentration reported by TPWD for fish collected in 1987 in the vicinity of the current project area (Appendix E, Table E2), but none of the 2004 tissue samples contained technical chlordane levels that equaled or exceeded the highest concentration reported by TPWD or the lowest detected concentration reported by the USFWS/USACE for fish collected in 2003 from the Trinity River in Tarrant County upstream of the current project area (Appendix E, Tables E2 and E4). Six of the 13 samples (the smallmouth buffalo, largemouth bass, and common carp collected from the Trinity River downstream of Sylvan Avenue, the smallmouth buffalo and flathead catfish from upstream of Sylvan Avenue, and the smallmouth buffalo from the Elm Fork Reach) contained technical chlordane concentrations that exceeded the cited USEPA (2000) screening value, however none of these 13 samples contained chlordane levels that equaled or exceeded the cited TDSHS (2001) HAC values or the USFDA (2000) action level.

[Dichloro-diphenyl-trichloroethane (DDT) and metabolites] First developed in 1939, dichloro-diphenyl-trichloroethane (DDT) was used extensively throughout the world as an all purpose insecticide (ATSDR, 1995). Considered a probable human carcinogen by the USEPA, commercial production of DDT was banned in the United States in 1972 because of adverse affects to non-target wildlife species and the potential harm to human health (ATSDR, 1995; ATSDR, 2000a). The metabolites dichloro-diphenyl-dichloroethane (DDD) and dichloro-diphenyl-dichloroethylene (DDE) are microbial degradation products formed by the dehydrohalogenation of DDT (ATSDR, 2000a). In wildlife, DDT exposure has resulted in birds, alligators, and turtles producing eggs with shells too thin for offspring survival (Baskin, 2002). This compound exhibits very low solubility in aquatic environments and bio-accumulates in the fatty tissues of fish, birds, and other animals (Baskin, 2002). Chronic exposure has resulted in hepatic non-carcinogenic toxicological effects to exposed organisms (USEPA, 2004). According to Irwin (1988), the National Academy of Sciences recommends a DDT level of 1 mg/kg wet weight as the maximum concentration in whole body fish for protection of piscivorous avian predators. Newell *et al.* (1987), recommend a total DDT concentration of 0.2 mg/kg in fish to be protective of all piscivorous wildlife, whereas the Canadian Council of Ministers of the Environment (CCME) (2002) recommends a total DDT concentration of 0.014 mg/kg wet weight in fish and/or aquatic organisms as the level protective of piscivorous wildlife. A composite whole body sample of 14 green sunfish collected from the West Fork in

September, 1988 by UNT within the current project area contained a DDD concentration of 0.004 mg/kg wet weight and a DDE concentration of 0.0003 mg/kg wet weight (Appendix E, Table E1), while a composite whole body blue catfish sample collected by the USGS in 1992 from the Trinity River off South Loop 12 downstream of the current project area contained a DDD concentration of 0.015 mg/kg wet weight, a DDE concentration of 0.14 mg/kg wet weight, and a DDT concentration of 0.006 mg/kg wet weight (Appendix E, Table E3).

In edible fish tissue, the USEPA recommends DDD, DDE, DDT, and total DDT concentrations of 0.0449, 0.0316, 0.0316, and 0.014 mg/kg wet weight, respectively, as conservative screening values for the protection of human health (Nowell and Resek, 1994; USEPA, 2000), whereas the USFDA (2000) action levels for total DDT and its metabolites are 5 mg/kg wet weight. Smallmouth buffalo and gizzard shad tissue samples (n = 5) collected by TPWD in 1987 from the Trinity River in the vicinity of the current project area contained detectable DDE and DDT levels that ranged from 0.03 to 0.17 mg/kg wet weight and from 0.05 mg/kg to 0.12 mg/kg wet weight, respectively (Appendix E, Table E2). Five of the 13 fish tissue samples collected from the Trinity River in Tarrant County by the USFWS/USACE in 2003 contained detectable amounts of DDE (Appendix E, Table E4). These detected concentrations ranged from 0.028 to 0.14 mg/kg wet weight. In addition, one the 13 fish sampled in 2003 from the Trinity River in Tarrant County also contained detectable amounts of DDT (0.022 mg/kg wet weight).

All of the fish submitted for analyses in 2004 contained detectable amounts of DDT and/or its metabolites (Tables 14 and 15). For screening purposes, the sum of the isomer concentrations of the metabolites DDD (2,4=-DDD + 4,4=-DDD) and DDE (2,4=-DDE + 4,4=-DDE) and the sum of the DDT isomers (2,4=-DDT + 4,4=-DDT) were calculated following Munn and Gruber (1997) for each sample where detected above the analytical detection limits. Total DDT values were determined from these data by adding the calculated DDD, DDE, and DDT concentrations for each sample (Table 17).

In the whole body fish samples collected in 2004, calculated DDD levels ranged from 0.00413 mg/kg wet weight in a channel catfish to 0.02867 mg/kg wet weight in a longnose gar, both collected from the Elm Fork Reach, while calculated DDE concentrations ranged from 0.01364 mg/kg wet weight in a channel catfish collected from the Trinity River downstream of Sylvan Avenue to 0.2285 mg/kg wet weight in the same longnose gar from the Elm Fork Reach. Calculated DDT levels ranged from 0.00366 mg/kg wet weight in the same channel catfish from the Elm Fork Reach to 0.01911 mg/kg wet weight in the same longnose gar from the Elm Fork Reach. Calculated total DDT concentrations ranged from 0.02184 mg/kg wet weight in a channel catfish collected from the Trinity River upstream of Sylvan Avenue to 0.2763 mg/kg wet weight in the longnose gar collected from the Elm Fork Reach.

All of the whole body fish samples from 2004 contained DDD and DDE concentrations greater then the values observed by UNT in fish from the West Fork in 1988 (Appendix E, Table E1). The smallmouth buffalo, largemouth bass, and common carp collected from the Trinity River downstream of Sylvan Avenue and the longnose gar taken from the Elm Fork Reach also contained

Table 17. Calculated DDD (DDD_{SUM}), DDE (DDE_{SUM}), DDT (DDT_{SUM}), and total DDT (DDT_{TOTAL}) values in mg/kg wet weight for whole body fish and skinless muscle (fillet) samples collected in 2004 from four reaches on the Trinity River, Dallas County, Texas (Note – TR is downstream of Sylvan Avenue; TR2 is upstream of Sylvan Avenue; EF is Elm Fork; WF is West Fork; SMB is smallmouth buffalo; LMB is largemouth bass; C is common carp; CC is channel catfish; FHC is flathead catfish; LNG is longnose gar; SG is spotted gar; and bdl is below the analytical detection limit).				
Sample ID	**DDD_{SUM}**	**DDE_{SUM}**	**DDT_{SUM}**	**DDT_{TOTAL}**
TRSMB2	0.02092	0.06987	0.01087	0.10166
TRLMB2	0.01606	0.05705	0.01024	0.08335
TRC2	0.02436	0.03003	0.00510	0.05949
TR2SMB2	0.01018	0.03596	0.05916	0.10530
TR2LMB2	0.00734	0.02086	0.00494	0.03314
TR2CC1	0.00424	0.01364	0.00396	0.02184
TREFSMB2	0.00575	0.06133	0.00554	0.07262
TREFCC1	0.00413	0.03505	0.00366	0.04284
TREFLNG1	0.02867	0.22850	0.01911	0.27628
TRWFSMB2	0.00493	0.01453	0.00490	0.02436
TRWFFHC1	0.00486	0.01695	0.00477	0.02658
TRWFSG1	0.01173	0.07748	0.01043	0.09964
TRSMB1*	0.00485	0.01512	0.00163	0.02160
TRLMB1*	0.00422	0.01899	0.00314	0.02635
TRC1*	0.00679	0.01955	0.00124	0.02758
TR2SMB1*	0.00602	0.06274	0.00103	0.06979
TR2LMB1*	0.00065	0.00194	0.00045	0.00304
TR2C1*	0.00061	0.00108	0.00023	0.00192
TR2FHC1*	0.00108	0.00613	0.00094	0.00815
TREFSMB1*	0.00398	0.04969	0.00570	0.05937
TREFLMB1*	0.00016	0.00064	0.00035	0.00115
TRWFSMB1*	0.00080	0.00779	0.00109	0.00968
TRWFLMB1*	0.00044	0.00130	0.00083	0.00257
TRWFC1*	0.00166	0.01699	0.00052	0.01917
TRWFCC1*	0.00145	0.00493	0.00205	0.00843

*Fillet.

DDD concentrations greater then the concentration reported by the USGS for whole body fish collected in 1992 from the Trinity River downstream of the current project area (Appendix E, Table E3). The same longnose gar from the Elm Fork Reach also contained a DDE concentration that exceeded the reported USGS DDE value from the 1992 data (Appendix E, Table E3). In addition, five of the 2004 whole body samples (the smallmouth buffalo and largemouth bass taken from downstream of Sylvan Avenue, the smallmouth buffalo collected from upstream of Sylvan Avenue, the longnose gar form the Elm Fork Reach, and the spotted gar from the West Fork Reach) contained

DDT levels that were greater then the value reported by the USGS (Appendix E, Table E3). Furthermore, all of the 2004 whole body samples contained total DDT levels that exceeded the criterion reported by the CCME (2002). However, only the longnose gar from the Elm Fork Reach contained a total DDT concentration that exceeded the screening value suggested by Newell *et al.* (1987), while none of the whole body samples collected in 2004 contained total DDT levels that equaled or exceeded the screening criterion reported by Irwin (1988).

In the fish tissue samples analyzed in 2004, calculated DDD concentrations ranged from 0.00016 mg/kg wet weight in a largemouth bass sampled collected from the Elm Fork Reach to 0.00679 mg/kg wet weight in a common carp collected from the Trinity River downstream of Sylvan Avenue. Calculated DDE levels ranged from 0.00064 mg/kg wet weight in the same largemouth bass from the Elm Fork Reach to 0.06274 mg/kg wet weight in a smallmouth buffalo collected from the Trinity River upstream of Sylvan Avenue, while calculated DDT concentrations ranged from 0.00023 mg/kg wet weight in a common carp collected from the Trinity River upstream of Sylvan Avenue to 0.0057 mg/kg wet weight in a smallmouth buffalo collected from the Elm Fork Reach. Calculated total DDT levels ranged from 0.00115 mg/kg wet weight in the same largemouth bass from the Elm Fork Reach to 0.06979 mg/kg wet weight in the same smallmouth buffalo collected from the Trinity River upstream of Sylvan Avenue.

All of the fish tissue samples collected in 2004 contained calculated DDD concentrations less then the cited USEPA human health criterion (Nowell and Resek, 1994). None of these samples contained calculated DDE levels that equaled or exceeded the highest concentration reported by TPWD in 1987 for fish collected in the vicinity of the current project area or the highest concentration reported by USFWS/USACE for fish collected in 2003 from the Trinity River in Tarrant County upstream of the current project area (Appendix E, Tables E2 and E4). Only two of these fish (the smallmouth buffalo collected from the Trinity River downstream of Sylvan Avenue and the smallmouth buffalo collected from the Elm Fork Reach) contained DDE levels that exceeded the cited USEPA human health screening value and the lowest concentrations reported by TPWD and the USFWS/USACE (Nowell and Resek, 1994; Appendix E, Tables E2 and E4). None of the tissue samples analyzed in 2004 contained calculated DDT levels that equaled or exceeded the cited USEPA human health screening criterion or the lowest concentrations reported from previous studies by TPWD and the USFWS/USACE (Nowell and Resek, 1994; Appendix E, Tables E2 and E4). Six of the 13 2004 tissue samples (the smallmouth buffalo, largemouth bass, and common carp from the Trinity River downstream of Sylvan Avenue; the smallmouth buffalo from upstream of Sylvan Avenue; the smallmouth buffalo from the Elm Fork Reach; and the common carp from the West Fork Reach) contained calculated total DDT concentrations that exceeded the cited USEPA (2000) human health screening value, however none of these samples contained total DDT levels that approached the cited USFDA (2000) action level.

[Dieldrin] Listed by the USEPA as a probable carcinogen, dieldrin is a synthetic cyclic hydrocarbon that exhibits high toxicity and is persistent in soils (Cornell, 1998). It is formed as a degradation product of aldrin (Cornell, 1998; USEPA, 2004). From 1950 through 1970, this compound was used in the United States as a pesticide (ATSDR, 1993). In 1974, the USEPA banned all uses of dieldrin except for termite control (ATSDR, 1993). Once in the environment, dieldrin degrades very slowly and binds tightly to soil and sediment particles (ATSDR, 1993). Chronic exposure has resulted in hepatic non-carcinogenic toxicological effects in mammals (USEPA, 2004). Newell *et al.* (1987), recommend a dieldrin concentration of 0.12 mg/kg in fish to be protective of piscivorous wildlife. A composite whole body sample of 14 green sunfish collected from the West Fork in September, 1988 by UNT in the vicinity of the current project area contained a dieldrin concentration of 0.0003 mg/kg wet weight (Appendix E, Table E1), while a composite whole body blue catfish sample collected by the USGS in 1992 from the Trinity River off South Loop 12 downstream of the current project area contained a dieldrin concentration of 0.066 mg/kg wet weight (Appendix E, Table E3). In edible fish tissue, the USEPA (2000) recommends a dieldrin concentration of 0.00031 mg/kg wet weight as a screening value for subsistence fishermen, whereas the TDSHS (2001) reports a non-cancer risk HAC value of 0.12 mg/kg wet weight and a cancer risk HAC value of 0.03 mg/kg wet weight. The action level reported by the USFDA (2000) for dieldrin in fish tissues is 0.3 mg/kg wet weight. Smallmouth buffalo and gizzard shad tissue samples (n = 5) collected by TPWD in 1987 from the Trinity River in the vicinity of the current project area contained detectable dieldrin concentrations that ranged from 0.02 to 0.1 mg/kg wet weight (Appendix E, Table E2). Four of the 13 fish tissue samples collected from the Trinity River in Tarrant County by the USFWS/USACE in 2003 upstream of the current project area contained detectable amounts of dieldrin that ranged from 0.014 to 0.026 mg/kg wet weight (Appendix E, Table E4).

Detectable levels of dieldrin were measured in all of the fish samples collected in 2004. Measured dieldrin concentrations in the whole body samples ranged from 0.00089 mg/kg wet weight in a channel catfish collected from the Trinity River upstream of Sylvan Avenue to 0.1361 mg/kg wet weight in a common carp collected from downstream of Sylvan Avenue (Table 14). In tissue samples, dieldrin levels ranged from 0.00079 mg/kg wet weight in a largemouth bass sample collected from the Elm Fork Reach to 0.03192 mg/kg wet weight in another common carp collected from the Trinity downstream of Sylvan Avenue (Table 15).

All of the whole body fish samples collected in 2004 contained dieldrin concentrations that were greater then the concentration reported by UNT for the West Fork in 1988, while only the largemouth bass and common carp collected from the Trinity River downstream of Sylvan Avenue in 2004 contained dieldrin levels greater then the value reported for whole body fish by the USGS from the 1992 data (Appendix E, Tables E1 and E3). In addition, all of the 2004 whole body samples contained dieldrin levels below the predator protection value suggested by Newell *et al.* (1987), with the exception of the common carp collected from downstream of Sylvan Avenue. Of the 13 tissue samples analyzed in 2004, only the three samples (smallmouth buffalo, largemouth bass, and common carp) collected from the Trinity River downstream of Sylvan Avenue contained dieldrin levels that were greater then the lowest concentrations reported from previous studies by TPWD and the USFWS/USACE, and of these three samples, none contained dieldrin levels greater then the highest concentration reported by TPWD, while only one sample (the common carp) had levels of dieldrin higher then the highest concentration reported from the USFWS/USACE Tarrant County data (Appendix E, Tables E2 and E4). All of the tissue samples collected in 2004 contained dieldrin concentrations that exceeded the level recommended by the USEPA (2000) to be protective of subsistence fishermen, however none of these samples contained dieldrin levels that equaled or exceeded the HAC values reported by the TDSHS (2001) or the USFDA (2000) action level, with the exception of the common carp collected from downstream of Sylvan Avenue. This fish contained a dieldrin level that exceeded the TDSHS (2001) cancer risk HAC value, but not the non-cancer risk HAC concentration

[Endosulfan II] The organochlorine pesticide endosulfan was first introduced in the United States in 1954, however it has not been commercially produced in the U.S. since 1982 (ATSDR, 2000b). This compound exists as two principal isomers, endosulfan I [alpha (α)-endosulfan] and endosulfan II [beta (β)-endosulfan] (ATSDR, 2000b). Endosulfan can degrade in the environment through photolysis, bio-transformation, and/or oxidation into the metabolite, endosulfan sulfate (ATSDR, 2000b). Chronic exposure to endosulfan has resulted in loss of body weight and hepatic non-cancer toxicological effects to exposed organisms (ATSDR, 2004; USEPA, 2004). Currently, there are no ecological screening criteria available for this compound, but in a whole body composite sample of three green sunfish and one bluegill collected in August, 1987 from the West Fork, UNT reported a detected concentration of 0.0089 mg/kg wet weight and in another composite sample of 14 green sunfish collected from the same area in September, 1988, UNT reported a concentration of 0.0072 mg/kg wet weight (Appendix E, Table E1). In edible fish tissues, the USEPA (2000) recommends an endosulfan II concentration of 2.95 mg/kg wet weight as a screening value for subsistence fishermen. No detectable amounts of endosulfan were measured in fish tissue samples (n = 13) collected from the Trinity River in Tarrant County upstream of the current project area by the USFWS/USACE in 2003 (Appendix E, Table E4).

Of the 12 whole body and 13 tissue samples analyzed in 2004, only two samples, a whole body smallmouth buffalo sample collected from the West Fork Reach and a largemouth bass tissue sample collected from the Trinity River downstream of Sylvan Avenue, contained endosulfan II concentrations above the analytical detection limits (Tables 14 and 15). The concentration detected in the whole body sample (0.00054 mg/kg wet weight) from the West Fork Reach was over 10- times less then the values reported by UNT for the West Fork in 1987 and in 1988 (Appendix E, Table E1). The concentration measured in the tissue sample (0.00011 mg/kg wet weight) from the Trinity River below Sylvan Avenue was over 10,000-times below the screening value recommended by the USEPA (2000) for protection of subsistence fishermen.

[Endrin] Endrin is a stereoisomer of dieldrin (ATSDR, 1996). It was first used as an insecticide, rodenticide, and avicide in 1951 (ATSDR, 1996). Manufacturing of this compound discontinued in the United States in 1991 primarily because of its toxicity to non-target populations of raptors and migratory birds (ATSDR, 1996). Once released into the environment, endrin degrades very slowly. The reported half-life in soil can range up to 12 years (UNEP, 2000). When released into an aquatic environment, endrin is highly toxic to fish, invertebrates, and phytoplankton and demonstrates a tendency to adhere to sediment particles (ATSDR, 1996; UNEP, 2000). Chronic exposure to endrin has resulted in hepatic and neurological non-cancer toxicological effects to exposed organisms (ATSDR, 2004; USEPA, 2004). According to the Risk Assessment Information System (RAIS) (2005), an endrin concentration less than 0.025 mg/kg in fish would be considered protective of piscivorous wildlife in the State of New York. No detectable amounts of endrin were recorded in whole body fish collected in 1987-1988 from the Trinity River in the vicinity of the current project area by UNT, nor were any detectable amounts measured in whole body fish collected in 1992 by the USGS from the Trinity River off South Loop 12 downstream of the current project area (Appendix E, Tables E1 and E3).

In edible fish tissues, the USEPA (2000) recommends an endrin concentration of 0.15 mg/kg wet weight as a screening value for subsistence fishermen. No detectable amounts of endrin were measured in fish tissue samples (n = 13) collected from the Trinity River in Tarrant County upstream of the current project area by the USFWS/USACE in 2003 (Appendix E, Table E4).

Ten of the 12 whole body fish samples collected in 2004 contained detectable amounts of endrin (Table 14). These detected concentrations ranged from 0.00032 mg/kg wet weight in a channel catfish collected from the Elm Fork Reach to 0.0538 mg/kg wet weight in a smallmouth buffalo taken from the Trinity River upstream of Sylvan Avenue. Of these 10 fish, only the smallmouth buffalo collected from the Trinity River above Sylvan Avenue contained an endrin concentration that exceeded the cited New York predator protection level (RAIS, 2005).

Seven of the 13 fish tissue samples analyzed in 2004 contained endrin levels above the analytical detection limits (Table 15). These detected endrin concentrations ranged from 0.00032 mg/kg wet weight in a largemouth bass to 0.0012 mg/kg wet weight in a smallmouth buffalo, both collected from the Trinity River, upstream of Sylvan Avenue. All of the detectable tissue-endrin levels were over 100-times below the screening value reported by the USEPA (2000) for subsistence fishermen.

[Hexachlorobenzene (HCB)] First introduced in 1945, hexachlorobenzene (HCB) was widely used in the United States as a fungicide (ATSDR, 1997a; EMS 2002a). It was also used in the manufacturing of fireworks, ammunition, and synthetic rubber, and can be produced as a by-product in the waste streams of chloralkali and wood-preserving plants and the incineration of industrial and municipal solid wastes (ATSDR, 1997a). This compound is a suspected carcinogen and is toxic to fish and avian species, while chronic exposure in humans may lead to liver disease and cancer (ATSDR, 1997a; EMS, 2002a). Production of HCB as a fungicide ceased in 1965 and currently there are no commercial uses for this compound in the United States (ATSDR, 1997a). Hexachlorobenzene is highly persistent in the environment, with reported half lives in soils ranging from 2.7 to 22.9 years (ETN, 1996a; EMS, 2002a). In whole body fish, Newell *et al.* (1987) recommend a HCB concentration of 0.33 mg/kg to be protective of piscivorous wildlife. No detectable amounts of HCB were measured in whole body fish collected from the Trinity River off South Loop 12 downstream of the current project area by the USGS in 1992 (Appendix E, Table E3). In edible fish tissue, the USEPA (2000) recommends a HCB concentration of 0.0031 mg/kg wet weight as a screening value for subsistence fishermen, whereas the criterion recommended by the TCEQ (2003) is 0.609 mg/kg wet weight.

All of the fish collected in 2004 contained detectable amounts of HCB. In the whole body samples, HCB levels ranged from 0.00033 mg/kg wet weight in a largemouth bass taken from the Trinity

River upstream of Sylvan Avenue to 0.00327 mg/kg wet weight in a longnose gar collected from the Elm Fork Reach (Table 14). Measured HCB concentrations in fish tissues ranged from 0.00004 mg/kg wet weight in a largemouth bass also collected from the Trinity River upstream of Sylvan Avenue to 0.00108 mg/kg wet weight in a smallmouth buffalo also collected from the Elm Fork Reach (Table 15). All of the whole body samples contained HCB levels over 100-times less then the predator protection limit suggested by Newell *et al.* (1987), while HCB concentrations in all of the tissue samples were less then the value reported by the USEPA (2000) protective of subsistence fishermen and well below the cited TCEQ (2003) screening criterion.

[Mirex] First developed in 1946, the pesticide mirex is a highly stable chlorinated hydrocarbon compound that exhibits very low solubility in water and is highly resistant to chemical, thermal, and biochemical degradation (Eisler, 1985). From 1959 to 1972, mirex was used to control fire ants and as a flame retardant in plastics, rubber, paint, paper, and electrical goods (Eco-USA, 2002). It has not been produced for commercial use in the United States since 1978 (Eco-USA, 2002). Because of its resistance to degradation, mirex has a projected half-life of over 10 years in the environemnt (Eisler, 1985; EMS, 2002b). In lentic sediments, mirex can continue to remain bio-available from 200 to 600 years (Eisler, 1985). Listed by the USEPA as a PBT chemical, mirex is a known endocrine disruptor and suspected carcinogen (Eco-USA, 2002; EMS, 2002b). Chronic exposure has resulted in hepatic non-carcinogenic toxicological effects in mammals (USEPA, 2004). In fish, Newell *et al.* (1987) recommend a mirex concentration of 0.33 mg/kg to be protective of piscivorous wildlife. No detectable amounts of mirex were measured in a composite sample of whole body blue catfish collected in 1992 by the U.S. Geological Survey (USGS) from the Trinity River off South Loop 12 downstream of the current project area (Appendix E, Table E3). In edible fish tissues, the USEPA (2000) recommends a mirex concentration of 0.098 mg/kg wet weight as a screening value for subsistence fishermen, while the USFDA (2000) action level for mirex in fish tissues is 0.1 mg/kg wet weight.

All of the fish analyzed in 2004 contained detectable amounts of mirex. In the whole body samples, concentrations ranged from 0.00023 mg/kg wet weight in a smallmouth buffalo collected from the West Fork Reach to 0.01043 mg/kg wet weight in a longnose gar taken from the Elm Fork Reach (Table 14). Measured concentrations in the tissue samples ranged from 0.00007 mg/kg wet weight in a largemouth bass to 0.00426 mg/kg wet weight in a smallmouth buffalo, both collected from the Elm Fork Reach (Table 15). All of the whole body samples contained mirex concentrations less then the level recommended by Newell *et al.* (1987) to be protective of wildlife, while all of the tissue samples contained mirex concentrations below the cited USEPA (2000) screening value and the cited USFDA (2000) action level.

[Pentachloroanisole] A suspected carcinogen, pentachloroanisole is a chlorinated aromatic compound that is widely distributed in the environment (NTP, 2002). It is formed as a degradation product of pentachloronitrobenzene and pentachlorophenol (NTP, 2002). Currently, neither ecological or human health screening criteria are available for pentachloroanisole. However, a composite whole body blue catfish sample collected by the USGS from the Trinity River off Loop 12 downstream of the current project area in 1992 contained a pentachloroanisole concentration of

0.087 mg/kg wet weight (Appendix E, Table E3).

All of the whole body fish samples collected in 2004 contained pentachloroanisole concentrations greater then the analytical detection limits, except a smallmouth buffalo collected from the West Fork Reach. Detected concentrations ranged from 0.00069 mg/kg wet weight in a largemouth bass taken from the Trinity River upstream of Sylvan Avenue to 0.03231 mg/kg wet weight in a common carp collected from the Trinity River downstream of Sylvan Avenue (Table 14). All of the 2004 fish tissue samples contained detectable amounts of pentachloroanisole. These tissue concentrations ranged from 0.00005 mg/kg wet weight in a largemouth bass taken from the Elm Fork Reach to 0.00876 mg/kg wet weight in a common carp collected from the Trinity River downstream of Sylvan Avenue (Table 15). All of the 2004 samples contained pentachloroanisole levels below the value reported by the USGS for a whole body fish sample collected from the Trinity River downstream of the current project are in 1992 (Appendix E, Table E3).

[Chlorpyrifos] First registered in 1965, chlorpyrifos is a broad spectrum organophosphate insecticide that targets the central nervous system (Eisler, 1988; ETN, 1996b). It is a known cholinesterase inhibitor and a suspected endocrine disruptor (Eisler, 1988; ATSDR, 1997b). When released into a terrestrial environment, chlorpyrifos degrades in soil through a combination of chemical hydrolysis and microbial degradation (ATSDR, 1997b; Spectrum, 2005). Reported half-lives in soil rarely exceed one year (Spectrum, 2005). In aquatic systems, chlorpyrifos is highly toxic to fish and invertebrates and can accumulate in the tissues of aquatic organisms (ETN, 1996a). Currently, ecological screening criteria are not available for this compound, but Eisler (1988) reported lethal doses to 50% of the organisms tested (LD_{50}) ranging from 5 to 157 mg/kg body weight for birds and 151 to 1,000 mg/kg body weight for mammals. In edible fish tissues, the USEPA (2000) recommends a chlorpyrifos concentration of 0.147 mg/kg wet weight as a screening value for subsistence fishermen.

Seven of the 12 whole body fish samples and nine of the 13 fish tissue samples analyzed in 2004 contained detectable amounts of chlorpyrifos. The detected whole body concentrations ranged from 0.00122 mg/kg wet weight in a channel catfish collected from the Elm Fork Reach to 0.00286 mg/kg wet weight in a largemouth bass taken from the Trinity River downstream of Sylvan Avenue (Table 14). The detected tissue levels ranged from 0.00001 mg/kg wet weight in a largemouth bass also collected from the Elm Fork Reach to 0.002 mg/kg wet weight in a channel catfish taken from the West Fork Reach (Table 15). None of the detected whole body concentrations remotely approached the values cited from Eisler (1988), while the measured tissue concentrations were over 70-times lower then the cited USEPA (2000) human health screening value.

[Polychlorinated Biphenyls (PCBs)] First developed in 1929, polychlorinated biphenyls (PCBs) were used extensively in the United States in electrical transformers, capacitors, heat transfer fluids, and electrical utilities as lubricants, insulators, and coolants until production ceased in 1977 due to potential adverse environmental and human health affects (Moring, 1997; USEPA, 2000; ATSDR, 2000c). Total PCBs represent a quantification of approximately 209 individual congeners (Moring, 1997). These congeners are relatively stable compounds that exhibit low water solubility, high heat capacity, low flammability, low electric conductivity, and low vapor pressure (Moring, 1997; USEPA, 2000). Aroclors, in turn, are industrial mixtures of various PCB congeners. These aroclors are identified by the number of carbon atoms present plus the percentage by weight of chlorine (ATSDR, 2000c). For example, Aroclor 1254 contains 12 carbon atoms and approximately 54% chlorine, while Aroclor 1260 would contain 12 carbons and 60% chlorine (TDSHS, 2000). The more highly chlorinated aroclors have demonstrated the greater potential for adverse affects to human health and the environment (TDSHS, 2000).

Polychlorinated biphenyls are not naturally occurring and when released into the environment, degrade very slowly (ATSDR, 2000c). Reported half-lives for PCBs in lentic systems can range from 4 to 60 years (Spectrum, 2003). In wildlife, PCBs can be teratogenic and tumorigenic and demonstrate a trend to bio-accumulate and bio-concentrate. In fish, PCBs are stored in fat, liver, and brain tissue, but can be found in trace amounts in all tissues (Irwin, 1988). According to Eisler (1986), total PCB concentrations greater than 0.4 mg/kg wet weight in whole body fish and greater than 3 mg/kg in the diet of avian species would result in lethal and/or sublethal toxicological affects. Studies cited by Niimi (1996), suggest that PCB concentrations greater than 25 mg/kg wet weight in macroinvertebrates and greater than 50 mg/kg wet weight in fish tissues may adversely affect reproduction and growth. Irwin (1988) reports that the Great Lakes International Joint Commission recommends a total PCB concentration of 0.1 mg/kg wet weight in whole body fish as an interim piscivorous predator protection level. Swain and Holms (1985) recommend a total PCB concentration of 0.5 mg/kg in fish to be protective of piscivorous fish and aquatic wildlife. Total PCB levels in composite whole body sunfish samples collected by UNT from the West Fork and Elm Fork in 1987 equaled 0.1766 and 0.4894 mg/kg wet weight, respectively, while whole body sunfish collected from the same areas in 1988 contained 0.1075 and 0.1105 mg/kg wet weight (Appendix E, Table E1). Whole body blue catfish collected in 1992 by the USGS from the Trinity River off Loop 12 downstream of the current project area contained a total PCB concentration of 0.64 mg/kg wet weight (Appendix E, Table E3).

Humans can absorb PCBs through the skin, lungs or gastrointestinal tract, but exposure is primarily through the consumption of PCB contaminated food. The USFDA reports a tolerance level of 2 mg/kg wet weight for PCBs in edible fish tissues (ODHS, 2004), whereas the USEPA (2000) considers a PCB concentration of 0.0025 mg/kg wet weight in edible fish tissue as a screening level for subsistence fishermen. The TDSHS (2001) reports a non-cancer risk HAC value of 0.047 mg/kg wet weight and a cancer risk HAC concentration of 0.272 mg/kg wet weight. Smallmouth buffalo and gizzard shad tissue samples (n = 5) collected in 1987 by TPWD from the Trinity River within the proximity of the current project area contained total PCB concentrations ranging from 0.22 mg/kg wet weight to 0.84 mg/kg wet weight (Appendix E, Table E2). Smallmouth buffalo tissue samples collected by the TDSHS in 2000 from the West Fork in the vicinity of the current project area contained a mean PCB concentration of 0.061 mg/kg wet weight, while smallmouth buffalo, channel catfish, and flathead catfish tissue samples collected during the same time frame from the Trinity River downstream of the Elm Fork within the current project area contained no detectable amounts of PCBs (TDSHS, 2003b).

All of the fish analyzed in 2004 contained detectable amounts of total PCBs. Measured concentrations in the whole body samples ranged from 0.2878 mg/kg wet weight in a smallmouth buffalo collected from the West Fork Reach to 2.2664 mg/kg wet weight in a longnose gar taken from the Elm Fork Reach (Table 14). All 12 of the whole body samples contained total PCB levels that were greater then the concentrations reported by UNT for the West Fork from the 1987 data and for both forks from the 1988 data (Appendix E, Table E1). All 12 samples also contained total PCB concentrations that exceeded the interim predator protection limit reported by Irwin (1988). Seven of these samples (the smallmouth buffalo and largemouth bass collected from the Trinity River downstream of Sylvan Avenue, the smallmouth buffalo and largemouth bass from upstream of Sylvan Avenue, the smallmouth buffalo and longnose gar from the Elm Fork Reach, and the spotted gar taken from the West Fork Reach) contained total PCB levels that were greater then the concentration reported by UNT for fish collected from the Elm Fork in 1987 (Appendix E, Table E1). These same seven fish also contained PCB levels that exceeded the predator protection limit recommended by Swain and Holmes (1985). In addition, four of these seven fish (the smallmouth collected from the Trinity River upstream of Sylvan Avenue, the smallmouth buffalo and longnose gar from the Elm Fork Reach, and the spotted gar taken from the West Fork Reach) contained total PCB concentrations that were greater then the value reported by the USGS for fish collected from the Trinity River downstream of the current project area in 1992 (Appendix E, Table E3).

In fish tissues analyzed in 2004, total PCB levels ranged from 0.0193 mg/kg wet weight in a largemouth bass to 0.4876 mg/kg wet weight in a smallmouth buffalo, both collected from the Elm Fork Reach (Table 15). All 13 of these samples contained total PCB concentrations that exceeded the cited USEPA (2000) screening value. Eight of these samples (the smallmouth buffalo, largemouth bass, and common carp collected from the Trinity River downstream of Sylvan Avenue, the smallmouth buffalo and flathead catfish from upstream of Sylvan Avenue, the smallmouth buffalo from the Elm Fork Reach, and the smallmouth buffalo and channel catfish taken from the West Fork Reach) contained PCB levels greater then the mean concentration reported by TDSHS (2003b) for smallmouth buffalo collected from the West Fork in 2000. Ten of these samples (the smallmouth buffalo, largemouth bass, and common carp collected from the Trinity River downstream of Sylvan Avenue, the smallmouth buffalo and flathead catfish from upstream of Sylvan Avenue, the smallmouth buffalo from the Elm Fork Reach, and the smallmouth buffalo, largemouth bass, common carp, and channel catfish taken from the West Fork Reach) contained total PCB concentrations that exceeded the non-cancer HAC value reported by the TDSHS (2001), while only one of these fish (the smallmouth buffalo from the Elm Fork Reach) contained a level of PCBs that exceeded the TDSHS cancer risk HAC concentration. This smallmouth buffalo was also the only tissue sample collected in 2004 to contain a PCB level greater then the lowest detected concentration reported by TPWD for fish collected in 1987 from the Trinity River within the proximity of the current project area (Appendix E, Table E2). None of the 13 samples contained PCB concentrations that equaled or exceeded the cited USFDA tolerance level (ODHS, 2004),

Conclusions and Recommendations

Results of the baseline fisheries survey conducted on the Trinity River in August-September, 2004, characterized the fish assemblages within reaches of the proposed Dallas Flood Control Project area as intermediate to exceptional. Overall, community degradation was low and aquatic life use values were high to exceptional within the entire study area. In comparing the 2004 results with previous studies conducted in the area, fish community indices demonstrated a shift to higher aquatic life use values, while a greater number of total species, including more species considered intolerant to poor water quality conditions as well as a greater number of individual game fish were encountered during this assessment then had been observed in the past.

Even though the fish assemblages were characterized as high to exceptional and appear to be recovering in comparison to previous studies, all of the fish sampled for chemical analyses in 2004 contained detectable amounts of organochlorine contaminants. This is not surprising considering that three of the four sample reaches are located within a portion of the Trinity River currently under a fish consumption advisory due to elevated organochlorine levels. These are legacy contaminants that have not been commercially distributed in the United States for over 15 years. Most likely, the fish are obtaining these contaminants from the sediments or from the water column through stormwater run-off from the surrounding watershed. Some of the residual organochlorines detected in the fish, such as aldrin, BHC, endosulfan, HCB, and mirex were detected at levels below which adverse effects to ecological resources and human health would be expected to occur. Other contaminants, such as chlordane, DDT, and dieldrin were detected at higher levels in some of the samples, but still at concentrations that appear to be lower then the levels measured from past studies. Total PCBs were detected at elevated levels throughout the project area. The elevated PCB concentrations detected in some of the fish collected from the Elm Fork Reach are surprising considering that this fork is not included in the current fish consumption advisory. Although the sample size for the Elm Fork was limited, the resulting data from this study appear to warrant further investigation to ascertain the degree of PCB contamination of fish within this fork. In addition, it is recommended that sediment samples be collected from the reaches and analyzed for organochlorine levels to evaluate the degree and extent of in-channel contamination within the proposed project area prior to the initiation of any excavation activities.

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Appendix A
(Analytical Methods)

LABORATORY: Geochemical & Environmental Research Group, Texas A&M

Method Code: 001 Analytical method for analyses of organics [1,2,3,4-terachlorobenzene, 1,2,4,5-tetrachlorobenzene, aldrin, hexachlorobenzene (HCB), heptachlor, alpha-hexachlorocyclohexane (∀BHC), alpha (∀) chlordane, beta-hexachlorocyclohexane (∃BHC), *cis*-nonachlor, delta-hexachlorocyclohexane (∗BHC), dieldrin, endosulfan II, endrin, gamma-hexachlorocyclohexane ((BHC), gamma (() chlordane, heptachlor epoxide, mirex, 2,4'-dichloro-diphenyl-dichloroethane (2,4'-DDD), 2,4'-dichloro-diphenyl-dichloroethylene (2,4'-DDE), 2,4'-dichloro-diphenyl-trichloroethane (2,4'-DDT), *oxy*chlordane, 4,4'-dichloro-diphenyl-dichloroethane (4,4'-DDD), 4,4'-dichloro-diphenyl-dichloroethylene (4,4'-DDE), 4,4'-dichloro-diphenyl-trichloroethane (4,4'-DDT), pentachloro-anisole, toxaphene, and *trans*-nonachlor, chlorpyrifos, and PCBs] in tissue:

The tissue samples were extracted by the NOAA Status and Trends Method (MacLeod et al., 1985) with minor revisions (Brooks et al., 1989; Wade et al., 1988). Briefly, the tissue samples were homogenized with a Teckmar Tissumizer. A 1 to 10-gram sample (wet weight) was extracted with the Teckmar Tissumizer by adding surrogate standards, Na_2SO4, and methylene chloride in a centrifuge tube. The tissue extracts were purified by silica/alumina column chromatography to isolate the aliphatic and PAH/pesticide/PCB fractions. The PAH/pesticide/PCB fraction was further purified by HPLC in order to remove interfering lipids.

The quantitative analyses were performed by capillary gas chromatography (CGC) with a flame ionization detector for aliphatic hydrocarbons, CGC with electron capture detector for pesticides and PCB's, and a mass spectrometer detector in the SIM mode for aromatic hydrocarbons (Wade et al., 1988).

There are specific cases where analytes requested for the pesticide and PCB analyses and are known to co-elute with other analytes in the normal CGC with electron capture. These include the pesticide Endosulfan I and the PCB congeners 114 and 157. In these cases, the samples will be analyzed by CGC with a mass spectrometer detector in the SIM mode.

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Method Code: 003 Analytical method for % Dry Weight, % Moisture, and % Lipids:

Approximately 1 gram of wet sample is weighed into a clean, labeled, pre-weighed 10 ml beaker. The beaker is placed in a forced air oven at approximately 75 degrees Celsius for 24 hours. The beaker with the dry sample is then weighed and the % dry weight is calculated by the formula:

$$\frac{(\text{wt. dry sample and beaker}) - (\text{wt. beaker})\ (100)}{(\text{wt. wet sample and beaker}) - (\text{wt. beaker})}$$

Appendix B
(Fishery Survey Data Sheets)

Dallas Flood Control Project - Trinity River Fishery Survey Data Sheet

Sample Site: 1 (Trinity River downstream of Sylvan Avenue) **Sample Date:** August 30, 2003

Family	Species	Number of individuals by seine	Number of individuals by electroshock	Total
Atherinidae	*Menidia beryllina* – Inland Silverside	6	-	6
Catostomidae	*Carpiodes carpio* - River Carpsucker	-	2	2
	Ictiobus bubalus - Smallmouth Buffalo	-	38	38
Centrarchidae	*Lepomis cyanellus* - Green Sunfish	-	1	1
	Lepomis gulosus – Warmouth	2	-	2
	Lepomis humilis – Orangespotted Sunfish	20	-	20
	Lepomis macrochirus – Bluegill	19	2	21
	Lepomis megalotis - Longear Sunfish	2	-	2
	Lepomis microlophus - Redear Sunfish	1	-	1
	Micropterus salmoides - Largemouth Bass	-	7	7
	Pomoxis annularis - White Crappie	4	1	5
Clupeidae	*Dorosoma cepedianum* - Gizzard Shad	15	266	281
	Dorosoma petenense - Threadfin Shad	18	-	18
Cyprinidae	*Cyprinella lutrensis* - Red Shiner	25	1	26
	Cyprinella venusta - Blacktail Shiner	1	-	1
	Cyprinus carpio - Common Carp	-	2	2
	Pimephales vigilax - Bullhead Minnow	50	-	50
Ictaluridae	*Ictalurus furcatus* - Blue Catfish	2	-	2
	Ictalurus punctatus - Channel Catfish	10	-	10
	Pylodictis olivaris - Flathead Catfish	-	4	4
Lepisosteidae	*Lepisosteus oculatus* - Spotted Gar	-	2	2
	Lepisosteus osseus - Longnose Gar	-	6	6
Percichthyidae	*Morone chrysops* - White Bass	-	8	8
Percidae	*Percina macrolepida* – Bigscale Logperch	1	-	1
	Percina sciera - Dusky Darter	2	-	2
Poecilidae	*Gambusia affinis* - Western Mosquitofish	4	-	4
	Total	182	340	522

Observations: Seined 2 grass shrimp, 3 crayfish and 1 Red-eared Slider (*Trachemys scripta elegans*); 6 unidentifiable juvenile sunfish (*Lepomis* sp.) were also seined; 2 common carp, 2 largemouth bass, and 2 smallmouth buffalo were retained for chemical analysis.

Notes: 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, B. Forsythe, C. Giggleman, J. Lewis, G. Linam, M. Merida, and B. Mobley; averaged 22.8 fish per seine haul and 5.7 fish per minute of electroshocking. Stream habitat run; substrate silt with little gravel. **26 species from 10 families**

Dallas Flood Control Project - Trinity River Fishery Survey Data Sheet

Sample Site: 2 (Trinity River upstream of Sylvan Avenue) **Sample Date:** August 30 and September 1, 2003

Family	**Species**	**Number of individuals by seine**	**Number of individuals by electroshock**	**Total**
Atherinidae	*Labidesthes sicculus* – Brook Silverside	2	-	2
	Menidia beryllina – Inland Silverside	2	-	2
Catostomidae	*Ictiobus bubalus* - Smallmouth Buffalo	-	33	33
Centrarchidae	*Lepomis cyanellus* - Green Sunfish	1	1	2
	Lepomis gulosus – Warmouth	-	2	2
	Lepomis macrochirus – Bluegill	26	6	32
	Lepomis megalotis - Longear Sunfish	1	-	1
	Micropterus punctulatus - Spotted Bass	4	-	4
	Micropterus salmoides - Largemouth Bass	-	5	5
	Pomoxis annularis - White Crappie	-	3	3
Clupeidae	*Dorosoma cepedianum* - Gizzard Shad	7	90	97
	Dorosoma petenense - Threadfin Shad	2	-	2
Cyprinidae	*Cyprinella lutrensis* - Red Shiner	7	3	10
	Cyprinus carpio - Common Carp	-	1	1
	Notropis buchanani - Ghost Shiner	1	-	1
	Pimephales vigilax - Bullhead Minnow	229	-	229
Cyprinodontidae	*Fundulus notatus* - Blackstripe Topminnow	2	-	2
Ictaluridae	*Ictalurus punctatus* - Channel Catfish	-	4	4
	Pylodictis olivaris – Flathead Catfish	-	16	16
Lepisosteidae	*Lepisosteus oculatus* - Spotted Gar	-	2	2
	Lepisosteus osseus - Longnose Gar	-	4	4
Percichthyidae	*Morone chrysops* - White Bass	2	6	8
Percidae	*Percina macrolepida* - Bigscale Logperch	4	1	5
	Percina sciera - Dusky Darter	2	-	2
Poecilidae	*Gambusia affinis* - Western Mosquitofish	6	-	6
Sciaenidae	*Aplodinotus grunniens* - Freshwater Drum	-	1	1
	Total	298	178	476

Observations: Seined 1 damselfly larvae and 1 Mississippi Map Turtle (*Graptemys pseudogeographica kohni*); 1 common carp, 1 channel catfish, 1 flathead catfish, 2 largemouth bass, and 2 smallmouth buffalo were retained for chemical analysis.

Notes: 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, B. Forsythe, C. Giggleman, J. Lewis, G. Linam, and B. Mobley; averaged 37.3 fish per seine haul and 3 fish per minute of electroshocking.
Stream habitat run; substrate silt. **26 species from 12 families**

B2

Dallas Flood Control Project - Trinity River Fishery Survey Data Sheet

Sample Site: 3 (Elm Fork Trinity River) **Sample Date:** August 31, 2003

Family	**Species**	**Number of individuals by seine**	**Number of individuals by electroshock**	**Total**
Atherinidae	*Labidesthes sicculus* - Brook Silverside	12	-	12
	Menidia beryllina – Inland Silverside	58	-	58
Catostomidae	*Carpiodes carpio* - River Carpsucker	-	2	2
	Ictiobus bubalus - Smallmouth Buffalo	1	19	20
Centrarchidae	*Lepomis cyanellus* - Green Sunfish	1	-	1
	Lepomis humilis – Orangespotted Sunfish	3	-	3
	Lepomis macrochirus - Bluegill	12	6	18
	Lepomis megalotis - Longear Sunfish	7	1	8
	Micropterus punctulatus - Spotted Bass	10	3	13
	Micropterus salmoides - Largemouth Bass	4	4	8
	Pomoxis annularis - White Crappie	1	3	4
Clupeidae	*Dorosoma cepedianum* - Gizzard Shad	21	41	62
	Dorosoma petenense - Threadfin Shad	10	-	10
Cyprinidae	*Cyprinella lutrensis* - Red Shiner	59	7	66
	Notropis buchanani - Ghost Shiner	3	-	3
	Pimephales vigilax - Bullhead Minnow	219	-	219
Cyprinodontidae	*Fundulus notatus* - Blackstripe Topminnow	3	-	3
Ictaluridae	*Ameiurus natalis* – Yellow Bullhead	-	1	1
	Ictalurus punctatus - Channel Catfish	9	2	11
	Pylodictis olivaris - Flathead Catfish	-	8	8
Lepisosteidae	*Lepisosteus oculatus* - Spotted Gar	-	2	2
	Lepisosteus osseus - Longnose Gar	-	3	3
Percichthyidae	*Morone chrysops* - White Bass	1	8	9
Percidae	*Percina macrolepida* - Bigscale Logperch	5	-	5
	Percina sciera - Dusky Darter	2	-	2
Poecilidae	*Gambusia affinis* - Western Mosquitofish	5	-	5
Sciaenidae	*Aplodinotus grunniens* - Freshwater Drum	2	-	2
	Total	448	110	558

Observations: Seined 1 crayfish; 1 unidentifiable juvenile sunfish (*Lepomis* sp.) was also seined; numerous mussel shells were observed on the bank; 1 channel catfish, 1 largemouth bass, 1 longnose gar, and 2 smallmouth buffalo were retained for chemical analysis.

Notes: 11 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, B. Forsythe, C. Giggleman, J. Lewis, G. Linam, B. Mobley, and M. Votaw; averaged 40.7 fish per seine haul and 1.8 fish per minute of electroshocking.
1 smallmouth buffalo seined had eroded fins. Stream habitat run; substrate silt with gravel. **27 species from 12 families**

Dallas Flood Control Project - Trinity River Fishery Survey Data Sheet

<u>Sample Site</u>: 4 (West Fork Trinity River) **<u>Sample Date</u>:** August 31, 2003

Family	**Species**	**Number of individuals by seine**	**Number of individuals by electroshock**	**Total**
Atherinidae	*Menidia beryllina* – Inland Silverside	5	-	5
Catostomidae	*Ictiobus bubalus* - Smallmouth Buffalo	-	22	22
Centrarchidae	*Lepomis cyanellus* - Green Sunfish	2	2	4
	Lepomis macrochirus - Bluegill	-	4	4
	Lepomis megalotis - Longear Sunfish	-	1	1
	Micropterus punctulatus - Spotted Bass	-	5	5
	Micropterus salmoides - Largemouth Bass	-	1	1
	Pomoxis annularis - White Crappie	3	7	10
Clupeidae	*Dorosoma cepedianum* - Gizzard Shad	20	4	24
	Dorosoma petenense - Threadfin Shad	10	-	10
Cyprinidae	*Cyprinella lutrensis* - Red Shiner	54	3	57
	Cyprinella venusta - Blacktail Shiner	5	-	5
	Cyprinus carpio - Common Carp	-	1	1
	Pimephales promelas - Fathead Minnow	-	1	1
	Pimephales vigilax - Bullhead Minnow	93	-	93
Ictaluridae	*Ictalurus punctatus* - Channel Catfish	3	2	5
	Pylodictis olivaris - Flathead Catfish	-	5	5
Lepisosteidae	*Atractosteus spatula* - Alligator Gar	-	1	1
	Lepisosteus oculatus - Spotted Gar	-	1	1
	Lepisosteus osseus - Longnose Gar	-	6	6
Percichthyidae	*Morone chrysops* - White Bass	1	6	7
Poecilidae	*Gambusia affinis* - Western Mosquitofish	1	-	1
Sciaenidae	*Aplodinotus grunniens* - Freshwater Drum	-	1	1
	Total	197	73	270

<u>Observations</u>: Seined 1 grass shrimp; 1 common carp, 1 largemouth bass, 1 channel catfish, 1 flathead catfish, 1 spotted gar, and 2 smallmouth buffalo were retained for chemical analysis.

<u>Notes</u>: 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, B. Forsythe, C. Giggleman, J. Lewis, G. Linam, B. Mobley, and M. Votaw; averaged 24.6 fish per seine haul and 1.2 fish per minute of electroshocking.
3 white crappie collected seining exhibited cysts and/or eroded fins; largemouth bass collected electroshocking was covered with lesions.
Stream habitat wide shallow riffle; substrate flat shale with little refugia; silt to sand substrate on northern bank.
23 species from 10 families

Appendix C
(TPWD Data, 1987-1988)

Table C1. Texas Parks and Wildlife fisheries survey of Trinity River near Sylvan Avenue, Dallas County, August 1987 and 1988; Note – IBI is index of biotic integrity, FDI is fish-community degradation index, I is intermediate, H is high, and L is low (from Kleinsasser and Linam, 1989).

Species	Aug - 1987 seine	Aug – 1987 electroshock	1987 Total	Aug - 1988 seine	Aug - 1988 electroshock	1988 Total
Inland Silverside	17	1	**18**	1	5	**6**
Smallmouth Buffalo	-	7	**7**	-	2	**2**
Green Sunfish	1	-	**1**	-	6	**6**
Warmouth	-	1	**1**	-	-	**-**
Orangespotted Sunfish	-	-	**-**	2	-	**2**
Bluegill	-	-	**-**	-	2	**2**
Longear Sunfish	-	5	**5**	-	6	**6**
Largemouth Bass	-	-	**-**	-	1	**1**
White Crappie	-	-	**-**	-	3	**3**
Gizzard Shad	2	25	**27**	2	29	**31**
Threadfin Shad	-	1	**1**	1	-	**1**
Red Shiner	103	11	**114**	1339	41	**1380**
Blacktail Shiner	-	-	**-**	1	-	**1**
Common Carp	-	5	**5**	-	-	**-**
Ghost Shiner	-	-	**-**	1	-	**1**
Pugnose Minnow	-	-	**-**	-	1	**1**
Bullhead Minnow	223	10	**233**	102	15	**117**
Blackstripe Topminnow	3	-	**3**	-	2	**2**
Blue Catfish	-	-	**-**	-	3	**3**
Spotted Gar	-	1	**1**	-	3	**3**
Longnose Gar	-	7	**7**	-	-	**-**
Western Mosquitofish	753	-	**753**	157	1	**158**
Total	1102	74	**1176**	1606	120	**1726**
Original IBI Scores			**38(I)**			**48(H)**
Regional IBI Scores			**38(I)**			**43(H)**
FDI Scores			**8(L)**			**8(L)**

1987 Total 14 species from 8 families + 5 unidentified juvenile sunfish not included in total number; 1988 Total 19 species from 9 families.

C1

Table C2. State Regional IBI Metric Calculations (IBI Score) for 1987 Sylvan Avenue Reach.			
1. Total # of fish species:	14(5)	7. % of individuals as invertivores:	96(5)
2. # of native cyprinid species:	2(3)	8. % of individuals as piscivores:	0.9(1)
3. # of benthic invertivore species:	0(1)	9a. # of individuals/seine haul:	122(5)
4. # of sunfish species:	3(3)	9b. # of individuals/minute of electro-fishing:	4.9(3)
5. % of individuals as tolerant species:	37(3)	10. % of individuals as non-native species:	0.4(5)
6. % of individuals as omnivores:	3.4(5)	11. % of individuals with disease or other anomaly:	0.7(3)
IBI Total Score: 38 (Intermediate)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (5) and 9b (3) which equals 4.

Table C3. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1987 Sylvan Avenue Reach.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	-	-	77(5)
2. Percent omnivores at site:	3.4(1)	-	-
3. Percent non-native individuals at site:	0.4(1)	-	-
4. Percent anomalies of individuals at site:	0.7(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table C4. State Regional IBI Metric Calculations (IBI Score) for 1988 Sylvan Avenue Reach.			
1. Total # of fish species:	19(5)	7. % of individuals as invertivores:	97(5)
2. # of native cyprinid species:	5(5)	8. % of individuals as piscivores:	0.9(1)
3. # of benthic invertivore species:	0(1)	9a. # of individuals/seine haul:	178(5)
4. # of sunfish species:	5(5)	9b. # of individuals/minute of electro-fishing:	8(5)
5. % of individuals as tolerant species:	91(1)	10. % of individuals as non-native species:	0(5)
6. % of individuals as omnivores:	2(5)	11. % of individuals with disease or other anomaly:	0(5)
IBI Total Score: 43 (High)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (5) and 9b (5) which equals 5.

Table C5. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1988 Sylvan Avenue Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	92(5)
2. Percent omnivores at site:	2(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table C6. Texas Parks and Wildlife fisheries survey of West Fork Trinity River near Belt Line Road, Dallas County, August 1987 and 1988; Note – IBI is index of biotic integrity, FDI is fish-community degradation index, I is intermediate, H is high, Li is limited, L is low, and M is moderate (from Kleinsasser and Linam, 1989).

Species	**Aug - 1987 seine**	**Aug - 1987 electroshock**	**1987 Total**	**Aug - 1988 Seine**	**Aug - 1988 electroshock**	**1988 Total**
Inland Silverside	-	-	**-**	6	-	**6**
Smallmouth Buffalo	-	3	**3**	-	1	**1**
Green Sunfish	-	4	**4**	1	4	**5**
Bluegill	-	1	**1**	-	-	**-**
Longear Sunfish	-	7	**7**	1	10	**11**
Largemouth Bass	-	-	**-**	-	5	**5**
Gizzard Shad	-	3	**3**	-	16	**16**
Red Shiner	256	8	**264**	173	76	**249**
Common Carp	-	2	**2**	-	2	**2**
Golden Shiner	1	-	**1**	-	-	**-**
Bullhead Minnow	368	9	**377**	28	56	**84**
Flathead Catfish	-	1	**1**	-	1	**1**
Longnose Gar	-	-	**-**	-	1	**1**
Western Mosquitofish	454	-	**454**	16	-	**16**
Total	1079	38	**1117**	225	172	**397**
Original IBI Scores			**39(I)**			**40(I)**
Regional IBI Scores			**33(Li)**			**35(I)**
FDI Scores			**10(M)**			**8(L)**

1987 Total 11 species from 6 families + 1622 unidentified juvenile shiners not included in total number; 1988 Total 12 species from 8 families.

Table C7. State Regional IBI Metric Calculations (IBI Score) for 1987 West Fork Reach.			
1. Total # of fish species:	11(3)	**7. % of individuals as invertivores:**	99(5)
2. # of native cyprinid species:	3(3)	**8. % of individuals as piscivores:**	0.4(1)
3. # of benthic invertivore species:	0(1)	**9a. # of individuals/seine haul:**	120(5)
4. # of sunfish species:	3(3)	**9b. # of individuals/minute of electro-fishing:**	2.5(1)
5. % of individuals as tolerant species:	41(3)	**10. % of individuals as non-native species:**	0.2(5)
6. % of individuals as omnivores:	0.7(5)	**11. % of individuals with disease or other anomaly:**	2.6(1)
IBI Total Score: 33 (Limited)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (5) and 9b (1) which equals 3.

Table C8. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1987 West Fork Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	65(5)
2. Percent omnivores at site:	0.7(1)	-	-
3. Percent non-native individuals at site:	0.2(1)	-	-
4. Percent anomalies of individuals at site:	-	2.6(3)	-
FDI Total Score: 10 (Moderate Degradation)			

Table C9. State Regional IBI Metric Calculations (IBI Score) for 1988 West Fork Reach.			
1. Total # of fish species:	12(3)	**7. % of individuals as invertivores:**	92(5)
2. # of native cyprinid species:	2(3)	**8. % of individuals as piscivores:**	3(1)
3. # of benthic invertivore species:	0(1)	**9a. # of individuals/seine haul:**	25(1)
4. # of sunfish species:	2(3)	**9b. # of individuals/minute of electro-fishing:**	11.5(5)
5. % of individuals as tolerant species:	72(1)	**10. % of individuals as non-native species:**	0.5(5)
6. % of individuals as omnivores:	4.8(5)	**11. % of individuals with disease or other anomaly:**	0.4(5)
IBI Total Score: 35 (Intermediate)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (1) and 9b (5) which equals 3.

Table C10. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1988 West Fork Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	73(5)
2. Percent omnivores at site:	4.8(1)	-	-
3. Percent non-native individuals at site:	0.5(1)	-	-
4. Percent anomalies of individuals at site:	0.4(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table C11. Texas Parks and Wildlife fisheries survey of Elm Fork Trinity River, Dallas County, August 1987 and 1988; Note – IBI is index of biotic integrity, FDI is fish-community degradation index, I is intermediate, H is high, Li is limited, and L is low (from Kleinsasser and Linam, 1989).

Species	**Aug - 1987 seine**	**Aug - 1987 electroshock**	**1987 Total**	**Aug - 1988 seine**	**Aug - 1988 electroshock**	**1988 Total**
Inland Silverside	-	-	**-**	7	-	**7**
River Carpsucker	-	-	**-**	-	1	**1**
Green Sunfish	3	7	**10**	-	-	**-**
Bluegill	3	11	**14**	-	14	**14**
Longear Sunfish	12	21	**33**	3	16	**19**
Spotted Bass	-	-	**-**	3	1	**4**
Largemouth Bass	-	-	**-**	1	2	**3**
White Crappie	-	2	**2**	-	-	**-**
Gizzard Shad	-	6	**6**	-	38	**38**
Red Shiner	3	-	**3**	32	2	**34**
Pugnose Minnow	1	-	**1**	3	1	**4**
Redfin Shiner	3	-	**3**	49	1	**50**
Bullhead Minnow	38	-	**38**	18	5	**23**
Blackstripe Topminnow	5	-	**5**	-	-	**-**
Slough Darter	1	-	**1**	-	-	**-**
Western Mosquitofish	71	-	**71**	-	-	**-**
Freshwater Drum	-	1	**1**	-	-	**-**
Total	140	48	**188**	116	81	**197**
Original IBI Scores			**44(H)**			**43(H)**
Regional IBI Scores			**41(H)**			**34(Li)**
FDI Scores			**8(L)**			**6(L)**

1987 Total 13 species from 7 families + 3 unidentified juvenile sunfish and 1 unidentified juvenile shiner not included in total number; 1988 Total 11 species from 5 families. In 1987 TPWD collected 2 gizzard shad, 2 smallmouth buffalo, and 1 longear sunfish using gill nets which are also not included in the total number.

Table C12. State Regional IBI Metric Calculations (IBI Score) for 1987 Elm Fork Reach.			
1. Total # of fish species:	13(3)	**7. % of individuals as invertivores:**	90(5)
2. # of native cyprinid species:	4(5)	**8. % of individuals as piscivores:**	6.4(3)
3. # of benthic invertivore species:	1(3)	**9a. # of individuals/seine haul:**	16(1)
4. # of sunfish species:	4(5)	**9b. # of individuals/minute of electro-fishing:**	3.2(1)
5. % of individuals as tolerant species:	29(3)	**10. % of individuals as non-native species:**	0.5(5)
6. % of individuals as omnivores:	3(5)	**11. % of individuals with disease or other anomaly:**	0.8(3)
IBI Total Score: 41 (High)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (1) and 9b (1) which equals 1.

Table C13. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1987 Elm Fork Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	56(5)
2. Percent omnivores at site:	3(1)	-	-
3. Percent non-native individuals at site:	0.5(1)	-	-
4. Percent anomalies of individuals at site:	0.8(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table C14. State Regional IBI Metric Calculations (IBI Score) for 1988 Elm Fork Reach.			
1. Total # of fish species:	11(3)	**7. % of individuals as invertivores:**	77(5)
2. # of native cyprinid species:	4(5)	**8. % of individuals as piscivores:**	3.5(1)
3. # of benthic invertivore species:	0(1)	**9a. # of individuals/seine haul:**	13(1)
4. # of sunfish species:	2(3)	**9b. # of individuals/minute of electro-fishing:**	5.4(3)
5. % of individuals as tolerant species:	44(3)	**10. % of individuals as non-native species:**	0(5)
6. % of individuals as omnivores:	19.8(1)	**11. % of individuals with disease or other anomaly:**	0(5)
IBI Total Score: 34 (Limited)			

Note – assume 9 seine hauls and 15 minutes shocking; overall score for Metric No. 9 is average between 9a (1) and 9b (3) which equals 2.

Table C15. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1988 Elm Fork Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	44(3)	-
2. Percent omnivores at site:	19.8(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 6 (Low Degradation)			

Table C16. Combined results of Texas Parks and Wildlife Department fisheries survey of three reaches of the Trinity River, Dallas County, 1987-1988; Note – SA is Sylvan Avenue, BL is West Fork near Belt Line Road, EF is Elm Fork, sp is species, IBI is index of biotic integrity, FDI is fish-community degradation index, H is high, I is intermediate, and L is low (from Kleinsasser and Linam, 1989).

Species	August, 1987				August, 1988			
	SA 14 sp	BL 11 sp	EF 13 sp	Total	SA 19 sp	BL 12 sp	EF 11 sp	Total
Inland Silverside	18	0	0	**18**	6	6	7	**19**
River Carpsucker	0	0	0	**0**	0	0	1	**1**
Smallmouth Buffalo	7	3	0	**10**	2	1	0	**3**
Green Sunfish	1	4	10	**15**	6	5	0	**11**
Warmouth	1	0	0	**1**	0	0	0	**0**
Orangespotted Sunfish	0	0	0	**0**	2	0	0	**2**
Bluegill	0	1	14	**15**	2	0	14	**16**
Longear Sunfish	5	7	33	**45**	6	11	19	**36**
Spotted Bass	0	0	0	**0**	0	0	4	**4**
Largemouth Bass	0	0	0	**0**	1	5	3	**9**
White Crappie	0	0	2	**2**	3	0	0	**3**
Gizzard Shad	27	3	6	**36**	31	16	38	**85**
Threadfin Shad	1	0	0	**1**	1	0	0	**1**
Red Shiner	114	264	3	**381**	1380	249	34	**1663**
Blacktail Shiner	0	0	0	**0**	1	0	0	**1**
Common Carp[1]	5	2	0	**7**	0	2	0	**2**
Golden Shiner[2]	0	1	0	**1**	0	0	0	**0**
Ghost Shiner	0	0	0	**0**	1	0	0	**1**
Pugnose Minnow[2]	0	0	1	**1**	1	0	4	**5**
Redfin Shiner[2]	0	0	3	**3**	0	0	50	**50**
Bullhead Minnow	233	377	38	**648**	117	84	23	**224**
Blackstripe Topminnow	3	0	5	**8**	2	0	0	**2**
Blue Catfish	0	0	0	**0**	3	0	0	**3**
Flathead Catfish	0	1	0	**1**	0	1	0	**1**
Spotted Gar	1	0	0	**1**	3	0	0	**3**
Longnose Gar	7	0	0	**7**	0	1	0	**1**
Slough Darter[2]	0	0	1	**1**	0	0	0	**0**
Western Mosquitofish	753	454	71	**1278**	158	16	0	**174**
Freshwater Drum	0	0	1	**1**	0	0	0	**0**
Total	1176	1117	188	**2481**	1726	397	197	**2320**
Regional IBI Scores				**42(H)**				**42(H)**
Basin Specific IBI Scores				**44(I)**				**50(H)**
FDI Scores				**8(L)**				**8(L)**

1987 Total 22 species from 11 families; 1988 Total 25 species from 9 families.
[1]Non-native species.
[2]Species not collected in 2004.

C 8

Table C17. State Regional IBI Metric Calculations (IBI Score) for 1987 Overall Study Area.			
1. Total # of fish species:	22(5)	**7. % of individuals as invertivores:**	97(5)
2. # of native cyprinid species:	5(5)	**8. % of individuals as piscivores:**	1.1(1)
3. # of benthic invertivore species:	1(3)	**9a. # of individuals/seine haul:**	96.7(5)
4. # of sunfish species:	5(5)	**9b. # of individuals/minute of electro-fishing:**	3.5(3)
5. % of individuals as tolerant species:	39(3)	**10. % of individuals as non-native species:**	0.28(5)
6. % of individuals as omnivores:	2(5)	**11. % of individuals with disease or other anomaly:**	1.3(1)
IBI Total Score: 42 (High)			

Note - assume 27 seine hauls and 45 minutes shocking; overall score for Metric No. 9 is average between 9a (5) and 9b (3) which equals 4.

Table C18. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for 1987 Overall Study Area.			
1. Total # of species:	22(5)	**8. % of individuals as invertivores:**	97(5)
2. Total # of cyprinid species:	5(5)	**9. % of individuals as piscivores:**	1.1(3)
3. Total # of catfish species:	1(3)	**10a. # of individuals collected electro-fishing:**	160(5)
4. Total # of sunfish species:	5(5)	**10b. # of individuals collected seining:**	2321(5)
5. Total # of intolerant species:	0(1)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	70(1)	**12. % of individuals with disease or other anomaly:**	1.3(1)
7. % of individuals as omnivores:	2(5)	**IBI Total Score: 44 (Intermediate)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (5) which equals 5.

Table C19. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1987 Overall Study Area.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	70(5)
2. Percent omnivores at site:	2(1)	-	-
3. Percent non-native individuals at site:	0.28(1)	-	-
4. Percent anomalies of individuals at site:	1.3(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table C20. State Regional IBI Metric Calculations (IBI Score) for 1988 Overall Study Area.			
1. Total # of fish species:	25(5)	**7. % of individuals as invertivores:**	95(5)
2. # of native cyprinid species:	6(5)	**8. % of individuals as piscivores:**	1.5(1)
3. # of benthic invertivore species:	0(1)	**9a. # of individuals/seine haul:**	81.1(3)
4. # of sunfish species:	5(5)	**9b. # of individuals/minute of electro-fishing:**	8.2(5)
5. % of individuals as tolerant species:	83(1)	**10. % of individuals as non-native species:**	0.09(5)
6. % of individuals as omnivores:	4(5)	**11. % of individuals with disease or other anomaly:**	0.07(5)
IBI Total Score: 42 (High)			

Note - assume 27 seine hauls and 45 minutes shocking; overall score for Metric No. 9 is average between 9a (3) and 9b (5) which equals 4.

Table C21. Trinity River Basin Specific IBI Metric Calculations (IBI Score) for 1988 Overall Study Area.			
1. Total # of species:	25(5)	**8. % of individuals as invertivores:**	95(5)
2. Total # of cyprinid species:	6(5)	**9. % of individuals as piscivores:**	1.5(3)
3. Total # of catfish species:	2(5)	**10a. # of individuals collected electro-fishing:**	373(5)
4. Total # of sunfish species:	5(5)	**10b. # of individuals collected seining:**	1947(5)
5. Total # of intolerant species:	0(1)	**11. % of individuals as hybrids:**	0(5)
6. % of individuals as tolerants:	84(1)	**12. % of individuals with disease or other anomaly:**	0.07(5)
7. % of individuals as omnivores:	4(5)	**IBI Total Score: 50 (High)**	

Note - overall score for Metric No. 10 is average between 10a (5) and 10b (5) which equals 5.

Table C22. Fish-Community Degradation Index Metric Calculations (FDI Score) for 1988 Overall Study Area.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	84(5)
2. Percent omnivores at site:	4(1)	-	-
3. Percent non-native individuals at site:	0.09(1)	-	-
4. Percent anomalies of individuals at site:	0.07(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Appendix D
(UNT Data, 1987-1988)

Table D1. Results of University of North Texas fisheries survey of two reaches of the Trinity River, Dallas County, 1987-1988; Note –WF is West Fork near Loop12, EF is Elm Fork upstream of SH 183, sp is species, IBI is index of biotic integrity, FDI is fish-community degradation index, H is high, E is exceptional, nc is not calculated, and L is low (from Dickson *et al.*, 1989).						
Species	**August, 1987**			**September, 1988**		
	WF (9 sp)	**EF (13 sp)**	**Total (14 sp)**	**WF (5 sp)**	**EF (20 sp)**	**Total (20 sp)**
Inland Silverside	2	9	**11**	0	1	**1**
River Carpsucker	1	0	**1**	0	0	**0**
Smallmouth Buffalo	0	0	**0**	0	1	**1**
Green Sunfish	18	0	**18**	22	6	**28**
Orangespotted Sunfish	0	15	**15**	0	30	**30**
Bluegill	5	8	**13**	0	15	**15**
Longear Sunfish	12	29	**41**	5	26	**31**
Spotted Bass	0	0	**0**	0	5	**5**
Largemouth Bass	0	1	**1**	0	1	**1**
White Crappie	0	1	**1**	0	0	**0**
Gizzard Shad	2	2	**4**	0	4	**4**
Threadfin Shad	0	0	**0**	0	6	**6**
Red Shiner	89	1	**90**	384	196	**580**
Blacktail Shiner	0	0	**0**	0	4	**4**
Redfin Shiner*	0	5	**5**	0	4	**4**
Bullhead Minnow	28	22	**50**	8	14	**26**
Blackstripe Topminnow	0	25	**25**	0	2	**2**
Channel Catfish	0	0	**0**	0	2	**2**
Spotted Gar	0	0	**0**	0	1	**1**
Bluntnose Darter*	0	5	**5**	0	0	**0**
Dusky Darter	0	0	**0**	0	2	**2**
Western Mosquitofish	1	13	**14**	5	15	**20**
Freshwater Drum	0	0	**0**	0	1	**1**
Total	158	136	**294**	424	336	**760**
Original IBI Scores	44 (H)	44 (H)	**nc**	44 (H)	52 (E)	**nc**
FDI Scores	8(L)	4(L)	**6(L)**	8(L)	8(L)	**8(L)**

*Species not collected in 2004.

Note - Fish assemblages from the 1987-1988 UNT combined study area were not assessed using the Regionalized IBI developed by Linam *et al.* (2002) nor the Trinity River basin specific IBI developed by Kleinsasser and Linam (1989) because the number of fish collected per sampling method (seining and electro-shocking) were not reported by Dixon *et al.* (1989) for either site during either time period.

Table D2. Fish-Community Degradation Index Metric Calculations for 1987 West Fork Reach.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	-	-	73(5)
2. Percent omnivores at site:	1.9(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table D3. Fish-Community Degradation Index Metric Calculations for 1987 Elm Fork Reach.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	18(1)	-	-
2. Percent omnivores at site:	1.5(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 4 (Low Degradation)			

Table D4. Fish-Community Degradation Index Metric Calculations for 1987 Combined Study Area.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	-	48(3)	-
2. Percent omnivores at site:	1.7 (1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 6 (Low Degradation)			

Table D5. Fish-Community Degradation Index Metric Calculations for 1988 West Fork Reach.			
Metric	Scoring Criteria		
	Low	Moderate	High
1. Percent tolerant individuals at site:	-	-	97(5)
2. Percent omnivores at site:	0(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table D6. Fish-Community Degradation Index Metric Calculations for 1988 Elm Fork Reach.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	71(5)
2. Percent omnivores at site:	3.9(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Table D7. Fish-Community Degradation Index Metric Calculations for 1988 Combined Study Area.			
Metric	**Scoring Criteria**		
	Low	**Moderate**	**High**
1. Percent tolerant individuals at site:	-	-	86(5)
2. Percent omnivores at site:	1.4(1)	-	-
3. Percent non-native individuals at site:	0(1)	-	-
4. Percent anomalies of individuals at site:	0(1)	-	-
FDI Total Score: 8 (Low Degradation)			

Appendix E
(Analytical Data from Other Studies)

Table E1. Organochlorine contaminants detected in mg/kg in whole body fish samples collected by University of North Texas from two reaches of the Trinity River, Dallas County, 1987-1988; Note – WF is West Fork near Loop12, EF is Elm Fork upstream of SH 183, bmdl is below minimum detection limit, and nr is not reported (from Dixon *et al.*, 1989).					
Analyte	**Minimum Detection Limit (mg/kg)**	**August, 1987**		**September, 1988**	
		WF Composite sample 3 Green Sunfish 1 Bluegill	**EF** Composite sample 2 Longear Sunfish	**WF** Composite sample 14 Green Sunfish	**EF** Composite sample 3 Longear Sunfish
Aldrin	0.00002	0.0032	bmdl	bmdl	bmdl
αBHC	0.00010	bmdl	bmdl	bmdl	0.0244
βBHC	0.00022	bmdl	bmdl	bmdl	bmdl
δBHC	0.00006	bmdl	bmdl	bmdl	bmdl
(BHC	0.00006	bmdl	bmdl	bmdl	bmdl
Chlordane	nr	0.3164	bmdl	bmdl	bmdl
DDD	0.00048	bmdl	bmdl	0.0040*	bmdl
DDE	0.00002	bmdl	bmdl	0.0003	bmdl
DDT	0.00020	bmdl	bmdl	bmdl	bmdl
Dieldrin	0.00020	bmdl	bmdl	0.0003	bmdl
Endosulfan	0.00003	0.0089	bmdl	0.0072	bmdl
Endrin	0.00007	bmdl	bmdl	bmdl	bmdl
Heptachlor	0.00002	bmdl	bmdl	bmdl	bmdl
Heptachlor epoxide	0.00002	bmdl	bmdl	bmdl	bmdl
Total PCBs	nr	0.1766	0.4894*	0.1075*	0.1105*

*Average of multiple composite samples.

Table E2. Analytical results in mg/kg wet weight of fillets from smallmouth buffalo (SMB), gizzard shad (GS), white crappie (WC), and longear sunfish (LES) collected from the Trinity River at Belt Line Road (BL), Commerce Street (CS), and Elm Fork (EF) by Texas Parks and Wildlife Department, Dallas County, 1987-1988; Note bdl is below analytical detection limit (from Kleinsasser and Linam, 1989).									
Analyte	**Detection Limit**	**SMB1 (BL)**	**SMB2 (BL)**	**SMB3 (CS)**	**SMB4 (CS)**	**GS1 (CS)**	**GS2 (CS)**	**WC (EF)**	**LES (EF)**
Chlordane	0.010	0.032	0.340	0.700	0.500	0.840	0.800	bdl	bdl
DDE	0.005	bdl	0.030	0.170	0.100	0.060	0.090	bdl	0.006
DDT	0.005	bdl	0.120	0.080	0.050	0.050	0.100	bdl	bdl
Dieldrin	0.006	bdl	0.032	0.035	0.020	0.100	0.070	bdl	bdl
PCB1260	0.040	bdl	0.390	0.270	0.220	0.660	0.840	bdl	bdl

Table E3. Analytical results of composite sample of five whole body blue catfish collected from the Main-stem of the Trinity River off South Loop 12 in Dallas County, Texas, by the U.S. Geological Survey in 1992-1993 (from Moring, 1997).		
Analyte	**Minimum Reporting Level**	**Measured Concentration**
Aldrin	0.005 mg/kg wet weight	bmrl
∀BHC	0.005 mg/kg wet weight	bmrl
∃BHC	0.005 mg/kg wet weight	bmrl
∗BHC	0.005 mg/kg wet weight	bmrl
(BHC	0.005 mg/kg wet weight	0.010 mg/kg wet weight
∀ Chlordane	0.005 mg/kg wet weight	0.084 mg/kg wet weight
(Chlordane	0.005 mg/kg wet weight	0.056 mg/kg wet weight
cis-Nonachlor	0.005 mg/kg wet weight	0.053 mg/kg wet weight
trans-Nonachlor	0.005 mg/kg wet weight	0.088 mg/kg wet weight
Oxychlordane	0.005 mg/kg wet weight	bmrl
Heptachlor	0.005 mg/kg wet weight	bmrl
Heptachlor epoxide	0.005 mg/kg wet weight	0.022 mg/kg wet weight
o,p'-DDD	0.005 mg/kg wet weight	bmrl
o,p'-DDE	0.005 mg/kg wet weight	bmrl
o,p'-DDT	0.005 mg/kg wet weight	bmrl
p,p'-DDD	0.005 mg/kg wet weight	0.015 mg/kg wet weight
p,p'-DDE	0.005 mg/kg wet weight	0.140 mg/kg wet weight
p,p'-DDT	0.005 mg/kg wet weight	0.006 mg/kg wet weight
Dieldrin	0.005 mg/kg wet weight	0.066 mg/kg wet weight
Endrin	0.005 mg/kg wet weight	bmrl
HCB	0.005 mg/kg wet weight	bmrl
Mirex	0.005 mg/kg wet weight	bmrl
Pentachloroanisole	0.005 mg/kg wet weight	0.087 mg/kg wet weight
Toxaphene	0.2 mg/kg wet weight	bmrl
Total PCBs	0.05 mg/kg wet weight	0.640 mg/kg wet weight

Note – bmrl is below minimum reporting level.

Table E4. Results of organochlorine pesticide analyses in mg/kg wet weight for skinless muscle tissue (fillet) samples collected from fish from five sites on the Trinity River, Tarrant County, Texas, July, 2003 (Note - mdl is the method detection limit; and bdl is below the method detection limit) (from Hale and Giggleman, 2003).								
Analyte	**Largemouth Bass Site 1**	**Channel Catfish Site 1**	**Common Carp Site 1**	**Spotted Bass Site 2**	**Channel Catfish Site 2**	**River Carpsucker Site 2**	**Largemouth Bass Site 3**	**Common Carp Site 3**
Aldrin	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
αBHC	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
βBHC	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
δBHC	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
γBHC	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chlordane	bdl	0.12	0.61	bdl	0.084	0.31	bdl	0.25
mdl	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
DDD	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
DDE	bdl	0.035	0.14	bdl	0.028	0.11	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
DDT	bdl	bdl	bdl	bdl	bdl	0.022	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dieldrin	bdl	bdl	0.026	bdl	bdl	0.017	bdl	0.016
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Endosulfan I	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Endosulfan II	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Endrin	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heptachlor	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heptachlor epoxide	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Toxaphene	0.14	bdl	bdl	0.15	bdl	2.2	0.16	bdl
mdl	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Note:
Site 1 – West Fork Trinity River adjacent to Riverside Park at Oakhurst Scenic Drive and Belknap Street, Ft. Worth (Tarrant County), Texas.
Site 2 – West Fork Trinity River at Samuel Avenue and confluence with Marine Creek, Ft. Worth (Tarrant County), Texas.
Site 3 – West Fork Trinity River after confluence with West and Clear Forks, below North Main Street, Ft. Worth (Tarrant County), Texas.

Table E4 (continued). Results of organochlorine pesticide analyses in mg/kg wet weight for skinless muscle tissue (fillet) samples collected from fish from five sites on the Trinity River, Tarrant County, Texas, July, 2003 (Note - mdl is the method detection limit; and bdl is below the method detection limit) (from Hale and Giggleman, 2003).

Analyte	**Largemouth Bass Site 4**	**Channel Catfish Site 4**	**Common Carp Site 4**	**Largemouth Bass Site 5**	**Common Carp Site 5**
Aldrin	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
αBHC	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
βBHC	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
δBHC	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
γBHC	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Chlordane	bdl	bdl	0.37	bdl	bdl
mdl	0.05	0.05	0.05	0.05	0.05
DDD	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
DDE	bdl	bdl	0.082	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
DDT	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Dieldrin	bdl	bdl	0.014	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Endosulfan I	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Endosulfan II	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Endrin	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Heptachlor	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Heptachlor epoxide	bdl	bdl	bdl	bdl	bdl
mdl	0.01	0.01	0.01	0.01	0.01
Toxaphene	0.25	0.23	2.90	0.13	0.22
mdl	0.05	0.05	0.05	0.05	0.05

Note:
Site 4 - Clear Fork Trinity River between confluence with West Fork Trinity River and 7th Street, Ft. Worth (Tarrant County), Texas.
Site 5 - West Fork Trinity River between confluence with Clear Fork Trinity River and Henderson Street, Ft. Worth (Tarrant County), Texas.

United States Department of the Interior

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Acting Commander, Fort Worth District, US Army Corps of Engineers Fort Worth, TX
U.S. Army Corps of Engineers
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Dear Lieutenant Colonel Craig:

This letter constitutes the Secretary of the Interior's Fish and Wildlife Coordination Act report on the Dallas Floodway Project. It is submitted by the U.S. Fish and Wildlife Service (Service) to the U.S. Army Corps of Engineers (Corps) under the authority, and in accordance with, Section 2(b) of the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) to accompany the Corps' final Detailed Project Report. The study was initiated by the Corps under authority of Section 205 of the 1948 Flood Control Act, as amended, to identify potential alternatives to reduce flood damage within the Trinity River watershed within the City of Dallas, Dallas County, Texas. Our report has been coordinated with the Texas Parks and Wildlife Department (TPWD).

The purpose of this report is to identify and evaluate anticipated impacts of implementing the proposed project on fish and wildlife resources in the project area within the Trinity River watershed and to recommend conservation measures for resource protection. This report is based on data collected during field investigations conducted by the Service, TPWD, and Corps on August 30 – September 1, 2004; October 12 – 14, 2005; April 25, 2006; coordination with environmental consultants representing Cardno TEC, Inc.; information received from the Corps and the project sponsor, the City of Dallas; and review comments from TPWD. A planning aid report has previously been submitted to the Corps regarding the existing environmental conditions within the project area in November 2010 (USFWS 2010), a supplement to the PAR was prepared and provided to the Corps in May 2013 and in January 2014, a final PAR was prepared which compiled all the changes over the study's planning horizon into a final document.

1. STUDY AREA

An environmental study area was delineated cooperatively by the Corps and the Service. Spatial data provided by the Corps indicate that the study area encompasses approximately 17,141.97 acres located within the City of Dallas, Dallas County, Texas within the Trinity River Basin. The term "Region of Influence," coined by the Corps, is synonymous with the term "study area." For consistency, "study area" will be used throughout this report.

The existing Dallas Floodway Levee System, authorized in 1945, extends along the Trinity River upstream from the Atchison, Topeka and Santa Fe (AT&SF) Railroad Bridge at Trinity River Mile (RM) 497.37, to the confluence of the West and Elm Forks at RM 505.50, thence upstream along the West Fork for approximately 2.2 miles and upstream along the Elm Fork approximately 4 miles. Of the 22.6 miles of levees within this reach, the East Levee is 11.7 miles in length and the West Levee is 10.9 miles in length. In addition to the levees, the floodway includes a modified river channel, and structures including seven pumping plants, five pressure conduits, and seven drainage structures. Construction of the existing Dallas Floodway Levee System was completed in 1959. The Dallas Floodway Project study area assessed within this document lies within the existing project boundaries and generally follows the Federal Emergency Management Agency 500-year flood extent.

2. PLAN OF DEVELOPMENT

Since the early 1900s, the City of Dallas has been periodically flooded and incurred damages. These flood events present the potential for significant and repetitive economic losses in the study area. A variety of previous studies, reports, and water projects have been conducted regarding flooding and various water resources related to the Dallas Floodway System. A selection of these activities led by the Corps and non-Federal entities including the City of Dallas is described below.

2.1 Historic Dallas Floodway Development

A catastrophic flood in 1908 led the City of Dallas to seek protection from Trinity River flooding. Between 1928 and 1932, the Dallas County Levee Improvement District (DCLID) constructed earthen levees to protect the City of Dallas from riverine flooding. The DCLID relocated the confluence of the West and Elm Forks, rerouted the Trinity River by constructing a channel within the leveed floodway, and filled or set aside the original channel for sump storage.

These original levees had a total length of 22.6 miles, an average crest width of 6 feet, an average height of 26 feet, and a maximum height of 37 feet (USACE 1955).

2.2 U. S. Army Corps of Engineers

To reduce the riverine flood risk within the City of Dallas, Congress authorized the flood control project (commonly referred to as the Dallas Floodway, or the Dallas Floodway Levee System) in 1945, and again in 1950. From August 1952 to June 1955, the Corps produced six reports for design of the Dallas Floodway improvements to the original (DCLID) levees and interior drainage facilities.

In May 1960, the non-Federal sponsor for the Dallas Floodway Levee System, the Dallas County Flood Control District (DCFCD) formally accepted the Corps Operation and Maintenance (O&M) Manual for the Dallas Floodway Levee System (USACE 1960). The purpose of the O&M Manual was to furnish detailed information regarding the Dallas Floodway Levee System and its essential features, and to aid local interests in carrying out their obligation under the regulations governing acceptance of a completed project constructed by the Corps. The DCFCD formally transferred O&M responsibilities to the City of Dallas in 1968.

In compliance with the National Environmental Policy Act (NEPA), the Trinity River and Tributaries Regional Environmental Impact Statement (TREIS) was prepared by the Corps Fort Worth District to address the proposed increases in floodplain development occurring in the upper Trinity River basin during the Dallas-Fort Worth Metroplex development boom in the mid-1980s (USACE 1988a). Individually or cumulatively, future projects are expected to have the potential to increase flood risk to existing floodplain developments.

The Record of Decision (ROD) prepared for the TREIS specified criteria that the Corps would use to evaluate future Section 404 permit applications in the Trinity River Basin; specifically, projects located within the Standard Project Flood (SPF) floodplain of the Elm Fork Trinity River, the West Fork Trinity River, and the main stem of the Trinity River. The TREIS ROD established criteria for actions that require a USACE permit to address hydrologic and hydraulic impacts and mitigation of habitat losses (USACE 1988a). The findings in the TREIS provided the impetus for follow-on studies under the 1988 Upper Trinity River Study Authority (USACE 1988b).

In response to the TREIS and ROD, cities and counties in the Trinity River watershed formed the Trinity River Steering Committee (Steering Committee), facilitated by the North Central Texas Council of Governments (NCTCOG). The Steering Committee adopted a Draft Statement of Principles for Common Permit Criteria (in January 1988), a Resolution for a Joint Trinity River Corridor Development Certificate (CDC) Process (in December 1988), and a Regional Policy Position on the Trinity River Corridor (in January 1989).

The CDC and the 1988 ROD hydrologic and hydraulic criteria are used to ensure that projects are designed in such a way that there are no flood rises in the water surface profile and that there are no valley storage losses for the 100-year flood and less than 5% valley storage loss for the SPF event. The process requires that a permit applicant prepare a Hydraulic Engineering Center River Analysis System (HEC-RAS) hydraulic model for the proposed project using the current CDC HEC-RAS model as a base condition. The CDC HEC-RAS model was developed to model the hydraulics of water flow through rivers and other channels. It is maintained and usually distributed by the Corps to be used for evaluation of any and all projects that require a Section 404 Permit or a CDC Permit.

The Corps initiated the Upper Trinity River Feasibility Study (UTRFS) in response to the authority contained in the U.S. Committee on Environment and Public Works Resolution dated April 22, 1988 and the findings of the 1990 Upper Trinity River Basin Reconnaissance Report. The UTRFS identified approximately 90 potential projects addressing flood risk management, ecosystem restoration, and recreation within the Upper Trinity River Basin (USACE 1988b). Of these 90 projects, three Corps projects were identified that had local sponsorship and were viewed as reasonably foreseeable, including modifications to the Dallas Floodway Project.

Initiated in 1996, the Upper Trinity River Basin Programmatic EIS (UTRB PEIS) focused on various potential Corps projects that were identified and investigated as part of the UTRFS. The Corps initiated the study under the 1988 authority.

The Dallas Floodway Extension (DFE) Project, authorized by the Flood Control Act of 1965, was initiated in December 2001 to construct the Chain of Wetlands, the Cadillac Heights and Lamar Levees, and recreation features immediately downstream of the existing Dallas Floodway Levee System (USACE 2003).

The Corps performed Period Inspection (PI) No. 9 (PI No. 9) using a new inspection template on December 3-5, 2007 (USACE 2009). This inspection was the 9th PI for the East Levee and West Levee, and the first PI for both the Rochester Park Levee and the Central Wastewater Treatment Plant (CWWTP) Levee systems which are components of the DFE Project. All eight prior PIs resulted in an acceptable rating for the Dallas Floodway Levee System. Very specific language and rating criteria described in the new inspection template resulted in an “unacceptable rating” for the Dallas Floodway Levee System meaning that it would not contain a Standard Project Flood. FEMA subsequently de-accredited the Dallas Floodway and began the process of redrawing a new 100-year floodplain map for the City for its National Flood Insurance Program.

2.3 City of Dallas

The approximate 2.8 mile Rochester Park Levee was constructed by the City of Dallas in 1991. The City of Dallas has since maintained the levee as part of their overall project operation and maintenance program. The Rochester Levee protects residential and commercial interests in East Dallas. The approximate 2.6 mile CWWTP Levee was constructed by the City of Dallas in the 1940s and the levee was raised and improved by the City in 1994. The CWWTP Levee protects critical utility infrastructure in South Dallas. At the direction of Congress, these two levee systems were added to the DFE project in 1996.

Beginning in the late 1990s and continuing through 2000, the City of Dallas has made improvements to the Trinity River channel, levees, and interior drainage system. These improvements included widening portions of the existing river channel and increasing the height of some portions of the levees to two feet above the 1950s design elevation.

2.3.1 Balanced Vision Plan

As a result of floods in 1989 and 1990, the City of Dallas stated its interest in revitalizing a number of projects to restore and expand the level of protection along the Trinity River within the City of Dallas limits. In 1994, the City of Dallas (in conjunction with regional stakeholders) began looking at ways to outline a long-range vision for the entire Trinity River Corridor: to reclaim the Trinity River as a great natural resource, create a great public domain, and achieve a model of environmental stewardship. In the subsequent years of planning and community input, the City of Dallas and stakeholders developed concepts for addressing five key issues:

1. Flood Risk Management (FRM)
2. Environmental Restoration and Management
3. Parks and Recreation
4. Transportation
5. Community and Economic Development

In 2004, the outcome of this effort cumulated in an update to the 2003 report. The Balanced Vision Plan (BVP) contains the FRM features and the ecosystem restoration and recreation features defined in the report prepared by the City of Dallas entitled, The Balanced Vision Plan (BVP) for the Trinity River Corridor, Dallas, Texas, dated December 2003, and amended in March 2004 as summarized in Table 2-1.

The BVP FRM component includes levee raises to provide flood risk management for the 277,000 cubic feet per second (cfs) riverine flood event. Features also include flattening the levee side slopes, removing an embankment, modifying the AT&SF Railroad Bridge, and non-structural public education and flood warning systems.

BVP Ecosystem Restoration and Recreation Enhancements include the development of three lakes, modification to the course of the Trinity River, construction of approximately 152 acres of new wetlands, construction of 115 acres of groomed athletic fields, and general elements to improve safety and access to the larger BVP elements.

Table 2-1 Summary of Balanced Vision Plan Elements

Category	*Descriptive Action*
BVP Flood Risk Management	
Levees	Raise to 277,000 cfs Flood Height
AT&SF Railroad Bridge	Removal of Wood Bridge Segment
	Removal of Concrete Bridge Segment
	Removal of Embankment Segments
Levee Flattening	Flattening the Riverside Levee Side Slopes to 4:1
Non-structural Flood Control Improvements	Emergency Response
	Public Awareness/Education
	Flood Forecasting
	Warning Systems
BVP Ecosystem and Recreation	
Lakes	West Dallas Lake
	Urban Lake
	Natural Lake
River	Realignment and Modification
Wetlands	Marshlands
	Hampton and Biofiltration Wetlands
	Forested Ponds
	Corinth Wetlands
Athletic Facilities	Potential Flex Fields
	Playgrounds
	River Access Points
General Features	Parking and Public Roads
	Lighting
	Vehicular Access
	Pedestrian Amenities
	Restrooms
Interior Drainage Outfall Modifications	Pump Station Outfalls
	Pressure Sewer Outfalls
Able Sump Ponds	Recreation and Ecosystem Enhancements

On March 9, 2005, the Dallas City Council adopted the Trinity River Corridor Comprehensive Land Use Plan (TRCCLUP) as a tool for guiding development and investment decisions in the Trinity River Corridor (TRC). In this way, the TRCCLUP guides zoning decisions relating to potential future private development towards land uses that complement identified public BVP elements.

Stormwater flooding events have demonstrated that improvements are needed to the East and West Levee Interior Drainage Systems (EWLIDS) to reduce the risk of interior flooding. In March 2006, the need for improving the EWLIDS was demonstrated when a significant local storm caused widespread stormwater flooding in the City of Dallas, resulting in one fatality and significant property damage.

2.3.2 Interior Drainage Plan

The Interior Drainage Plan (IDP) consists of proposed improvements to the existing EWLIDS. The objective of the IDP improvements is to provide stormwater FRM for areas served by the EWLIDS from the 100-year storm event. Implementation of the IDP would reduce the stormwater flood risk for structures located with the predicted flood area.

The threat of interior flooding within the EWLIDS remains a concern in light of stormwater flooding events including the aforementioned loss of life and substantial property damage during a March 2006 flooding event. Police and Fire-Rescue responded to hundreds of emergency calls from stranded residents and motorists during this storm as well. Upgrading of existing individual pump stations and associated sump areas within the floodway has been an ongoing effort of the City of Dallas in recent years. Ongoing IDP projects include improvements to the Pavaho Pump Station which have been completed and improvements to the Baker and Able Pump Stations are in design or underway. Other proposed IDP projects are depicted in Table 2-2.

Table 2-2. Proposed Interior Drainage Plan Improvements

Category	*Descriptive Action*
Interior Drainage Plan	
East Levee	Demolish Old Hampton Pump Station
	Construct New Hampton Pump Station
	Nobles Branch Sump Improvements
	Construct New Baker Pump Station
	Construct New Able Pump Station
West Levee	Demolish Old Charlie Pump Station
	Construct New Charlie Pump Station
	Rehabilitate Existing Delta Pump Station
	Construct New Delta Pumping Station
	Eagle Ford and Trinity-Portland Sump Improvements
	Construct New Trinity-Portland Pumping Plant

2.4 Local Features - Section 408 Projects

Projects referred to as Local Features are proposed additions or modifications to features within the Dallas Floodway, submitted by the Corps, and require Section 408 review. While Local Features are not part of the Recommended Plan for Dallas Floodway, their implementation does represent a modification to an existing Federal project. As such, these Local Features will be considered as part of the Comprehensive Analysis for Dallas Floodway along with the BVP and IDP features. Local features to be evaluated in the Comprehensive Analysis include the Trinity Parkway, Trinity River Standing Wave, the Santa Fe Trestle Trail, the Pavaho Wetlands, the Dallas Horseshoe Project, the Sylvan Avenue Bridge, Jefferson Bridge, Dallas Water Utilities (DWU) Waterlines, Continental Bridge, and the East Bank/West Bank Interceptor Line.

2.5 Trinity Parkway

The Trinity Parkway is a proposed toll road that would span approximately 9 miles from the juncture of State Highway 183 and Interstate Highway 35E to US-175/Spur 310. Several route alignments were reviewed by the Federal Highway Administration (FHWA) as part of a separate environmental compliance action independent of the Dallas Floodway Project. Because it has the potential to significantly affect the Dallas Floodway Project, it is being considered as part of the Comprehensive Analysis for Dallas Floodway as a Local Feature (USACE 2014).

The EIS prepared by the FHWA/Texas Department of Transportation for the Trinity Parkway includes a No Action Alternative and a Build Alternative placing the Parkway's construction within the Dallas Floodway Levee System. As part of the Dallas Floodway Comprehensive analysis, the Trinity Parkway alternative within the Dallas Floodway was evaluated to determine whether it would be hydraulically, geotechnically, and structurally sound. Because, depending on whether the Build Alternative is approved, the potential construction of this feature could have impacts on the BVP FRM and BVP Ecosystem and Recreation features. The implementation guidance for Section 5141 authorization mandated that the comprehensive analyses include both a With and Without Trinity Parkway alternative analyses. The City of Dallas has preliminarily prepared two different BVP design variations to accommodate either scenario. The With Parkway design assumes the chosen alignment of the Trinity Parkway will be within the Dallas Floodway Levee System and constructed as a local feature. This design includes modifications to the BVP Ecosystem and Recreation features to accommodate the inclusion of the Trinity Parkway within the Dallas Floodway Levee System. The Without Parkway design assumes Trinity Parkway is not constructed within the contexts of this evaluation and would have no bearing on the BVP Ecosystem and Recreation features (USACE 2014).

Preliminary designs of the Trinity Parkway are at less than a 35% submittal and show the proposed tollway extending along the face of the East Levee for approximately 5.3 miles, starting at the far downstream end of the Dallas Floodway Levee System at the AT&SF Railroad Bridge before exiting the Floodway just east of the Hampton Pump Station. As proposed, the Trinity Parkway would be built through a combination of elevated earthen berms and bridge structures. The berms and bridges would support six lanes of traffic, three in each direction. Exit and entrance ramps and bridges would be built as needed to merge with existing roadways crossing the Levee System. The earthen berm, built on the face of the East Levee, ranges in height from within a few feet of the top of the levee to an elevation of a few feet above the existing toe of the levee. This fluctuates from upstream to downstream depending on the constraints of bridges and other features within the Dallas Floodway. The Trinity Parkway and its earthen berm are separated from the remainder of the Floodway by a flood separation wall, designed for the 100-year recurrence interval flood event. Supporting the Trinity Parkway and its operation and maintenance goals is a network of access roads that are on the interior of the levee system and on the levee crest (USACE 2014).

3. FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Sites were selected in an effort to document biotic communities in the study area. Two general assessment tools were selected for aquatic and terrestrial habitats: TPWD's Index of Biotic Integrity (IBI) for assessing aquatic life use within a given waterbody and Service's habitat evaluation procedure (HEP).

3.1 Terrestrial Resources

The pre-development landscape of the study area was likely predominantly tall grass prairie with trees along watercourses, sometimes scattered on the prairie or concentrated in certain areas possibly as a result of locally favorable soil conditions or topography. Trees along the mainstem of the Trinity would have been those species tolerant to frequent flooding with additional species less tolerant of flooding found along inflows to the river. With the exception of preserves, small remnants, or native hay meadows, almost nothing remains of the original Blackland Prairie communities (Diggs et al., 1999). Conversion of the Blackland Prairie for agriculture was the most significant cause of the destruction of this ecosystem, with only marginal, steeply sloped land not rapidly brought under cultivation. Once stripped of protective grass, these areas eroded rapidly with disastrous effects. Given the relatively high rainfall and continuing suppression of fire by humans, native trees and shrubs (e.g. eastern red cedar (Juniperus virginiana) and cedar elm (Ulmus crassifolia), as well as introduced species are able to invade and eventually take over areas that were formerly prairie (Diggs et al., 1999).

The study area was further divided into three evaluation groups: the Confluence, Interior Drainage System (IDS), and Mainstem. Each of these areas is expected to be impacted in different ways by the project and was independently analyzed for habitat suitability in order to assess possible differences in their existing conditions. Existing habitat conditions across these groupings also vary due to differences in topography and past impacts. This targeted approach is intended to better illustrate the likely impact of project alternatives on habitat values within these differing reaches.

Three terrestrial habitat types were evaluated using the Service's Habitat Evaluation Procedures (HEP); grassland (4,283.57 acres), bottomland hardwood (1,412.63 acres), and emergent wetland (418.58 acres). A majority (70.05%) of terrestrial habitat in the study area is classified as grassland, much of it managed through mowing and other means. Bottomland hardwood habitats in the study area are largely concentrated upstream within the Elm Fork and West Fork reaches. Emergent wetlands are scattered throughout but generally concentrated along the mainstem within the downstream two-thirds of the study area.

HEP requires the use of Habitat Suitability Index (HSI) models developed for indicator species that best represent groups of species that use existing habitat types. Baseline terrestrial habitat conditions are expressed as a numeric function (HSI value) ranging from 0.0 to 1.0, where 0.0 represents no suitable habitat for an indicator species and 1.0 represents optimum conditions for the species. HSI values ranging from 0.99 to 0.75 represents "good" habitat. HSI values ranging from 0.74 to 0.50 represent habitats considered "average." HSI values ranging from 0.49 to 0.25 represent habitats considered "below average." HSI values ranging from 0.24 to 0.01 represent habitats considered "poor." Habitat Units (HU) are calculated by multiplying the numeric HSI values by the amount of acres of habitat available.

The biologist team collected field data on August 30 – September 1, 2004; October 12 – 14, 2005; April 25, 2006. Data were also used for several of the HEP sites that were collected on May 5, 1999, while the Service was conducting another study. In November 2010, the Service provided the Corps with a Planning Aid Report (PAR) containing HEP scores for indicator species selected, HSI values and HUs for each habitat type evaluated, and detailed descriptions of these habitats as observed during fieldwork.

The 2010 PAR presented habitat conditions within the study area for the proposed action as they existed in 2010. In addition, the 2010 PAR projected the future conditions with the study area if the Proposed Action were not implemented. As part of that effort, the Service, in coordination with the Corps, compiled a list of planned projects with the study area, and evaluated their potential impacts using HEP. Planning delays resulted in a need to update the 2010 PAR, as several of these planned projects went to construction. Due to this need for updated information, a supplemental PAR (largely assembled by the firm of Cardno TEC, Inc.) was provided to the Corps in May of 2013. This document provided information supplemental to the 2010 PAR including:

1. Revised existing conditions for grasslands.
2. The 2010 PAR considered a project as part of the Future Without Project Condition if it had not started construction as of December 31, 2009. The Supplemental PAR considered any project that had not begun construction before March 31, 2012 as part of the Future Without Project Condition.
3. Future With Project Conditions chapters provided new information regarding impacts to habitats and habitat values from implementation of Alternatives 2 and 3.

Since that time, the Corps elected to discard the use of several indicator species' HEP models that are not currently considered fully certified for use by Corps standards. Species no longer included in HEP evaluation for this project are the raccoon, American kestrel, Carolina chickadee, and green heron. Emergent wetlands were then left with data for only a single species (wood duck) for HEP/HSI/HU evaluation. To augment data for emergent wetlands, the HEP model for American coot was also utilized with data collected in the field prior for other emergent wetland species, through examination of photographs taken during data collection for emergent wetlands, and review of aerial photography of the HEP data plots taken in 2004 and 2005.

In January 2014, Cardno TEC, Inc. compiled all of these changes to approved HEP species and all new information since the 2010 PAR and provided the resulting figures to the Service and the Corps to supplement the 2010 PAR. The most current analysis of habitat Existing Conditions, Future Without Project, and Future With Project for the Dallas Floodway project can be found in our January 2014 PAR (USFWS 2014).

Current data, also found within the Dallas Floodway January 2014 PAR, are as follows:

3.1.1 Bottomland Hardwoods:

Table 3-1. Existing HSI Values for Bottomland Hardwood Habitat |per Indicator Species within the Dallas Floodway Project Area

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Barred Owl	0.31	0.54	0.26
Wood Duck	0.29	0.16	0.11
Fox Squirrel	0.13	0.46	0.28
HSI Average	**0.24**	**0.39**	**0.21**

Table 3-2. Existing Acres, HSI Values, and Habitat Units for Bottomland Hardwood within the Dallas Floodway Project Area

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	966.49	0.24	231.96
IDS	351.50	0.39	137.09
Mainstem	94.64	0.21	19.87
Total	**1,412.63**	**N/A**	**388.92**

Bottomland hardwoods in the Confluence and Mainstem were valued as poor habitat (0-0.24) while bottomland hardwoods in the IDS were valued as below average habitat (0.25-0.49). The limiting factors for bottomland hardwood habitat for the three evaluation groups were similar and are listed below.

- Minimal winter and brood cover along the banks for the wood duck
- Minimal winter food (hard mast producing vegetation) available for the fox squirrel
- The overstory trees are generally too small to provide nest sites for barred owl
- Available trees provide minimal nesting opportunities for wood duck (IDS and Mainstem)

Riparian woodland corridors are critical in maintaining an abundance of quality water to meet future demands. They have several hydrological and biological functions, including flood control, surface water storage, ground water supply recharge, and biological diversity. Vegetation in riparian corridors acts as a filter trapping sediment, organics, nutrients, and pesticides from surface runoff from agricultural fields, pastures, and lawns, therefore improving water quality.

3.1.2 Emergent Wetlands:

Table 3-3. Existing HSI Values for Emergent Wetland Habitat per Indicator Species within the Dallas Floodway Project Area

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Wood Duck	0.29	0.16	0.11
American Coot	0.31	0.29	0.33
HSI Average	**0.30**	**0.22**	**0.22**

Table 3-4. Existing Acres, HSI Values, and Habitat Units for Emergent Wetland within the Dallas Floodway Project Area

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	67.95	0.30	20.39
IDS	87.72	0.22	19.30
Mainstem	262.91	0.22	57.84
Total	**418.58**	**N/A**	**97.53**

Emergent wetland habitats within the Confluence were valued at the lower range of below average quality while emergent wetland habitats in the IDS and Mainstem were valued as poor quality. The limiting factors for emergent wetland habit for the three evaluation groups were similar and are listed below.

- Available trees provide minimal nesting opportunities for wood duck
- Minimal winter and brood cover along the banks for wood duck
- Minimal nesting and winter cover along the banks for American coot

Emergent wetlands provide food and cover for fish, resident and migratory birds, small mammals, invertebrates, and the predators that feed on these species. Wetlands are important nesting habitat for waterfowl. Wetlands in the project area consists of rushes, sedges, wetland grasses, and aquatic plants located along the edges of the river and creeks, small impoundments, sumps, and seasonally flooded areas. Some of these wetlands are permanent, but most are seasonal. The emergent wetlands in the sump areas along the floodway have the potential of providing relatively good habitat for wildlife species if enhanced with vegetation for cover.

3.1.3 Grasslands:

Table 3-5. Existing HSI Values for Grassland Habitat per Indicator Species within the Dallas Floodway Project Area

Indicator Species	*Evaluation Areas*		
	Confluence	*IDS*	*Mainstem*
Eastern Meadowlark	0.27	0.54	0.53
Eastern Cottontail	0.59	0.61	0.70
HSI Average	**0.43**	**0.57**	**0.62**

Table 3-6. Existing Acres, HSI Values, and HU for Grassland

\within the Study Area

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	1,573.16	0.43	676.46
IDS	958.26	0.57	546.21
Mainstem	1,752.15	0.62	1,086.33
Total	**4,283.57**	**N/A**	**2,309.00**

Grassland habitats within the Confluence were valued as below average while grassland habitats within the IDS and Mainstem were valued as average. The limiting factors for grassland habitat for the three evaluation groups were the same and listed below.

- Distance to perch sites too great for eastern meadowlark
- Minimal cover for eastern cottontail (shrub/tree and persistent herbaceous vegetation)

Grasslands provide open space, a food source for passerines and the eastern cottontail, and cover for escape and nesting by means of tall grass, scattered brush piles, and shrubs for a variety of animals. Red-tailed hawks hunt for prey in open grasslands. There are two types of grasslands in the study area, managed and unmanaged. Managed grasslands are located in lawns, parks, sump areas and the floodway on and along the levees that are routinely mowed. They are comprised of short native and introduced grasses and forbs, and sometimes scattered trees. A few acres are located on private lands. Unmanaged grasslands are fallow fields also containing a combination of native and introduced grasses, forbs, and trees, but the composition is different from those in the short grass areas. There are very few of these grasslands in the project area.

Table 3-7. Existing HUs per Habitat Type Within the Study Area

Habitat Types	*Baseline HU*
Bottomland Hardwood	388.92
Emergent Wetland	97.53
Grassland	2,309.00
Aquatic Riverine	345.77
Open Water	143.76
Total	**3,284.98**

4. AQUATIC RESOURCES

4.1 Riverine:

The aquatic habitat in the project area is limited as a result of numerous and continuous landscape modifications over time. Degradation as a result of urbanization, vegetative maintenance, contaminated stormwater runoff, and conversion of native rangeland to exotic grasses in the associated watershed has led to a narrowing of the riparian corridor and loss of habitat. Much of the river channel through the project area has been subjected to routine mowing making it difficult for woody and certain native herbaceous plants to establish further, an expected byproduct of prior levee and floodway maintenance.

A fisheries survey was conducted on the Trinity River in Dallas County, Texas, from August 30 - September 1, 2004, by the Service and the Corps, with technical assistance provided by TPWD (USFWS 2004). The purpose of this survey was to determine baseline fish-community structure within the area of the Trinity River that could be potentially impacted by stream modifications, development, and/or construction activities associated with the proposed Dallas Flood Control Project. Four reaches were selected on the Trinity River to conduct this survey. Reaches 1 and 2 were within the mainstem of the Trinity River while Reaches 3 and 4 were upstream within the Elm Fork and West Fork, respectively. All reaches were located within an area of the river that could be potentially impacted by the proposed project.

An IBI provides a means to assess aquatic life use within a given water body using multiple metrics. Two differing IBI methods were utilized:

1. State regional IBI - Accounting for the high variability in fish assemblages in aquatic systems between various ecological regions (eco-regions) in Texas.
2. Trinity River Basin IBI - regionalized IBI developed specifically for the Trinity River. Results of the state regional IBI assessments demonstrated high aquatic life use values for Reaches 2 (mainstem) and 3 (Elm Fork), while fish assemblages at Reaches 1 (mainstem) and 4 (West Fork) were characterized as intermediate. The fish community within the overall study area was classified as high. Scoring of the Trinity River basin specific IBIs yielded slightly different results. The basin specific aquatic life use value calculated for Reach 1 was intermediate to high, while aquatic life use values were high at Reaches 2 and 4. At Reach 3 and within the overall study area, the fish communities were characterized as high to exceptional.

In comparing these 2004 results with previous studies conducted in the area, fish community indices demonstrated a shift to higher aquatic life use values. A greater number of total species, including more species considered intolerant to poor water quality conditions as well as a greater number of individual game fish were encountered during this assessment then had been observed in the past. These observed trends would suggest a recovering system.

Table 4-1. Existing HSI Values for Aquatic Riverine Survey Sites within the Dallas Floodway Project Area

Reach	*Confluence*	*Mainstem*
1	-	0.75
2	-	0.87
3	0.90	-
4	0.82	-

Table 4-2. Existing Acres, HSI Values, and Habitat Units for Aquatic Riverine Habitat within the Dallas Floodway Project Area

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	132.42	0.90	119.18
IDS	165.18	0.75	123.89
Mainstem	123.73	0.83	102.70
Total	**421.33**	**N/A**	**345.77**

The limiting factors for aquatic riverine habitat for the Confluence and Mainstem are taken from the Service's 2004 Dallas Floodway IBI report (USFWS 2004) and are listed below. The limiting factors for the IDS are assumed to be the same.

- Number of benthic invertivore species (Confluence)
- Percent of individuals as tolerants (Mainstem)

- Percent of individuals as omnivores (Confluence and Mainstem)
- Percent of individuals as invertivores (Mainstem)
- Number of individuals per seine haul (Confluence and Mainstem)
- Number of individuals per minute of electro-fishing (Confluence and Mainstem)
- Percent of individuals with diseases or other anomaly (Confluence)
- Total number of intolerant species (Confluence)

4.2 Open water systems:

A follow-up IBI study was conducted on June 16, 2010 by the Service, Corps, and TPWD targeting open water bodies expected to be similar to the proposed Natural, Urban, and West Dallas Lakes (USACE 2010). This was done to draw assumptions about eventual fish communities expected to be present in these proposed waterbodies that will have no direct inflows, but would periodically be inundated by the Trinity River during heavy rain events at 0.5 to 2.0 year intervals. Since the Trinity River serves as the primary population source for the off-channel waterbodies, it is likely that most of the species within the Trinity River may also be found within these systems. However, species with more specific habitat requirements may not successfully make the transition from lotic to lentic environments. Six open water systems were initially identified to meet initial screening criteria, of which three were later determined feasible for survey: Trammel Crow Lake, Bart Simpson Lake, and Dallas Floodway Extension (DFE) Cell D.

IBI metrics were modified accordingly to assess lentic systems. Results of these modified IBI assessments demonstrated high aquatic life use values for Trammel Crow and Bart Simpson Lake, while the fish assemblage at DFE Cell D was characterized as intermediate.

Table 4-3.Existing HSI Values for Open Water Survey Sites within the Dallas Floodway Project Area

Survey Site	*HSI*
Crow Lake	0.77
Bart Simpson Lake	0.77
DFE Wetland Cell D	0.60
Average	**0.71**

Table 4-4. Existing Acres, HSI Values, and Habitat Units for Open Water within the Dallas Floodway Project Area

Evaluation Area	*Acres*	*HSI Average*	*HUs*
Confluence	150.93	0.71	107.16
IDS	49.30	0.65	32.05
Mainstem	6.41	0.71	4.55
Total	**206.64**	**N/A**	**143.76**

The limiting factors for open water habitat for the three evaluation groups were assumed to be the same as the limiting factors for the open water survey sites (Crow Lake, Bart Simpson Lake, and DFE Wetland Cell D) and are listed below.

- Total number of fish species
- Number of cyprinid species
- Number of catfish species
- Number of intolerant species

Riverine fish from the Trinity River sampled in 2004 (discussed prior) showed detectable amounts of organochloride contaminants (USFWS 2004). It is likely that the fish sampled in the open water systems also have these contaminants since they are also utilizing the Trinity River as a primary water and population source. The open water survey sites are also located with a region of the Trinity River currently under a fish consumption advisory due to elevated organochlorine levels. These are legacy contaminants that have not been commercially distributed in the United States for almost 20 years. Most likely, the fish are obtaining these contaminants from the sediments or from the water column through stormwater run-off from the surrounding watershed.

5. ENDANGERED AND THREATENED SPECIES

The federally listed threatened or endangered species known to occur in Dallas County include the endangered whooping crane (*Grus americana*), interior least tern (*Sterna antillarum*), black-capped vireo (*Vireo atricapilla*), golden-cheeked warbler (*Dendroica chrysoparia*) and the threatened piping plover (*Charadrius melodus*).

Whooping cranes may be encountered in any county in north central Texas during migration. Autumn migration normally begins in mid-September, with most birds arriving on the wintering grounds at Aransas National Wildlife Refuge between late October and mid-November. Spring migration occurs during March and April. Whooping cranes prefer isolated areas away from human activity for feeding and roosting, with vegetated wetlands and wetlands adjacent to cropland being utilized along the migration route. Foods consumed usually include frogs, fish, plant tubers, crayfish, insects, and waste grains in harvested fields. This information as well as additional information on this species may be accessed on the Service's ECOS website at http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B003.

It is possible that whooping cranes may temporarily utilize habitats present within the study area during their annual migration but an encounter would be a rare occurrence. It is unlikely that any of the current activities or proposed modifications to the floodplain would have an adverse impact on this species.

The interior least tern nests in colonies on bare to sparsely vegetated sandbars along rivers and streams in Texas from May through August. Nesting areas are ephemeral, changing as sandbars form, move and become vegetated. Because natural nesting sites have become sparse, interior least terns have nested in atypical/non-natural areas, which provide similar habitat requirements. For example, one colony has been nesting for several years at the Southside Wastewater Treatment Plant in Dallas. Non-natural nesting sites include sandpits, exposed areas near reservoirs, gravel levee roads, dredged islands, gravel rooftops, and dike-fields. In recent years, terns have been utilizing artificial habitat more frequently within the Dallas area with small colonies being established in highly developed areas. Ground disturbance related to construction activities near the Trinity River may incidentally create areas that are attractive to least terns for use as potential nesting sites. Should least terns arrive at any of the project areas during the breeding season, the Service should be notified to discuss alternative development plans or the need for consultation under Section 7 of the Endangered Species Act.

The golden-cheeked warbler's habitat is generally described as mature (at least 12 feet tall) oak-juniper woodlands, with 50 percent or greater canopy cover, although warblers have been found in habitat with as little as 30 percent canopy cover. Steep, narrow canyons, with deciduous trees located along the drainage bottoms and juniper on the side slopes, provide an ideal mix of vegetation for this species. However, suitable habitat may also occur on hilltops or other relatively flat areas. Ideal habitat areas have a diverse mixture of juniper and hardwood trees, including oaks, hackberry, sycamore, and cedar elm.

The black-capped vireo is a habitat specialist, nesting in mid-successional brushy areas (i.e., before the area develops into a mature woodland) where the dominant woody species are oaks, sumacs, persimmon, and other broad-leaved shrubs. Juniper may be common in vireo habitat, but juniper prominence is not essential or even preferred by the birds. Typical nesting habitat is composed of a shrub layer extending from the ground to about six feet covering about 35-55% of the total area, combined with a tree layer that may reach to 30 feet or more. Open, sometimes grassy spaces separate clumps of trees and shrubs. The vireo also depends on broad-leaved shrubs and trees, especially oaks, which provide insects on which the vireo feeds.

The habitat evaluation team did not encounter any habitats that appeared suitable for nesting golden-cheeked warblers or black-capped vireos. Therefore, it is unlikely that either species would be present within the study area.

The piping plover is considered to be a statewide migrant in Texas. Current information indicates that this species may stop-over during migration in Grayson County, especially near Lake Texoma and the Red River. Winters are spent along the Gulf Coast. Habitat requirements include bare to sparsely vegetated river sandbars for nesting and foraging. Its diet consists mainly of marine worms, mollusks, crustaceans, and insects. Although piping plovers have been seen in Dallas County, an encounter would be expected to be a rare event. Should piping plovers arrive at any of the project areas during the breeding season, the Service should be notified to discuss alternative development plans or the need for consultation under Section 7 of the Endangered Species Act.

The bald eagle (*Haliaeetus leucocephalus*) was listed under the Endangered Species Act but have since recovered and removed from the list effective August 8, 2007. However, bald eagles are still afforded safeguards under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. We recommend all activities be conducted in accordance with the Service's National Bald Eagle Management Guidelines, which may be accessed at https://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf.

6. CONSIDERATION OF PROJECT ALTERNATIVES

Ongoing NEPA compliance review by the USACE for the Trinity Parkway includes a review of one built within the Dallas Floodway alternative alignment, as well as the No-Action Alternative. The City of Dallas has initiated preliminary design of two different versions of the BVP Study Ecosystem and Recreation features for Dallas Floodway, each addressing either a build or no build option for the Trinity Parkway. Alternative 1 is a No- Action Alternative also undergoing consideration. Alternative 2 considers the implementation of the BVP/IDP under two different design variations – one if the Trinity Parkway is constructed within the Dallas Floodway Project and another if the Trinity Parkway is not constructed within the Dallas Floodway Project. Descriptions of the No-Action Alternative and the Action Alternative follow.

6.1 Alternative 1: The No-Action Alternative

The No-Action Alternative, or "Future Without Project Condition," is an alternative that assumes the BVP/IDP is not constructed. An analysis of the No-Action Alternative is included as required by the NEPA process to establish baseline conditions against which potential impacts can be evaluated.

6.1.1 Alternative 1 – Future Without Project or No Action Alternative Impact Analysis and Discussion

It is difficult to predict what will happen within the project area in the future. However, using historic land use trends and the calculated HSIs, predictions of habitat conditions without the project can be expressed in terms of HUs.

<u>Confluence</u>

Table 6-1 displays Alternative 1 - Future Without Project HSIs, acres, and HUs for the Confluence for bottomland hardwood, emergent wetland, grassland, aquatic riverine, and open water habitat over the next 50 years. It is an extension of the Mainstem group and expected to change little in 50 years. The quality of bottomland hardwoods and open water is expected to remain the same over the next 50 years while emergent wetlands, grassland, and aquatic riverine would increase only slightly. For aquatic riverine, the HSI is expected to remain the same between years 0 and 10, but it expected to increase by year 50 due to increased regulations and improved technology related to water quality. Quality of open water is not expected to change over the next 50 years.

Table 6-1. Estimated HSIs, Acreages, and HUs for Habitat Types in the Confluence Group over the Next 50 Years under Alternative 1 - Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.24	0.24	0.24	0.24	0.24
Acres	966.49	963.41	963.41	973.13	1,011.20
HUs	231.96	231.22	231.22	233.55	242.69
Emergent Wetland					
HSI	0.30	0.30	0.30	0.30	0.31
Acres	67.95	67.95	67.95	67.95	67.27
HUs	20.39	20.39	20.39	20.39	20.85
Grassland					
HSI	0.43	0.43	0.43	0.43	0.45
Acres	1,573.16	1,501.04	1,501.04	1,471.02	1,412.86
HUs	676.46	645.45	645.45	632.54	635.79
Aquatic Riverine					
HSI	0.9	0.9	0.9	0.9	0.93
Acres	132.42	132.36	132.36	131.04	124.49
HUs	119.18	119.12	119.12	117.94	115.78
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	150.93	150.93	150.93	147.91	136.08
HUs	107.16	107.16	107.16	105.02	96.62

Mainstem

Habitats in the Mainstem area are believed to have changed little if any in the past 50 years. Bottomland hardwoods consist of a narrow fringe along the river's edge which does not expand due to mowing. Table 6-2 presents estimated HSIs, acreages, and HUs for habitat types in the Mainstem group over the next 50 years under Alternative 2 - future without project condition. Acreage of bottomland hardwoods are expected to increase between years 10 and 50 from the conversion of aquatic riverine to bottomland hardwood. Emergent wetlands are typically mowed when dry and are of low habitat quality. Due to ongoing maintenance, no changes are expected to emergent wetlands habitats until year 50, when a one percent decrease in acreage due to siltation and warmer, drier conditions associated with climate change.

Grassland habitats are regularly mowed and maintained and are not expected to change until approximately year 50, when a one percent increase may occur due to the conversion of emergent wetland to grassland.

Aquatic riverine habitat is the main channel of the Trinity River while the only open water present is Crow Park Lake. Aquatic riverine acreage is expected to decrease by one percent and covert to bottomland hardwood due to less water reaching the mainstem. By year 50, five percent is also expected to covert to bottomland hardwood associated with and warmer, drier conditions expected from climate change.

Table 6-2. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under Alternative 1 - Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.21	0.22	0.21	0.21	0.21
Acres	94.64	87.35	87.35	88.50	94.19
HUs	19.87	19.22	18.34	18.59	19.78
Emergent Wetland					
HSI	0.22	0.22	0.22	0.22	0.22
Acres	262.91	260.41	260.41	260.41	257.81
HUs	57.84	57.29	57.29	57.29	56.72
Grassland					
HSI	0.62	0.62	0.62	0.62	0.64
Acres	1,752.15	1,669.64	1,669.64	1,669.64	1,672.24
HUs	1,086.33	1,035.18	1,035.18	1,035.18	1,070.23
Aquatic Riverine					
HSI	0.83	0.83	0.83	0.83	0.86
Acres	123.73	114.95	114.95	113.80	108.11
HUs	102.7	95.41	95.41	94.45	92.97

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	6.41	6.41	6.41	6.41	6.41
HUs	4.55	4.55	4.55	4.55	4.55

<u>Interior Drainage System</u>

The Interior Drainage System is a largely urban area with small amounts of habitat adjacent to the existing pumps, sumps, and drainage channels. Table 6-3 represents estimated HSIs, acreages, and HUs for habitat types in the Interior Drainage System group over the next 50 years under Alternative 3 - future without project condition. At year 5, one percent of bottomland hardwood habitat is expected to be developed while at year 10, three percent of bottomland hardwood habitat is expected to be developed. At year 50, seven percent of bottomland hardwood habitat is expected to be lost to urban development.

The emergent wetlands are part of the sump pump areas and would remain. No change to acreage is expected over the next 50 years. The primary purpose of the emergent wetland areas is flood control, not to provide habitat.

At year 5, one percent of grassland habitat is expected to be developed. At year 10, three percent of grassland habitat is expected to be developed. At year 50, seven percent of grassland habitat is expected to be lost to urban development.

The aquatic riverine acreage is expected to remain at 165 acres from year 0 to 5. At year 10, one percent of the aquatic habitat is expected to convert to bottomland hardwoods due to less water from the urban area reaching the IDS. This could be due to warmer and drier conditions and/or residents and businesses retaining more water on their properties so less water reaches the storm drains. By year 50, five percent of the aquatic riverine habitat is expected to convert to bottomland hardwoods, primarily due to warmer and drier conditions from climate change.

Open water acreage is expected to remain the same from year 0 to 5. At year 10, two percent of open water is expected to convert to bottomland hardwood (1 percent) and urban (1 percent). The habitat conversion is expected to occur from the open water filling in due to siltation and as a result of less rainfall and more evaporation from warmer temperatures. It is anticipated that half the area would grow into bottomland hardwood and the other half would become disturbed (urban). At year 50, conditions are expected to be warmer and drier from changes in global climate conditions, thus more habitat would convert to bottomland hardwoods and disturbed (urban) areas.

Table 6-3. Estimated HSIs, Acreages, and HUs for Habitat Types in the Interior Drainage System Group over the Next 50 Years under Alternative 1 - Future Without Project Condition

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.39	0.39	0.39	0.39	0.39
Acres	351.50	351.47	347.96	339.66	325.97
HUs	137.09	137.07	135.7	132.47	127.13
Emergent Wetland					
HSI	0.22	0.23	0.22	0.22	0.19
Acres	87.72	89.00	89.00	89.00	89.00
HUs	19.3	20.47	19.58	19.58	16.91
Grassland					
HSI	0.57	0.57	0.57	0.57	0.62
Acres	958.26	941.32	931.91	903.95	840.67
HUs	546.21	536.55	531.19	515.25	521.22
Aquatic Riverine					
HSI	0.75	0.7	0.7	0.75	0.8
Acres	165.18	164.92	164.92	163.27	155.11
HUs	123.89	115.44	115.44	122.45	124.09
Open Water					
HSI	0.65	0.65	0.65	0.65	0.65
Acres	49.30	49.02	49.02	48.04	44.20
HUs	32.05	31.86	31.86	31.23	28.73

Within the entire study area (Confluence, Mainstem, and Interior Drainage System), changes to HUs under Alternative 1 at year 50 are depicted in Table 6-4:

Table 6-4. Habitat Units per Habitat Type Within the Study Area under Alternative 1 - Future Without Project Condition

Habitat Types	*HUs*		
	Baseline	*FW/OPC* (Year 50)*	*Change*
Bottomland Hardwood	388.92	389.6	0.68
Emergent Wetland	97.53	94.48	-3.05
Grassland	2,309.00	2,227.24	-81.76
Aquatic Riverine	345.77	332.84	-12.93
Open Water	143.76	129.9	-13.86
Total	**3,284.98**	**3,174.06**	**-110.92**

*****Future Without Project Conditions

6.2 Alternative 2: Proposed Action With and Without the Trinity Parkway

Alternative 2 consists of implementation of FRM and ecosystem restoration features of the BVP and IDP that were selected as part of the federally cost-shared Modified Dallas Floodway Project (MDFP) and the remaining non-Federal BVP and IDP features to be implemented by the City of Dallas. The MDFP and non-Federal IDP features are identical in both of the design variations (with and without the Trinity Parkway) being considered under Alternative 2. The non-Federal BVP features do have minor design variations under the two design assumptions.

Under the Proposed Action with the Trinity Parkway design, the Trinity Parkway would be constructed within the Dallas Floodway Project using the preferred alternative identified in the Trinity Parkway EIS. The Trinity Parkway proposed action includes excavation of fill material for support and berm building. To maximize construction efficiency, NTTA, the City of Dallas, and the USACE would coordinate to determine if the Trinity Parkway can take their fill material from the proposed Dallas Floodway lake sites. Thus, the excavation needs of the BVP would be decreased, because the Trinity Parkway project would excavate a portion of the lakes for use in the parkway berm, thereby resulting in “double-use” for the lakes. All mitigation associated with impacts from construction of the Trinity Parkway would occur outside of the Floodway (M. Hackett, USACE, personal communication, 2014).

While the Trinity Parkway is currently a “reasonably foreseeable” project, there is a possibility that the Trinity Parkway project would not be constructed. Therefore, the USACE and City of Dallas decided to provide NEPA flexibility for this potential outcome by designing a Future Condition without the Trinity Parkway also. Under the Proposed Action without the Trinity Parkway design, the MDFP and remaining BVP/IDP elements would be implemented, but the Trinity Parkway project would not be constructed within the Dallas Floodway. Because the Proposed Action without Parkway assumes that the Trinity Parkway is not in-place in the Dallas Floodway Project, certain BVP Ecosystem and Recreation features included in the Proposed Action with the Trinity Parkway would be different under implementation of the Propose Action without the Trinity Parkway. There would be no change to the FRM, IDP, and ecosystem restoration elements of the MDFP under either with or without Parkway design.

6.2.1 Alternative 2: Proposed Action With the Trinity Parkway Impacts Analysis and Discussion

It is difficult to predict what will happen within the project area in the future. However, using historic land use trends and the calculated HSIs, predictions of habitat conditions with or without the project can be expressed in terms of HUs. The action alternative under both the with and without Trinity Parkway designs were compared with the impact predictions associated with the Future Without the Project analysis for the 50 year project period

Ninety-nine acres of existing habitat would become urban from the implementation of the Proposed Action with Trinity Parkway design. Open water habitat would increase under the with Trinity Parkway design from the creation of the Urban, Natural, and West lakes. Bottomland hardwood acreage would also increase with hardwoods planted along the Trinity River; the largest amount of hardwoods would be planted at the southeastern end of the project area. Aquatic riverine acreage would increase from the realignment of the river. The greatest decrease of habitat would be to grassland habitat.

Confluence

The Confluence Group includes the Elm Fork and West Fork of the Trinity River and the associated emergent wetland and upland habitat in the area. The Proposed Action with Trinity Parkway actions in the Confluence consist of the FRM Elements and the IDP Trinity-Portland Pumping Plant and Eagle Ford and Trinity-Portland sump improvements.

Table 6-5 presents estimated HSIs, acreages, and HUs for habitat types in the Confluence Group over the next 50 Years under alternative 2. Progressions of these metrics are predicted to be the same as that presented for Alternative 1.

Table 6-5. Estimated HSIs, Acreages, and HUs for Habitat Types in the Confluence Group over the Next 50 Years under Alternative 2 – Proposed Action with Trinity Parkway

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.24	0.24	0.24	0.24	0.24
Acres	966.49	966	966	976	1016
HUs	231.96	231.84	231.84	234.24	243.84
Emergent Wetland					
HSI	0.30	0.30	0.30	0.30	0.31
Acres	67.95	68	68	68	67
HUs	20.39	20.40	20.40	20.40	20.77
Grassland					
HSI	0.43	0.43	0.43	0.43	0.45
Acres	1,573.16	1574	1574	1543	1482
HUs	676.46	676.82	676.82	663.49	666.90
Aquatic Riverine					
HSI	0.90	0.90	0.90	0.90	0.93
Acres	132.42	133	133	132	125
HUs	119.18	119.7	119.7	118.8	116.25
Open Water					
HSI	0.71	0.71	0.71	0.71	0.71
Acres	150.93	151	151	148	136
HUs	107.16	107.21	107.21	105.08	96.56

Mainstem

Table 6-6 presents estimated HSIs, Acreages, and HUs for habitat types in the Mainstem Group over the next 50 years under the Proposed Action with Trinity Parkway. Most of the habitats within mainstem area would be temporarily impacted by the construction of the BVP Study features. HSIs within bottomland hardwood, emergent wetland, and grassland-urban

forest would be low at years 0, 1, and 5 because they would not have had enough time to establish and function. HSI values for bottomland hardwoods and emergent wetlands would be expected to increase over time as these habitats mature.

Mainstem grasslands will consist of 3 types: native meadow, turf, and urban forest. Native meadow would be expected to have the highest eventual HSI value with its planned native species diversity when compared with turf (mowed and managed) and urban forest (composed largely of non-native ornamental trees).

Open water and riverine HSIs are not expected to change much over time until approximately year 50, when aquatic riverine may improve due to increase regulations and technology related to water quality.

Table 6-6. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under Alternative 2 – Proposed Action with Trinity Parkway

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	195	195	195	198	203	215
HUs	19.87	17.55	17.55	17.55	25.74	42.63	92.45
Emergent Wetland							
Existing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	32	32	32	32	32	32
HUs	57.84	7.04	7.04	7.04	7.04	7.04	7.04
Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	152	152	152	152	152	150
HUs	0.00	19.76	19.76	51.68	63.84	71.44	78
Total Wetland HU	***57.84***	***26.8***	***26.8***	***58.72***	***70.88***	***78.48***	***85.04***
Grassland							
Existing Maintenance Levels							
HSI	0.62	0.4	0.4	0.4	0.4	0.4	0.4
Acres	1,752.15	192	192	192	192	192	194
HUs	1,086.33	76.8	76.8	76.8	76.8	76.8	77.6

Metric	Existing Conditions	Year					
		0	1	5	10	25	50
Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	887	887	887	887	887	887
HUs	0.00	443.50	532.20	620.90	576.55	620.90	753.95
Landscaping: Turf							
HSI	-	0	0	0.4	0.4	0.4	0.4
Acres	-	158	158	158	158	158	158
HUs	0.00	0.00	0.00	63.20	63.20	63.20	63.20
Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	5	5	5	5	5	5
HUs	0.00	2.50	2.50	2.00	2.00	2.00	2.00
Total Grassland HU	***1,086.33***	***522.8***	***611.5***	***762.9***	***718.55***	***762.9***	***896.75***
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	250	250	250	247	242	230
HUs	102.70	207.50	187.50	207.50	209.95	210.54	207.00
Open Water							
Crow Lake							
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Urban Lake & West Dallas Lake							
HSI	-	0.00	0.00	0.43	0.77	0.77	0.77
Acres	-	207	207	207	207	207	207
HUs	-	0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI	-	0.00	0.00	0.60	0.77	0.77	0.77
Acres	-	50	50	50	50	50	50
HUs	-	0.00	0.00	30.00	38.50	38.50	38.50
Total Open Water HU	***4.55***	***4.55***	***4.55***	***123.56***	***202.44***	***202.44***	***202.44***

Interior Drainage System

Table 6-7 presents estimated HSIs, Acreages, and HUs for habitat types in the Interior Drainage System over the next 50 years under the Proposed Action with Trinity Parkway. Within this area, bottomland hardwoods are typically found along existing drainage channels. Bottomland hardwoods have no protection from development, and would be expected to decrease within this continually developing area.

Grassland area would likely be decrease due to development while grassland HSIs would likely increase over time as trees in the urban forest provide increase foraging opportunities for grassland species.

Emergent wetlands would be expected to decrease somewhat in acreage, HU and HSI value over the next 50 years due to anticipated effects of climate change.

Aquatic riverine habitat conditions would be expected to decrease in HSI value between years 0 and 5 due to the adverse effects associated with construction of the with Trinity Parkway design. By year 50, HSIs are expected to have increased due to increased regulations and technology related to water quality. Open water acreage would increase somewhat, but HSI values are expected to remain the same over the next 50 years under Alternative 2 – Proposed Action with the Trinity Parkway.

Table 6-7. Estimated HSIs, Acreages, and HUs for Habitat Types in the Interior Drainage System Group over the Next 50 Years under Alternative 2 – Proposed Action with Trinity Parkway

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Bottomland Hardwood					
HSI	0.39	0.39	0.39	0.39	0.39
Acres	351.50	350	347	339	326
HUs	137.09	136.50	135.33	132.21	127.14
Emergent Wetland					
HSI	0.22	0.23	0.22	0.22	0.19
Acres	87.72	67	67	67	67
HUs	19.30	15.41	14.74	14.74	12.73
Grassland					
Existing Maintenance Levels					
HSI	0.57	0.57	0.57	0.57	0.62
Acres	958.26	945	936	908	844
HUs	546.21	538.65	533.52	517.56	523.28
Landscaping: Urban Forest					
HSI		0.50	0.40	0.40	0.40
Acres		22	22	22	22
HUs	0	11	8.8	8.8	8.8
Total Grassland HU	***546.21***	***549.65***	***542.32***	***526.36***	***532.08***
Aquatic Riverine					
HSI	0.75	0.70	0.70	0.75	0.80
Acres	165.18	162	162	160	152
HUs	123.89	113.40	113.40	120.00	121.60

Metric	*Existing Conditions*	*Year*			
		0	*5*	*10*	*50*
Open Water					
HSI	0.65	0.65	0.65	0.65	0.65
Acres	49.30	72	72	71	65
HUs	32.05	46.80	46.80	46.15	42.25

Within the entire study area (Confluence, Mainstem, and Interior Drainage System), changes to HUs under the Proposed Action with Trinity Parkway at year 50 are depicted in Table 6-8:

Table 6-8. HUs per Habitat Type Within the Study Area under Alternative 2 – Proposed Action with Trinity Parkway

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	463.43	74.51
Emergent Wetland	97.53	118.54	21.01
Grassland	2,309.00	2,095.73	-213.27
Aquatic Riverine	345.77	444.85	99.08
Open Water	143.76	341.25	197.49
Total	**3,284.98**	**3,463.80**	**178.82**

6.2.2 Alternative 2: Proposed Action Without the Trinity Parkway Impacts Analysis and Discussion

Under the Proposed Action without Trinity Parkway design, five more acres of existing habitats would be converted to urban developments. The greatest decrease of habitat would be loss of grassland while the greatest increase would be to open water from the construction of the BVP Study lakes. Bottomland hardwood acreage would increase along with aquatic riverine habitat acreage from the realignment of the river.

Confluence

Within the Confluence area, all activities proposed by the without Parkway design would be the same as those proposed by the with Parkway design. Therefore, changes to habitat acreages within the Confluence would not be expected to differ from the results presented prior regarding the Proposed Action with Trinity Parkway.

Mainstem

Table 6-9. Estimated HSIs, Acreages, and HUs for Habitat Types in the Mainstem Group over the Next 50 Years under Alternative 2 – Proposed Action without Trinity Parkway

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Bottomland Hardwood							
HSI	0.21	0.09	0.09	0.09	0.13	0.21	0.43
Acres	94.64	194	194	194	197	202	214
HUs	19.87	17.46	17.46	17.46	25.61	42.42	92.02
Emergent Wetland							
Existing/Continuing							
HSI	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Acres	262.91	32	32	32	32	32	32
HUs	57.84	7.04	7.04	7.04	7.04	7.04	7.04
Proposed							
HSI	-	0.13	0.13	0.34	0.42	0.47	0.52
Acres	-	154	154	154	154	154	152
HUs	0	20.02	20.02	52.36	64.68	72.38	79.04
Emergent Wetland HU	***57.84***	***27.06***	***27.06***	***59.40***	***71.72***	***79.42***	***86.08***
Grassland							
Existing Maintenance Levels							
HSI	0.62	0.40	0.40	0.40	0.40	0.40	0.40
Acres	1,752.15	191	191	191	191	191	193
HUs	1,086.33	76.40	76.40	76.40	76.40	76.40	77.20
Landscaping: Meadow							
HSI	-	0.50	0.60	0.70	0.65	0.70	0.85
Acres	-	844	844	844	844	844	844
HUs	0.00	422.00	506.40	590.80	548.60	590.80	717.40
Landscaping: Turf							
HSI	-	0.00	0.00	0.40	0.40	0.40	0.40
Acres	-	186	186	186	186	186	186
HUs	0.00	0.00	0.00	74.40	74.40	74.40	74.40
Landscaping: Urban Forest							
HSI	-	0.50	0.50	0.40	0.40	0.40	0.40
Acres	-	15	15	15	15	15	15
HUs	0.00	7.50	7.50	6.00	6.00	6.00	6.00
Grassland HU	***1,086.33***	***505.90***	***590.30***	***747.60***	***705.40***	***747.60***	***875.00***
Aquatic Riverine							
HSI	0.83	0.83	0.75	0.83	0.85	0.87	0.90
Acres	123.73	250	250	250	247	242	230
HUs	102.70	207.50	187.50	207.50	209.95	210.54	207.00

Metric	*Existing Conditions*	*Year*					
		0	*1*	*5*	*10*	*25*	*50*
Open Water							
Crow Lake							
HUs	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Urban Lake & West Dallas Lake							
HSI		0.00	0.00	0.43	0.77	0.77	0.77
Acres		207	207	207	207	207	207
HUs		0.00	0.00	89.01	159.39	159.39	159.39
Natural Lake							
HSI		0.00	0.00	0.60	0.77	0.77	0.77
Acres		50	50	50	50	50	50
HUs		0.00	0.00	30.00	38.50	38.50	38.50
Open Water HU	***4.55***	***4.55***	***4.55***	***123.56***	***202.44***	***202.44***	***202.44***

Under the Proposed Action without the Trinity Parkway, most of the existing bottomland hardwoods (94.64 acres) would be removed during the realignment and modification of the Trinity River under the BVP Study features. During the implementation of the BVP Study features, 194 acres of bottomland hardwood would be planted in the Mainstem adjacent to the levee but kept from expanding further toward the levee. After the initial 194 acres are established, a gradual increase of bottomland habitat is expected from the conversion of aquatic riverine to bottomland hardwood between years 10 and 50.

Emergent wetlands within the Mainstem under the Proposed Action without the Trinity Parkway would include approximately 186 acres consisting of approximately 32 acres of existing wetlands and approximately 154 of wetlands created from the implementation of the BVP Study features. The created wetlands would include Corinth, Forested Ponds, and fringe marsh wetlands along the edge of the lakes.

Due to the proposed maintenance of the BVP Study features in the Mainstem, the acreage of emergent wetlands in the Mainstem is expected to stay the same over the next 10 years. At year 50, one percent of the emergent wetlands are expected to convert to grassland due to siltation and warmer and drier climate conditions.

Due to the proposed maintenance of the BVP Study features in the Mainstem, no changes to grassland acreage is expected over the next 50 years. At year 50, the acreage is expected to increase by one percent, due to the emergent wetland converting to grassland.

The aquatic riverine habitat value and acreage in the Mainstem would change significantly under the Proposed Action without Trinity Parkway. BVP Study features include realignment of the Trinity River to increase both sinuosity and habitat value along with planting of riparian fringe vegetation. Acreage is expected to remain at 250 acres from year 0 to 5. By year 50, five percent of the aquatic riverine habitat is expected to convert to bottomland hardwoods, due to anticipated warmer and drier climate conditions.

Existing acreages of open water habitat along with the BVP Study feature lakes (263 acres) would not be expected to change over the next 50 years due to ongoing maintenance.

<u>Interior Drainage System:</u>

Within the Interior Drainage System area, all activities proposed by the without Parkway design would be the same as those proposed by the with Parkway design. Therefore, changes to habitat acreages within the Interior Drainage System would not be expected to differ from the results presented prior regarding the Proposed Action with Trinity Parkway.

Within the entire study area (Confluence, Mainstem, and Interior Drainage System), changes to HUs under the Proposed Action without the Trinity Parkway at year 50 are depicted in Table 6-11:

Table 6-11. Habitat Units per Habitat Type Within the Study Area under Alternative 2 – Proposed Action without Trinity Parkway

Habitat Types	*HUs*		
	Baseline	*Year 50*	*Change*
Bottomland Hardwood	388.92	463.00	74.08
Emergent Wetland	97.53	119.58	22.05
Grassland	2,309.00	2,073.98	-235.02
Aquatic Riverine	345.77	444.85	99.08
Open Water	143.76	341.25	197.49
Total	**3,284.98**	**3,442.66**	**157.68**

7. COMPARISON OF HABITAT UNITS AT YEAR 50 FOR ALL ALTERNATIVES

Perhaps the most effective method to compare project alternative effects on wildlife habitat over time is in comparison of changes to Habitat Units (HU). As stated prior, HUs are calculated by multiplying the numeric HSI values by the amount of acres of habitat available. This comparative analysis accounts for both changes to habitat acreage as well as habitat suitability. Table 6-12 illustrates a comparison of HUs for all project alternatives at year 50.

Table 6-12. Comparison of Habitat Units (HU) at Year 50 for All Alternatives with Cumulative Projects as Compared to Existing Conditions

Habitat Type	*Existing Conditions*	*Alternative 1 Future W/out Project*		*Alternative 2 – with Parkway Cumulative*		*Alternative 2 – without Parkway Cumulative*	
	HU	*HU*	*Difference*	*HU*	*Difference*	*HU*	*Difference*
Bottomland Hardwood	388.92	389.60	0.68	449.67	60.75	458.89	69.97
Emergent Wetland	97.53	94.48	-3.05	145.55	48.02	147.66	50.13
Grassland	2,309.00	2,227.24	-81.76	1,952.33	-356.67	1,982.68	-326.32
Aquatic Riverine	345.77	332.84	-12.93	445.75	99.98	445.75	99.98
Open Water	143.76	129.90	-13.86	341.25	197.49	341.25	197.49
Total	**3,285**	**3,174.06**	**-110.92**	**3,334.55**	**49.57**	**3,376.23**	**91.25**

Results suggest that under both Alternative 2 with and without Trinity Parkway designs, habitat quality would increase over time as compared with the No Action Alternative 1. The greatest increases would be to open water habitats from the construction of the BVP Study lakes and to aquatic riverine habitats from the realignment of the Trinity River. The BVP Study along with other project components of Alternative 2 would also have substantial positive effects to the current habitat quality of bottomland hardwoods, emergent wetlands, and aquatic riverine habitats. The only decrease in habitat quality would be to grasslands primarily due to loss of acreage. Existing grasslands within the study area are possibly the least ecologically valuable habitats present due to their continual mowing disturbances and invasion of non-native species, circumstances expected to continue under either Alternative 1 or Alternative 2.

7.1 Evaluation and Comparison of the Alternatives

The following is a comparison of Alternative 1 - No Action and Alternative 2 - Proposed Action with the Trinity Parkway and Alternative 2 - Proposed Action without the Trinity Parkway in regards to how they will impact fish and wildlife resources over the 50 year project analysis period.

7.1.1 Alternative 1 - No Action

Through the course of normal urban development within the project area over a period of 50 years, the greatest losses to fish and wildlife resources in all habitats except grasslands are expected to occur under this alternative.

7.1.2 Alternative 2 (Design Variation A) - Proposed Action with the Trinity Parkway

Temporary adverse impacts to all habitats within the project area are expected to occur with this alternative. However, adverse impacts to fish and wildlife resources associated with this design would be compensated for through in-kind and out-of-kind mitigation. In-kind mitigation would be in the form of an increase of open water habitat acreage and quality from the construction of the BVP Study lakes as well as an increase in aquatic riverine habitat acreage and quality through the realignment of the Trinity River. Temporary impacts to the bottomland hardwood habitat would be adequately compensated for by in-kind compensation with an increase of approximately 73.83 HUs over future without project conditions (at year 50). Grassland habitat would decrease by 131.51 HUs, but the overage of bottomland hardwood habitat, which is considered more valuable due to greater biodiversity and habitat rarity, would compensate for this loss as out-of-kind mitigation. Emergent wetland habitats would also be substantially increased by an additional 21.01 HUs over future without project conditions.

7.1.3 Alternative 2 (Design Variation B) - Proposed Action without the Trinity Parkway

Temporary and long term impacts resulting from this design would differ little from the with Trinity Parkway design. Specifically, the implementation of the Proposed Action without the Trinity Parkway would yield 1.4 emergent wetland HUs more than the Proposed Action with the Trinity Parkway, but would also result in 21.75 Grassland HUs less than the with Trinity Parkway design. All other in-kind and out-of-kind mitigation expected from the Proposed Action with Trinity Parkway would also result from the implementation of the Proposed Action without Trinity Parkway due to their similarities.

7.2 Alternatives Summary

Both Proposed Action design variations would result in the improvement of existing bottomland hardwood, emergent wetland, open water, and aquatic riverine habitats, while offsetting impacts to grasslands through gains in higher value habitats. Because of these actions, it is expected that both design variations would fully meet the ecosystem preservation and restoration objectives within the project area. Unavoidable impacts to habitat within the project area associated with these design variations are relatively minimal. The small amount of habitat that would temporarily be lost through construction activities would be fully compensated for through in-kind and out-of-kind mitigation. High quality riparian and wetland habitats would be established in lieu of grasslands which are of limited ecological value. Consequently, the losses to fish and wildlife resources associated with the Proposed Action with or without the Trinity Parkway are expected to be self-mitigating and would be acceptable from a fish and wildlife resource perspective.

8. RECOMMENDED FISH AND WILDLIFE CONSERVATION MEASURES

The Service has evaluated this project in accordance with the guidelines and directives contained in the Fish and Wildlife Mitigation Policy (Federal Register 46(15):7644-7663; January 23, 1981). The Mitigation Policy is the basis by which the Service makes recommendations, in order of priority, to avoid, minimize, rectify, reduce or eliminate the loss over time, or compensate project-related impacts to fish and wildlife resources. Our recommendations are based on the value and relative abundance of the affected habitats to the evaluation species. The Policy includes four Resource Categories (1-4) to provide a consistent value rating for wildlife habitats. Based on the HSI values and IBI evaluations, the Service has designated a Resource Category for each terrestrial habitat in each area assessed and aquatic habitat in each segment studied.

8.1 Aquatic Habitat

The Service has designated the aquatic habitats within the study area as Resource Category 3. Category 3 habitat is of high to medium value for the evaluation species and is relatively abundant on a national basis. The mitigation goal for this category is no net loss of habitat value while minimizing loss of in-kind values. As noted in our Trinity River Basin IBI, the Elm Fork (Reach 3) support exceptional fisheries, and therefore, impacts to this system should be avoided and/or minimized before any enhancement of these resources might occur.

As indicated prior, Alternatives 2 under either the with or without Trinity Parkway design would result in substantial net gains of aquatic habitat quality and acreage. Any temporary construction impacts to aquatic habitats would be self-mitigating and the Service concludes that no additional mitigation efforts would be necessary.

Although the degree and extent of contamination in sediments within the portion of the Trinity River that would be impacted by the proposed actions are unknown, the Service is concerned that there is a likelihood that contaminated sediments would be re-suspended into the water column from the excavation activities. This in turn would allow these contaminants to become more readily available to the aquatic biota inhabiting the river. Therefore, the Service recommends that the degree and extent of sediment contamination within the project area be further analyzed prior to the commencement of excavation operations. The Service also recommends that best management practices be implemented to control the increased pollutant loading in storm water runoff associated with construction activities and the projected increase in traffic usage within this area.

8.2 Terrestrial Habitat

All terrestrial habitats within the project area have medium to low habitat value for the evaluation species and have been designated as Resource Category 4. The mitigation planning goal for Category 4 habitat is to minimize loss of habitat value. Out-of-kind habitat values may be used for mitigation. Habitat improvements and restoration measures proposed for the project may be used for the mitigation of adverse impacts associated with the construction of the preferred plan of development.

As stated prior, implementation of Alternative 2 under either the with or without Trinity Parkway designs would result in the improvement of existing bottomland hardwood and emergent wetland habitats, while offsetting impacts to grasslands through gains in higher value habitats. The small amount of habitat that would temporarily be lost through construction activities would be fully compensated for through in-kind and out-of-kind mitigation. High quality riparian and wetland habitats would be established in lieu of grasslands which are, in comparison, of lesser ecological value. Consequently, the losses to fish and wildlife resources associated with Alternative 2 under either design variation are expected to be self- mitigating and would be acceptable from a fish and wildlife resource perspective.

Implementation of Alternative 2 under either the with or without Trinity Parkway design would result in substantial net gains of terrestrial habitat quality and acreage. Any temporary construction impacts to terrestrial habitats would be self-mitigating and the Service concludes that no additional mitigation efforts would be necessary.

Executive Order 11990 requires all Federal agencies to “take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities.” Wetlands are of national importance and have been documented as one of the most productive and important habitats for a variety of fish and wildlife species. At year 50, the Proposed Action with the Trinity Parkway would result in a net increase of 21.01 emergent wetland HUs and the Proposed Action without the Trinity Parkway would result in an increase of 22.05 HUs. Either of these scenarios would fully mitigate for temporary wetland impacts associated with project construction.

9. SUMMARY OF FINDINGS AND FISH AND WILDLIFE SERVICE’S POSITION

Due to the lack of suitable habitat and the urbanized character of the project area, it is unlikely that any federally listed threatened or endangered species would become established in any of the study areas. The Trinity River has a high diversity of bird species, and the area is likely to become more popular as an urban park. The interior least tern is the only listed species likely to be found in the area with any regularity. However, given the urban area, breeding populations are not likely to be established. Therefore, adverse effects to federally listed species are not anticipated with implementation of either the with or without Trinity Parkway designs.

No permanent detrimental effects to aquatic or terrestrial communities within the project area would be expected to occur from the implementation of any of the project alternatives. Long term effects of Alternative 2 would result in net benefits to fish and wildlife resources. Therefore, no additional mitigation efforts are recommended.

The Service commends the Corps and the sponsor for incorporating habitat creation/restoration plans into the action alternatives. These efforts would fully compensate for the impacts caused by initial project construction. The Service recommends that future plans for the project area incorporate more aspects of the conceptual Ecosystem Restoration Plan throughout the project area. These actions would provide additional benefits to fish and wildlife resources, and the public's enjoyment of these resources, throughout the entire project area.

Both Alternative 2 with and without Trinity Parkway designs would result gains to fish and wildlife resources and both would support the Dallas Floodway Project objectives of flood protection, habitat creation/restoration, and public recreation. However, the Proposed Action without the Trinity Parkway would likely be the least environmentally damaging. Locating a portion of the Trinity Parkway within the levee system (Proposed Action with the Trinity Parkway) could potentially introduce more runoff contaminants and litter from vehicles passing through this area. While both the with and without Trinity Parkway design variations would support substantial gains to fish and wildlife resources, the Service recommends the Proposed Action without the Trinity Parkway design. If the Proposed Action with the Trinity Parkway is selected, the Service recommends that efforts be made to fully manage pollutants and litter that the Trinity Parkway might introduce into the study area.

In summary, we believe the implementation of these recommended measures would serve to minimize the adverse impacts associated with the proposed project. We appreciate the opportunity to provide our evaluation and recommendations on this project. Please contact Sean Edwards of my staff at (817) 277-1100 if you have any questions or require additional assistance.

Sincerely,

Debra T. Bills

Debra Bills
Field Supervisor

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