APPENDIX H
Supplemental Biological Resources Information

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Dallas Floodway Project Environmental Impact Statement
Draft Threatened and Endangered Species Report
April 2014

Introduction

Dallas County is potentially home to 17 federal- and state-listed animal species. Of those 17 species, 4 are federally endangered, 1 is federally threatened, 1 is a candidate for federal listing, and 3 are federally delisted. The remaining eight species are state-listed threatened. Fifteen of these species—including all three federally delisted species, the federal candidate species, federally threatened species, and two of the federally endangered species—are potentially found within the Dallas Floodway Project Region of Influence (ROI) for biological resources (refer to Dallas Floodway Project Environmental Impact Statement [EIS] Section 3.5). Table 1 identifies each listed species, summarizes their preferred habitat, lists their federal and state status, and describes their likelihood of being in the ROI. Species in bold are those that have the potential to be found in the ROI.

Table 1. Dallas County Federal and State Threatened and Endangered Species

Species	*Habitat*	*Federal Status*	*State Status*	*Occurrence in the ROI*
BIRDS				
American Peregrine Falcon *(Falco peregrinus anatum)*	**Nests in the Trans-Pecos region of West Texas; nests on high cliff, often near water where prey species are most common.**	**D**	**E**	**Potential migrant; this species may temporarily use portions of the ROI for resting or foraging during migration.**
Arctic Peregrine Falcon *(Falco peregrinus tundrius)*	**Nests in tundra regions; migrates through Texas; winters along gulf coast. Open areas near water.**	**D**	**T**	**Potential migrant; this species may temporarily use portions of the ROI for resting or foraging during migration.**
Bald Eagle *(Haliaeetus leucocephalus)*	**Nests and winters near rivers and large lakes; nests in tall trees or on cliffs near large bodies of water; all reservoirs in north central Texas are considered potential nesting habitat.**	**D**	**T**	**Potential migrant or winter resident; this species could use the Confluence or Mainstem Groups for migration or wintering.**
Black-capped Vireo *(Vireo atricapilla)*	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	E	E	Not likely due to lack of habitat.
Golden-cheeked Warbler *(Dendroica chrysoparia)*	Oak-juniper woodlands; dependent on mature Ashe juniper (cedar) for long fine bark strips from mature trees in nest construction; nests in various other trees; forage for insects in broad-leaved trees and shrubs.	E	E	Not likely due to lack of habitat.
Interior Least Tern *(Sternula antillarum athalassos)*	**Nests along sand and gravel bars within braided streams and rivers; also known to nest on man-made structures near water.**	**E**	**E**	**Potential; the ROI does not contain sand and gravel bars within braided streams or rivers, however, several man-made structures occur near water.**

Species	*Habitat*	*Federal Status*	*State Status*	*Occurrence in the ROI*
Piping Plover *(Charadrius melodus)*	**Wintering migrant along the Texas Gulf Coast; prefers beaches and bayside mud or salt flats.**	**T**	**T**	**Potential migrant; this species could be migratory through the ROI. Suitable habitat occurs in the floodplain.**
Sprague's Pipit (*Anthus spragueii)*	**Occurs in Texas during migration and winter, mid-September to early April. Strongly tied to native upland prairie.**	**C**	**-**	**Potential migrant; this species could be migratory through the ROI. Low quality grassland habitat occurs in the floodplain.**
White-faced Ibis *(Plegadis chihi)*	**Prefers freshwater marshes, sloughs, and irrigated rice fields; nests in marshes, in low trees, in bulrushes or reeds, or on floating mats.**	**-**	**T**	**Potential migrant; this species could be migratory through the ROI. Suitable habitat occurs in the floodplain.**
Whooping Crane *(Grus americana)*	**Potential migrant via plains throughout most of the state to the coast; winters in Texas coastal marshes in Aransas, Calhoun, and Refugio counties.**	**E**	**E**	**Potential migrant; this species could temporarily use portions of the Confluence and Mainstem Groups as stopover locations during migration.**
Wood Stork *(Mycteria americana)*	**Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water; usually roosts in tall snags.**	**-**	**T**	**Potential migrant; this species could temporarily use portions of the Confluence and Mainstem Groups as stopover locations during migration.**
MOLLUSKS				
Texas pigtoe (*Fusconaia askewi*)	**Rivers with mixed mud, sand, and fine gravel in protected areas. Occurs in western Gulf drainages of Texas and Louisiana. Most Texas records are from the Neches and Sabine rivers in east Texas, but also from the Sabine and San Jacinto Rivers; and it likely occurs in a few dozen localities in the southern portion of the Mississippi Interior Basin drainage in Louisiana.**	**-**	**T**	**Likely to occur in the river channel within the Confluence and Mainstem Groups. Documented under IH-35E in 2011-2012.**
Louisiana Pigtoe (*Pleurobema riddellii)*	**Streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) Rivers.**	**-**	**T**	**Potential; historically this species occurred in the Trinity River.**
Texas Heelsplitter (*Potamilus amphichaenus)*	**Quiet waters in mud or sand and in reservoirs. Sabine, Neches, and Trinity River basins.**	**-**	**T**	**Potential; the Elm Fork and West Fork in the Confluence Group and the Trinity River in the Mainstem Group provide suitable habitat for this species.**
REPTILES				
Alligator Snapping Turtle *(Macrochelys temminckii)*	**Perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps and ponds near deep running water.**	**-**	**T**	**Potential; the ROI contains perennial water bodies; suitable habitat for this species.**
Texas Horned Lizard *(Phrynosoma cornutum)*	**Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.**	**-**	**T**	**Low potential; this species is not likely to occur in the ROI. The soil on the levees is hard and compacted and majority of the soil in the floodplain is moist. However, there could be pockets of loose sandy soil in the floodplain.**

Species	*Habitat*	*Federal Status*	*State Status*	*Occurrence in the ROI*
Timber Rattlesnake *(Crotalus horridus)*	**Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland, limestone bluffs, sandy soil or black clay. Prefers dense ground cover, i.e. grapevines or palmetto.**	**-**	**T**	**Potential; suitable habitat includes dense bottomland hardwood habitat within the ROI.**

Notes: E = Endangered, T = Threatened, C= Candidate, D = Delisted. Bold = potential to occur in the ROI.
Sources: Campbell 2003; Texas Parks and Wildlife (TPWD) 2013, U.S. Fish and Wildlife Service (USFWS) 2014.

Species within the Region of Influence

Birds

As shown in Table 1, three of the five federally listed species potentially found in Dallas County also have the potential to occur in the Dallas Floodway EIS Biological Resources' ROI: the endangered whooping crane and interior least tern, and the threatened piping plover. The Sprague's pipit also has the potential to be found in the ROI and is a candidate for federal listing.

The three bird species that have been federally delisted are all still state listed species. All three of these birds have the potential to migrate through the ROI. Similarly, the state-listed threatened white-faced ibis and wood stork are also both potential migrants in the ROI.

Mollusks

The three state-listed mussel species potentially found in Dallas County are known to or have the potential to occur in the Trinity River in the ROI (TPWD 2013). Specifically, the Texas pigtoe has been documented in the ROI (U.S. Department of Transportation 2012). In addition, the Texas heelsplitter mussels are likely to occur in suitable habitat in the confluence and main stem reaches of the Trinity River. The Louisiana pigtoe has not been documented as a current resident of the ROI, but has historically been found within the Trinity River.

Reptiles

The three state-listed reptile species potentially found in Dallas County also have the potential to occur in the ROI. No federally listed reptile species are known or likely to occur in Dallas County or the ROI (TPWD 2013).

Descriptions of Listed Species Potentially Found within the ROI

Birds

American Peregrine Falcon/Arctic Peregrine Falcon

The American subspecies of the peregrine falcon was federally delisted in 1999 and is listed as endangered in Texas. The Arctic subspecies was federally delisted in 1994 and is listed as threatened in Texas (USFWS 1994, 1999; TPWD 2013).

The peregrine falcon nests on cliffs and in cliff-like areas near wetlands and water bodies. The American subspecies breeds throughout the western U.S., Canada, and Mexico, and in the Trans-Pecos region of Texas. The Arctic subspecies breeds within the tundra regions of Alaska, Canada, and Greenland. Both subspecies migrate through Texas and can be found seasonally along the Texas Gulf Coast.

This species could use the ROI as a stopover location during migration (TPWD 2013). Either subspecies of the peregrine falcon could roost on the levees and forage in the floodplain or grasslands. If a peregrine falcon is encountered in the breeding season during pre-construction bird surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Bald Eagle

The bald eagle was listed as threatened under the Endangered Species Act, but was removed from the list effective August 8, 2007 (USFWS 2007a). Bald eagles are still afforded federal protection under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (TPWD 2013, USFWS 2014). The bald eagle is a state threatened species (TPWD 2013).

Bald eagles are primarily found near rivers and large lakes. They nest in tall trees (40 to120 feet) or on cliffs near water. All reservoirs in north central Texas are considered potential nesting habitat (TPWD 2013). In December 2008, a bald eagle was observed by U.S. Army Corps of Engineers (USACE) engineers flying over the Lower Chain of Wetlands, Wetland Cell F, within the Dallas Floodway Extension project area. This Wetland Cell is very close to the Trinity River and is located off IH-45 South, approximately 1 mile southeast of the southeastern edge of the ROI (City of Dallas 2009). During the winter from 2010 to 2013, one bald eagle had been observed near the south end of the ROI. On February 9, 2013, a bald eagle was observed at the Loop 12 Boat Launch. On April 6, 2013, a bald eagle was observed at the Trinity Audubon Center (Ebird 2013). While the most suitable habitat for wintering bald eagles is southeast of the ROI in the Great Trinity Forest, the confluence and main stem Trinity River reaches also provide potential foraging/roosting habitat.

The USFWS recommend all activities be conducted in accordance with the Service's National Bald Eagle Management Guidelines (USFWS 2007b). However, new procedures govern the protection and non-purposeful take of bald eagles under the Bald and Golden Eagle Protection Act. If a bald eagle is encountered during pre-construction bird surveys or during construction, USFWS and TPWD would be notified to discuss ways to minimize any potential impact and ensure compliance with the Bald and Golden Eagle Protection Act.

Interior Least Tern

The interior least tern was federally listed as endangered on June 27, 1985 and is listed as endangered by the state of Texas (USFWS 1985a, TPWD 2013). No critical habitat has been designated for this species and the recovery plan was finalized in 1990 (USFWS 1990).

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.

If a least tern is observed in the ROI during the breeding season, the USFWS would be notified to discuss additional minimization measures or the need for consultation under Section 7 of the Endangered Species Act (ESA) (USFWS 2014).

Piping Plover

The piping plover is both state and federally listed as threatened (TPWD 2013). It was federally listed in December 1985 (USFWS 1985b). Critical habitat includes wintering habitat along the gulf coast of Texas. Dallas County does not contain any critical habitat (USFWS 2009).

Breeding populations of piping plover exist along the Atlantic Coast, within the Northern Great Plains, and within the Great Lakes region of North America. All populations migrate south for the winter, with individuals from both Northern Great Plains and Great Lakes populations wintering along the Texas Gulf Coast. All populations prefer open, sandy beaches, mudflats, and sparsely vegetated sand and gravel coastlines for nesting.

The piping plover is considered 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 (USFWS 2014). If a piping plover is observed in the ROI during the breeding season, the USFWS would be notified to discuss additional minimization measures or the need for consultation under Section 7 of the ESA (USFWS 2014).

Sprague's Pipit

The Sprague's pipit was listed as a federal candidate species in 2010 (TPWD 2013). This species warrants protection under the ESA but listing the species is precluded by the need of the USFWS to address the listing actions of other higher priority species (USFWS 2010).

This species breeds in Minnesota, Montana, North Dakota, South Dakota, and south-central Canada and winters in southern United States. The Sprague's pipit occurs in Texas during migration and winter, mid-September to early April; and is strongly tied to native upland prairie (TPWD 2013, USFWS 2013). The Sprague's pipit is one of the few endemic species to North American grasslands (USFWS 2010, 2013).

As no high quality native grasslands occur in the ROI, the Sprague's pipit has a low potential to briefly stopover in the low quality grasslands that occur in the ROI. If a Sprague's pipit is observed in the ROI during the breeding, the USFWS would be notified to discuss alternative development plans or the need for consultation under Section 7 of the ESA (USFWS 2014).

White-faced Ibis

The white-faced ibis is not federally-listed, but is state-listed as threatened (TPWD 2013). It prefers freshwater marshes, sloughs, and irrigated rice fields. It nests in low trees, on the ground in bulrushes or reeds, or on floating mats in isolated colonies from Oregon to Kansas. The greatest numbers of nesting white-faced ibis occur in Utah, Texas, and Louisiana. In Texas it breeds and winters along the Gulf Coast (TPWD 2013).

The white-faced ibis migrates through Dallas County. This species could use the ROI as a stopover location for foraging and roosting during migration. If a white-faced ibis is encountered in the breeding season during pre-construction bird surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Whooping Crane

The whooping crane is both federally- and state-listed as endangered (TPWD 2013). It was federally listed as endangered on March 11, 1967 (USFWS 1967). A revised recovery plan was prepared in 2007 and the USFWS Whooping Crane 5-Year Review was available in 2012 (USFWS 2012).

Historically, the whooping crane occurred throughout most of North America. Whooping crane populations increased from a low of 18 in 1938-1939 to 599 (437 wild and 162 captive) in 2011 (Stehn 2011). In 2012, the population size remained in the 500s (Whooping Crane Conservation Association 2013). The only remaining natural breeding area for whooping cranes is in Canada. The birds winter in the coastal wetlands of the Aransas National Wildlife Refuge in Texas.

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 (USFWS 2012). It is possible that whooping cranes may temporarily utilize emergent wetlands, and areas adjacent to the Trinity River and Crow Lake within the ROI during their annual migration but an encounter would be a rare occurrence. The USFWS Whooping Crane 5-Year Review states that whooping cranes are unlikely to use large metropolitan areas (USFWS 2012). It is unlikely that any of the current activities or proposed modifications to the floodplain would have an adverse impact on this species (USFWS 2014).

In the unlikely event that whooping cranes are observed in the ROI, the USFWS and TPWD would be notified to discuss alternative development plans or the need for consultation under Section 7 of the ESA (USFWS 2014).

Wood Stork

The wood stork is listed as threatened by the state of Texas (TPWD 2013). The work stork prefers low-lying wetland areas that may be seasonably flooded. When natural wetland cycles are disturbed, wood storks often fail to nest successfully. This species usually roosts in tall snags (TPWD 2013). The majority of wood storks in the U.S. nest in Florida (City of Dallas 2008).

Wood storks occur in the Dallas area during migration, usually July through September. In 2009 and 2010, wood storks were only reported at the Trinity Audubon Center, approximately 5 miles southeast of the southeastern edge of the ROI. In 2011 and 2012, additional observations of work storks in the Dallas area were reported. On June 12, 2012, one wood stork was observed in the northern portion of the ROI, near the Elm Fork of the Trinity River and IH-35 (Ebird 2013). Wood storks are observed at the Trinity River Audubon Center during fall migration from late July to October or November. In July 2012, a high of 122 wood storks were observed at the Trinity Audubon Center (Ebird 2013). This species could use the ROI as a stopover location during migration (TPWD 2013). If a wood stork is encountered in the breeding

season during pre-construction bird surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Mollusks

Three species of state-listed threatened mussels occur in Dallas County and have the potential to occur in aquatic riverine or open water habitat in the ROI (refer to Table 3.5-5). The three species include Texas pigtoe (*Fusconaia askewi*), Louisiana pigtoe (*Pleurobema riddellii*), and Texas heelsplitter (*Potamilus amphichaenus*). These three mussel species have been petitioned for federal listing (TPWD 2013).

Louisiana pigtoe and Texas heelsplitter had a USFWS positive 90-day finding, i.e. the USFWS has found that substantial scientific or commercial information in a petition indicates that the petitioned action may be warranted. Upon making a positive finding, the USFWS is required to promptly commence a review of the status of the species concerned, during which the USFWS conducts a comprehensive review of the best available scientific and commercial information. The outcome of the review is called a 12-month finding; however, the 12-month finding often takes longer than 12 months to complete. For the Louisiana pigtoe and Texas heelsplitter, the 12-month finding will not be issued until after 2016 (USFWS 2011).

During a 2012 presence/absence survey mussel beds and state-listed mussels were documented in the Trinity River, in the Horseshoe Project area. According to TPWD, state-listed mussels occur upstream of the Elm Fork. These species are most likely to occur in aquatic riverine habitat in the Elm and West Forks in the Confluence and in the Mainstem groups in the Trinity River. Research is being conducted at Texas A&M but there are still many unknowns about mussel habitat requirements (TPWD 2013). Texas pigtoe is known to occur in the ROI. It was found at the IH-30 and IH-35E crossings of the Trinity River during 2011 mussel surveys for the Dallas Horseshoe Project (USDOT 2012, TPWD 2013). Texas pigtoe were also observed in 2012 in the Elm Fork, upstream of the ROI (TPWD 2013).

The City of Dallas would coordinate with the TPWD and Texas Commission on Environmental Quality to create an Aquatic Resource Recovery, Relocation, and Monitoring Plan or similar method to minimize impacts to mussel beds and other sensitive aquatic resources (TPWD 2013).

Reptiles

Alligator Snapping Turtle

The alligator snapping turtle is listed as threatened by the state of Texas (TPWD 2013). The alligator snapping turtle is the largest freshwater turtle in North America and one of the largest freshwater turtles in the world. The alligator snapping turtle requires perennial water bodies as it is highly aquatic, spending most of its life submerged. These turtles utilize rivers, creeks, estuaries, ponds, lakes, and wetlands for their habitats and prefer deep water with a mud bottom and abundant aquatic vegetation. Distribution of this species stretches from east Texas through the southeast to the panhandle of Florida, and north along the Mississippi River Valley. Dallas County is the western edge of its range.

The ROI contains perennial water bodies that this species could use; however, there is no recent evidence of the alligator snapping turtle in the area (TPWD 2013). If an alligator snapping turtle is encountered during pre-construction surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Texas Horned Lizard

The Texas horned lizard is listed as threatened by the state of Texas but is widespread and relatively stable in some areas of south-central U.S. and northern Mexico (TPWD 2013, NatureServe 2009).

The preferred habitat of the Texas horned lizard is open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees; soil may vary in texture from sandy to rocky. The Texas horned lizard burrows into soil, enters rodent burrows, or hides under rock when inactive (TPWD 2013).

This species has a low potential to occur in the ROI. The soil on the levees is hard and compacted and the majority of the soil in the Dallas Floodway is moist; however, there could be pockets of loose sandy soil in the ROI that the Texas horned lizard could use. If a Texas-horned lizard is encountered during pre-construction surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Timber Rattlesnake

The timber rattlesnake is listed as threatened by the state of Texas (TPWD 2013). The distribution of the timber rattlesnake stretches from the east coast westward into Texas, and as far north as New England. In the southern portions of its range, this species prefers to make its den in somewhat swampy, wetland habitats. The Dallas-Fort Worth Metroplex represents the far western edge of its range, and is characterized by drier conditions than generally preferred by this snake. Populations tend to be higher in eastern Texas where greater concentrations of wetlands and humid forests are found. Forested areas located near permanent water sources are also used, as fallen debris from trees can act as refuge for the timber rattlesnake.

Within the proposed ROI, possible habitat includes bottomland hardwoods (TPWD 2013). Higher quality habitat for this species occurs in southeast of the ROI in the Great Trinity Forest. If a timber rattlesnake is encountered during pre-construction surveys or during construction of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact.

Conclusion

No federally listed species are known to reside or breed in the ROI; therefore, no impacts to federally listed species are anticipated. If a federally listed bird is observed in the ROI during the breeding season, the USFWS would be notified to discuss alternative development plans or the need for consultation under Section 7 of the ESA.

If a state listed species is encountered in the project area of project elements sponsored by the City of Dallas, TPWD would be notified to discuss ways to minimize any potential impact. TPWD would be notified and a mussel relocation plan would be developed prior to any work aquatic riverine habitat known to support state-listed mussels.

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United States Department of the Interior

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April 8, 2014

Colonel Charles H. Klinge Jr., P.E.
Commander, Fort Worth District, US Army Corps of Engineers Fort Worth, TX
U.S. Army Corps of Engineers
(Attn: Marcia Hackett, CESWF-PER-EC)
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Fort Worth, Texas 76102-0300

Dear Colonel Klinge:

We have received and reviewed the Dallas Floodway Project Environmental Impact Statement Draft Threatened and Endangered Species Report, April 2014 as prepared by Cardno TEC, Inc. Upon review of this document and our information, we concur with the determination that the Dallas Floodway Project is not likely to adversely impact federally listed species known to occur in Dallas County, Texas. We believe that this conclusion is sound and well supported due to a lack of suitable habitats within the action area and the presence of ongoing human disturbances. If any federally listed species are encountered during project construction, please contact this office to discuss additional avoidance measures or to initiate consultation under Section 7 of the Endangered Species Act.

If you need any additional information or have questions, please contact Mr. Sean Edwards of this office at 817-277-1100.

Sincerely,

for Debra Bills
Field Supervisor

Draft

BALANCED VISION PLAN
MONITORING AND ADAPTIVE MANAGEMENT PLAN

APRIL 2014

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List of Tables

Acronyms and Abbreviations

BVP	Balanced Vision Plan
CWWTP	Central Wastewater Treatment Plant
EIS	Environmental Impact Statement
EWLIDS	East and West Levee Interior Drainage Systems
FRM	Flood Risk Management
HEP	Habitat Evaluation Procedure
IBI	index (or indices) of biotic integrity
IDP	Interior Drainage Plan
IDS	Interior Drainage System
MAMT	Monitoring and Adaptive Management Team
PAR	Planning Aid Report
PED	Pre-Construction, engineering and design
PDT	Project delivery team
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TXRAM	Texas Rapid Assessment Method
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

This document outlines the feasibility level Monitoring and Adaptive Management Plan for the Balanced Vision Plan (BVP) Study Ecosystem Restoration and Habitat Enhancement within the Dallas Floodway Project. This plan identifies and describes the monitoring and adaptive management activities proposed for the Proposed Action and duration. This plan will be further developed in the pre-construction, engineering, and design (PED) phase as specific design details are made available.

This BVP Monitoring and Adaptive Management Plan describes and justifies that monitoring and adaptive management are needed under the alternatives identified in the Environmental Impact Statement (EIS) prepared for the Dallas Floodway Project. The plan outlines how the results of the project-specific monitoring program would be used to adaptively manage the project, including specification of conditions that will define project success.

The primary intent of this Monitoring and Adaptive Management Plan is to develop monitoring and adaptive management actions appropriate for the project's restoration goals and objectives. The presently identified management actions permit estimation of the adaptive management program costs and duration for Alternatives 2 and 3, as outlined in the Dallas Floodway Project EIS. This plan is based on currently available data and information developed during the EIS, plan formulation as part of the Feasibility Study, U.S. Fish and Wildlife (USFWS) Planning Aid Report (PAR), USFWS Coordination Act Letter, and the 404(b)(1) analysis.

Uncertainties remain regarding the exact project features, monitoring elements, and adaptive management opportunities. Components of the Monitoring and Adaptive Management Plan were estimated using currently available information. Uncertainties will be addressed in PED, and a detailed monitoring and adaptive management plan, including cost breakdown, will be drafted by the project delivery team (PDT) as a component of the design document.

2.0 AUTHORITY AND PURPOSE

Proposed actions including ecosystem restoration are required to include a plan for monitoring the success of the restoration (Section 2039, Water Resources Development Act of 2007): "*Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits*." Section 2039 also directs that a Contingency Plan (Adaptive Management Plan) be developed for all ecosystem restoration projects.

3.0 PROJECT GOALS AND OBJECTIVES

The goals and objectives of the BVP Study Ecosystem Restoration and Habitat Enhancement are to:

- create and restore structure and function of aquatic riverine, open water, emergent wetland, bottomland hardwoods, and native grasslands (meadows)in the Dallas Floodway;
- improve water quality in the Trinity River and surrounding aquatic habitats;
- improve and increase habitat for native aquatic and terrestrial wildlife;
- create and restore stop-over and breeding habitat for migratory birds;
- remove non-native invasive plants and animals;
- to restore ecosystems without reducing the level of Flood Risk Management;

- identify and implement ecologically sound ways to use available water; and
- maximize ecosystem benefits as well as provide secondary positive recreational benefits.

4.0 MANAGEMENT AND RESTORATION ACTIONS

The Proposed Action is described in detail in Chapter 2 of the Dallas Floodway Project EIS. The BVP Study Ecosystem Restoration and Habitat Enhancement components proposed under both Alternatives 2 and 3 are included in this Plan.

All BVP Study restoration activities are the same for Alternatives 2 and 3 except the amount of meadow (native grassland) habitat that will be planted. These restoration elements include the development of three lakes, modification to the course of the Trinity River, and construction of approximately 179 acres of emergent wetlands and 100 acres of bottomland hardwoods (Table 1).

Table 1. Alternatives 2 and 3 BVP Study Ecosystem Restoration Components

Restoration Component		*Habitat Type*	*Acres of Habitat*
Lakes and surrounding Fringe Wetlands	West Dallas Lake	Open Water	123
		Emergent Wetland	7
	Urban Lake	Open Water	84
		Emergent Wetland	2
	Natural Lake	Open Water	49
		Emergent Wetland	7
River	Realignment and Modification	Aquatic Riverine	208
Wetlands	Forested Wetlands Corinth Wetlands Additional Emergent Wetlands	Bottomland Hardwood Emergent Wetland	163
Bottomland Hardwood	Bottomland Hardwood	Bottomland Hardwood	100

Source: USFWS 2014.

Alternative 2 includes 887 acres of meadow and Alternative 3 includes 844 acres of habitat. A description of the ecosystem components follows below.

4.1 LAKES

West Dallas Lake

The West Dallas Lake would approximately 123 acres of open water habitat and an additional **7** acres of wetland habitat. The lake would be a narrow body of water approximately 1.5 miles long and 18 feet deep. The lake would range between 600 to 700 feet in width and the estimated storage volume would be approximately 1,730 acre-feet. Water levels would be maintained between 12 and 18 inches from the top of bank by way of two spillways, one at each end of the lake. Filling water would be supplied to the lake during overflow flood events, when the Trinity River stage exceeds an elevation of 405 feet. Once the lake has been filled and when the Trinity River is below the spillway overflow elevation, make-up water for seepage and evaporation losses would be supplied to the lake by pumping water from the Trinity River into the lake via a small pump station (City of Dallas 2009a).

Natural and Urban Lakes

The estimated storage volumes for the Natural and Urban lakes are 630 and 1,020 acre-feet respectively. The two lakes would be connected by a narrow strait referred to as the "isthmus." Treated effluent from the Dallas Water Utility's Central Wastewater Treatment Plant (CWWTP) would be conveyed to the south end of the Natural Lake through an existing 60-inch diameter pipe and would enter the Natural Lake through an effluent discharge structure. The treated effluent would flow north through the isthmus into the Urban Lake, through the Urban Lake and through an outlet structure at the north end into an outlet channel, and through the outlet channel into the Trinity River. On average, up to 60 million gallons per day of treated effluent would be supplied to the lakes (City of Dallas 2009a).

The proposed lakes would be permitted by the Texas Commission on Environmental Quality (TCEQ) as impoundments and meet the current state and federal guidelines for definition of a dam. At least 18 inches of the lake bottom would be removed, the bottom be inspected for sand seams or other pervious materials, and clay would be added and compacted in relatively thin layers (6 to 8 inches) (City of Dallas 2009a).

Urban Lake

The Urban Lake is proposed to be approximately 84 acres, with an additional 2 acres of wetlands around its banks. The Urban Lake would be approximately one mile in length and average 800 feet in width. The lake would be 12 feet deep, and water elevation would average 399 feet. The Urban Lake would be the most developed of the three lakes, and would be edged with a formal promenade along the downtown side of the lake. The overflow weirs would be armored and controlled as dictated by hydrologic requirements. The overflow weirs would be set at elevation 404 and placed under existing and proposed bridges to limit hardscape areas of the Central Island.

Natural Lake

The Natural Lake would be located to the southeast of the Urban Lake, adjacent to the southern part of The Cedars and Cedars West areas. It is intended to provide a water recreation experience of a more natural character than the developed Urban Lake. The Natural Lake would be approximately 49 acres in size with an additional 7 acres of wetlands around its shores. The lake's water level would remain constant at an elevation of 402 feet and provide a depth of approximately 12 feet. The lake shore would have walking and biking paths and picnic or nature observation areas. Trees, grasses and other vegetation would create habitat for birds and wildlife. Water sports would include canoeing and kayaking, fishing and other family outdoor activities.

4.2 RIVER MODIFICATION

Past channelization and clearing of the Floodway, along with urbanization, has significantly degraded the natural terrestrial and aquatic habitat of the Floodway. The Trinity River now reflects little of its historic course, water quality, or habitat. Prior to the 1920s, the Trinity River's course through the City of Dallas included significant meandering consistent with a river of its geologic age. The construction of the Dallas Floodway Levee System essentially eliminated these meanders, and with it, high-value habitat and connections to adjacent ecosystems (U.S. Army Corps of Engineers [USACE] 2000).

Aquatic habitat in the Dallas Floodway area is limited as most of this reach of the Trinity River flows through a constructed channel. The banks are denuded and contain sparse vegetation. The sediment consists of slippery, clayey mud to fine sand. Bridge supports, concrete blocks, undercut banks, channel snags, and channel bed shape irregularities all provide limited aquatic habitat in the form of shelter, feeding zones, invertebrate colonization sites, and nursery pools (USACE 2000).

A major ecosystem restoration feature proposed by the BVP is the creation of sinuosity (i.e., bends) in the main channel of the river, with the goal of creating a more "natural" river. Approximately 8 miles of river channel would be realigned, from the confluence of the West and Elm Forks of the Trinity River downstream to the Dallas Area Rapid Transit Rail Bridge. While the existing channel pattern and channel profile would be altered substantially, the intent is to preserve the existing average slope of the channel profile while mimicking historical conditions.

The realigned river channel would have a stable channel pattern that would avoid encroaching within 200 feet of where the toe of the levee would be upon completion of the proposed 4:1 widening. The channel pattern would be offset from other BVP features by a distance sufficient to allow channel adjustments to occur without impacting other features over the life of the project. Where this is not possible, the channel would be strengthened, using bioengineering approaches that incorporate native vegetation and other natural materials.

To minimize the extent of channel bank armoring required in the channel realignment design, the channel pattern would be offset from all sensitive BVP features by the maximum migration corridor width described in the Geomorphic Assessment and Basis of Design document (City of Dallas 2009b). Terrace elevations would be set in relation to water surface elevations at effective flow frequencies, with stable slopes given local hydraulic, geotechnical, and vegetation conditions, and would include adequate terrace drainage. Landscape terrace elevations would be constructed to provide river access and views with safe and accessible slopes.

River terraces would be constructed along the banks of the realigned Trinity River and are intended to provide the functions and values of forested wetlands. This would be achieved by designing the river terraces to be graded to an elevation that would be completely inundated by river flows for at least 10 consecutive days during the growing season (i.e., from February 22 to December 11) for greater than 50% of the years (e.g., greater than 25 years out of 50 years). These areas would also be designed to include appropriate soil requirements to meet the proposed wetland conditions and planted with wetland plants considered typical for natural forested wetlands within the vicinity of the study area. The 15 river terraces would account for approximately 23 acres of forested wetlands.

Lower elevation (i.e., at or below the base flow water surface elevation) terraces would not be vegetated as frequent inundation would not support vegetation. Conversely, the landscape terraces set at a higher elevation would be vegetated. Species, locations, and planting density on higher geomorphic terraces and landscape terraces would be based on local inundation frequency, hydraulics, geotechnical conditions, channel roughness requirements and orientation of the terrace to the river channel and other project features.

River slopes would be designed based on local hydraulic conditions, maximum water force during high flows, local geotechnical conditions, proximity to other BVP features, and existing or proposed vegetation. Typical bank slopes would be designed for river reaches with similar conditions and would extend the length of a given reach. Transitions between different bank types would be designed to withstand hydraulic discontinuities and changes in water levels and energy.

The final design of all river modification features would satisfy all applicable standards for channel modifications within the Floodway. These include, but are not limited to, requirements of USACE, the City of Dallas, and TCEQ.

4.3 WETLANDS

The BVP Study envisions the construction of roughly 154 acres of new emergent and forested wetland habitat within the Dallas Floodway, as well as the enhancement of existing wetlands. The wetland environments would include newly constructed stormwater management wetlands, forested wetlands, and marshland wetlands. The City of Dallas also proposes to enhance existing emergent wetlands already occurring in the floodplain. These wetlands would be designed with the goal of improving overall water quality by removing nitrogen, phosphorus and other pollutants from urban runoff, and to increase both the amount and quality of plant and wildlife habitat in the Floodway. The wetlands would receive supplemental water from the interior drainage pump station outfalls, and by recycled water from the CWWTP.

Locally available sedges, water-willow (*Justicia americana*), softstem bulrush (*Schoenoplectus tabernaemontani*), water pennywort (*Hydrocotyle umbellata*), switchgrass, smartweeds (*Polygonum* sp.), and buttonbush (*Cephalanthus occidentalis*) will be planted.

Fringe Wetlands

The fringe wetlands include the wetlands constructed along the shoreline of Urban Lake, Natural Lake, and West Dallas Lake. The fringe wetlands would be planted with herbaceous hydrophilic species native to North Texas (as identified in City of Dallas 2009a) with appropriate species planted at appropriate levels along the slopes. Invasive species would be treated immediately through either biological or manual control. If chemical control is required, only herbicides approved for aquatic environments would be used. Urban Lake fringe wetlands would account for approximately two acres of emergent wetlands. Natural Lake fringe wetlands would account for approximately seven acres of emergent wetlands. West Dallas Lake fringe wetlands would account for approximately seven acres of emergent wetlands. The fringe wetlands would be of high value due to their ecotonal location between grassland and open water.

Flex Field Wetlands

The flex field wetlands would be constructed between the Athletic Fields and the Trinity River. These wetlands are intended to capture and treat stormwater runoff from the turf and paved areas associated with the Athletic Facilities and ultimately drain the treated stormwater to the Trinity River. These areas would also be inundated when flow in the Trinity River reaches 15,000 cubic feet per second (cfs) (flow with an approximately 1.5 year return interval). The eight stormwater management wetlands would account for approximately 20 acres of emergent wetlands.

Meadow Wetlands

Three meadow wetlands would be constructed between the Parkway/East Levee and the Trinity River. These wetlands are intended to capture and treat stormwater runoff from the paved areas associated BVP facilities and ultimately drain the treated stormwater to the Trinity River. A fourth meadow wetland would be located between the Pavaho Wetlands and the Trinity River and would receive water from the Pavaho Wetlands. Most of these areas would also be inundated when flow in the Trinity River reaches 15,000 cfs (flow with an approximately 1.5 year return interval). The four stormwater management wetlands would account for approximately 21 acres of emergent wetlands.

Crow Lake Wetland

The Crow Lake wetland would be constructed between the Parkway/East Levee and the Trinity River near Crow Lake. This wetland is intended to capture and treat stormwater runoff from paved areas

associated BVP facilities and ultimately drain the treated stormwater to the Trinity River. The Crow Lake wetland would account for approximately three acres of emergent wetlands.

Forested Ponds

Forested ponds would be constructed alongside the edge of the Urban Lake Promenade and near the Natural Lake Headwaters. The forested ponds along the Urban Lake Promenade would function as biofiltration areas capable of absorbing lake nutrients. These constructed wetland ponds would be planted with native North Texas bottomland hardwood species and other water-tolerant herbaceous plants (as identified in City of Dallas 2009a) capable of high rates of biofiltration. Forested ponds along the Urban Lake would be periodically filled with water from the bottom third of the Urban Lake. Pumped from the lake under the Promenade, lifted up and over the adjacent water wall, the water would first be aerated by the water wall and then further filtered by the ponds before finally returning to the Urban Lake. The wetland ponds would be 5 feet in depth and be equipped with overflow mechanisms to prevent overtopping. The seven forested ponds along Urban Lake would account for approximately three acres of forested wetlands.

Along the Natural Lake Headwaters, a forested pond would be designed to receive, retain and filter stormwater runoff from the bridge crossings proposed in other projects. The pond would have a retention area 4 feet deep, stretching like a plume from the headwaters to the Corinth Bridge. Filtered water would be released to the Natural Lake. This forested pond at the Natural Lake Headwaters would account for approximately seven acres of forested wetlands.

Corinth Wetlands

These emergent wetlands already exist in part at the southeast edge of the project, just before the Trinity River flows into the Great Trinity Forest, but are of poor quality. Under the BVP Component, there would be two separate wetlands (one on the "island" between the Trinity River and Oxbow Lake and one between the Trinity River and West Levee) that would be enhanced/restored through grading and planting with native North Texas wetland species in appropriate numbers and diversity (as identified in City of Dallas 2009c). These areas would be inundated when flow in the Trinity River reaches 15,000 cfs (flow with an approximately 1.5 year return interval). The two wetlands would account for a total of approximately 84 acres of emergent wetlands.

4.4 BOTTOMLAND HARDWOOD

Bottomland hardwoods are areas dominated by deciduous trees, usually along streams, and that are occasionally flooded. Depending on the frequency of flooding, bottomland hardwood may be riparian or forested wetland habitat. 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 and escape cover for birds and other animals within the Floodway. Large mast producing trees and shrubs provide food for forages. Brush piles and snags provide necessary food, cover, and shelter for a variety of species. Riparian forest habitats are essential in maintaining biodiversity and providing important wildlife travel corridors. The majority of the bottomland hardwoods would be planted along the southeastern portion of the Floodway near the new Trinity River Channel. Native mast producing trees and shrubs, such as pecan (*Carya illinoinensis*), bur oak (*Quercus macrocarpa*), black walnut (*Juglans nigra*), wild plum (*Prunus mexicana*), sumac (*Rhus* sp.), Texas hawthorne (*Crataegus texana*) should be planted in the expanded portion of the bottomland hardwoods to improve canopy cover and food base for native wildlife (refer to the planting list in Appendix M of the EIS).

4.5 MEADOWS

The meadow areas would be planted with a diverse range of native grasses and forbs, consistent with the numbers and species found in the north Texas Blackland Prairie Ecoregion. Meadow areas would be mowed annually in the late winter/early spring. This would allow the meadow to grow and thrive while simultaneously ensuring that successional shrubby and woodland species do not take hold (refer to the planting list in Appendix M of the EIS).

5.0 IMPLEMENTATION

Pre-construction, construction, and post construction monitoring would be conducted by utilizing a Monitoring and Adaptive Management Team (MAMT) consisting of representatives of the USACE, City of Dallas, and contracted personnel.

Monitoring will focus on evaluating project success and guiding adaptive management actions by determining if the project has met Performance Standards identified below. Performance Standards are the criteria that any proposed restoration or enhancement must meet to be considered successful. Validation monitoring will involve various degrees of quantitative monitoring aimed at verifying that restoration objectives have been achieved for both biological and physical resources. Effectiveness monitoring will be implemented to confirm that project construction elements perform as designed. Monitoring will be carried out until the project has been determined to be successful (performance standards have been met).

Habitat quality monitoring objectives are tied to original baseline measurements that were performed for emergent wetlands, bottomland hardwoods, and grasslands during USFWS Habitat Evaluation Procedure (HEP) surveys from 2004 to 2006. These data are included in the 2014 PAR (USFWS 2014).

Wetland monitoring will also include Texas Rapid Assessment Method (TXRAM) evaluations (refer to the 404(b)(1)). A functional assessment for Regulatory Program needs (i.e., TXRAM) was applied to assess these features and generated TXRAM scores ranging from 53 to 61 for emergent wetlands in the Floodway (Halff Associates 2011). These scores reflect the baseline conditions of the existing wetlands to be restored, enhanced, or relocated. Existing wetlands exhibit poor hydrologic connectivity, limited buffers, and the topographic and vegetative simplicity and homogeneity of existing wetlands. These conditions limit the value of emergent wetlands to wildlife.

Aquatic riverine baseline data was extrapolated from 2004 Assessment of Trinity River Fisheries within the Proposed Dallas Flood Control Project Area Index of Biotic Integrity (IBI) (USFWS 2014). Open water baseline surveys were conducted in 2010 and are included in the Lentic (open water) IBI, an appendix in the PAR.

Adaptive management measures will be considered upon the first instance of failure to meet a performance standard. Performance standards are included in Sections 5.1, 5.2, and 5.3. Metrics and specific adaptive measure triggers will be refined during PED.

5.1 VEGETATION

Metrics compiled during PAR surveys will be used for baseline vegetation data. Table 2 presents the vegetation monitoring criteria (i.e., the criterion being measured), performance standards for that criterion, and adaptive management strategies available for meeting those performance standards.

Table 2. Success Criteria and Adaptive Management Techniques for Habitat Restoration

Measurement	*Performance Standard*	*Adaptive Management*
Open Water		
Non-native invasive species	Prevent establishment of invasive aquatic species	Chemical and mechanical removal
Aquatic Riverine		
Riparian vegetation along the river banks (River terraces).	> 75% tree cover within the 23 acres of riparian terrace.	Supplemental bank planting if necessary
Non-native invasive species	Prevent establishment of invasive aquatic plant species	Chemical and mechanical removal
Emergent Wetlands		
Aquatic and emergent vegetation	> 50% absolute cover	Supplemental planting /seeding; modification of plant species composition; amending the soil; increased irrigation
Non-native invasive species	< 10% absolute cover of non-native species; no establishment of invasive weeds	Chemical and mechanical removal
Bottomland Hardwoods		
Woody stem density	70 stems per acre	Replacement of dead woody vegetation; modify woody species composition or location within the assigned habitat category area; allow natural succession of native woody species
Hard mast producing trees	> 75% of the trees	Replacement of dead woody vegetation
Soft mast producing trees	< 25% of the trees	Removal of individuals if percentage is too high
Non-native invasive species	< 25% absolute cover of non-native species; no establishment of invasive weeds	Chemical and mechanical removal
Meadow		
Native plant cover	> 80% absolute cover	Supplemental planting /seeding; modification of plant species composition; amending the soil; increased irrigation
Non-native invasive species	< 20% absolute cover of non-native species; no establishment of invasive weeds	Chemical and mechanical removal
Bare ground	< 20% bare ground	Not applicable

5.2 WILDLIFE

Wildlife will be documented during vegetation and TXRAM monitoring. Existing habitat in the Floodway surrounding the Trinity River is low quality non-native grassland and low quality depressional wetlands. Therefore, wildlife abundance and diversity is expected to increase as the habitat is restored (Table 3).

Table 3. Wildlife Success Criteria and Adaptive Management Techniques within Restored Areas

Measurement	*Performance Standard*	*Adaptive Management*
Wildlife	Diversity and species composition within expected ranges based on reference sites.	Investigate causes of low diversity. Provide temporary enhancements of food, cover, nest sites, or other resources that appear limiting.

5.3 AQUATIC FAUNA SPECIES

In the PAR and IBI analysis, the open water and aquatic riverine habitats within the Floodway were found to have high fish diversity and abundance. Since the new lakes would begin with zero fish diversity and abundance, the USFWS recommended a fish stocking program (USFWS 2014). Fish, mussel, and aquatic species diversity and abundance will take time to get established in the lakes and in the new segments of the Trinity River. A detailed fish, mussel, and other aquatic species monitoring plan is recommended to define appropriate management to meet the performance standards identified in Table 4.

Table 4. Aquatic Species Success Criteria and Adaptive Management Techniques within Open Water and Aquatic Riverine Habitats

Measurement	*Performance Standard*	*Adaptive Management*
Aquatic species	Maintain aquatic species diversity and abundance.	Develop a Texas Parks and Wildlife Department Aquatic Resources and Relocation Plan.
Fish and Invertebrates	Diversity and species composition within expected ranges based on reference sites.	Investigate causes of low diversity. Assist colonization if dispersal is limiting.
Native Mussels	Native mussel species and diversity are expected within the new Trinity River alignment with similar densities as the mussels documented in the Trinity River prior to realignment.	Manage mussels according to the Aquatic Resources and Relocation Plan listed under "Aquatic Species."
Non-native invasive aquatic species	Prevent establishment of invasive aquatic animal species.	Chemical and mechanical removal. Programs to prevent the infestation of zebra mussels.

5.4 AQUATIC RIVERINE HYDROLOGY

The channel design of the Trinity River is designed to mimic natural stream flow systems with riffle, pool, and run sections where appropriate and processes such as sediment transport, energy dissipation, and channel formation. The channel would be constructed with water bodies with shelved floors of variable depths and appropriate substrates such as boulders and cobbles, where possible, to provide adequate habitat cover and spawning conditions. Canopy overhang, which would shade the water's edges (i.e. river banks), would improve habitat conditions. Sediment transport, bank erosion, and re-deposition of sediments will be monitored.

6.0 REPORTING

Evaluation of the success of the Dallas Floodway Restoration will be assessed annually until all performance standards are met. Different components of the BVP will be monitored according to different schedules, in different seasons and with different frequencies as appropriate to the feature of interest. The results, however, will be consolidated in an annual report by the MAMT. The report will be submitted to the USFWS, TPWD, the USACE, City of Dallas, and other interested parties by January 31 following each monitoring year.

7.0 MONITORING AND ADAPTIVE MANAGEMENT PLAN COSTS

Costs to be incurred during PED and construction phases include creating and implementing a detailed monitoring and adaptive management plan for planting, monitoring, and maintenance of lake, emergent wetland, riparian scrub, and bottomland hardwood vegetation and habitat success standards.

It is intended that monitoring conducted under the Dallas Floodway BVP Study Ecosystem restoration and habitat enhancement would utilize centralized data management, data analysis, and reporting functions associated with a Sharepoint® site. All data collection activities will follow consistent and standardized processes established in the detailed monitoring and adaptive management plan. Cost estimates will include monitoring equipment, photo point establishment, data collection, quality assurance/quality control, data analysis, assessment, and reporting for the proposed monitoring elements. Unless otherwise noted, costs will begin at the onset of the PED phase and will be budgeted as construction costs.

Costs for monitoring and adaptive management associated with project elements that are part of the Federal Recommended Plan are incorporated in the Dallas Floodway Feasibility Report, Appendix I (USACE 2014). Costs for monitoring and adaptive management of project elements for which the City of Dallas is the proponent would be estimated at the time of project design and included in the City Section 408 package to be submitted to the USACE for authorization to construct.

8.0 REFERENCES

City of Dallas. 2009a. Schematic Design Report: Natural, Urban and West Dallas Lakes. September.

City of Dallas. 2009b. Final Report: Trinity River Corridor Project: Fluvial Geomorphic Assessment and Basis of Design for River Realignment. Prepared by CH2M HILL. September.

City of Dallas. 2009c. Trinity River Corridor Design Guidelines. August.

Halff Associates. 2011. Re-verification of Dallas Floodway Jurisdictional Determination (USACE# SWF-2000-00308). January.

USACE. 2000. Final Programmatic Environmental Impact Statement: Upper Trinity River Basin, Trinity River, Texas.

USACE. 2014. Dallas Floodway Project Draft Feasibility Report. April.

USFWS. 2014. PAR for the Dallas Floodway Project. Dallas County, Texas. January.

Dallas Floodway BVP Landscaping Plant Habitats and Species

Below are vegetation descriptions and planting tables from the Design Guidelines for BVP Study: Ecosystem and Recreation features.

Grasslands

Meadow. The meadow areas would be planted with a diverse range of **native** grasses and forbs, consistent with the numbers and species found in the north Texas Blackland Prairie Ecoregion. Meadow areas would be mowed annually in the late winter/early spring. This would allow the meadow to grow and thrive while simultaneously ensuring that successional shrubby and woodland species do not take hold.

Table 1. Meadow Species

Scientific Name	*Common Name*	*Vegetation Type*
Anisacanthus quadrifidus var *wrightii*	Flame acanthus	Shrub
Andrdpdgon gerardi	Big bluestem	Grass
Castilleja spp.	Indian paintbrush	Forb
Coreopsis grandiflora	Large flower tickseed	Forb
Desmodium psilophyllum	Tick clover	Forb
Echinacea purpurea	Purple coneflower	Forb
Elymus virginicus	Virginia wildrye	Grass
Gaillardia pulchella	Indian blanket	Forb
Glandularia bipinnatifida	Prairie verbena	Forb
Helianthus maximiliani	Maximilian sunflower	Forb
Liatris pycnostachya	Prairie blazing star	Forb
Lobelia cardinalls	Red lobelia	Forb
Malvaviscus arboreus var drummonii	Turk's cap	Shrub
Monarda citriodora	Horsemint	Forb
Muhlenbergia capillaris	Purple muhly	Grass
Muhlenbergia lindheimeri	Big muhly	Grass
Muhlenbergia rigens	Deer grass	Grass
Nassella tenuiss (Stipa tenuissima)	Mexican feather grass	Grass
Panicum virgatum	Switch grass	Grass
Pavonia lasiopetala	Rock rose	Forb
Phlox andicola	Prairie phlox	Forb
Ratibida columnaris	Mexican hat	Forb
Salvia azurea	Blue sage	Shrub
Salvia greggii	Autumn sage	Shrub
Salvia leucantha	Mexican bush sage	Shrub
Schizachyrium scaparium	Little bluestem	Grass
Solidago (Euthamia) spp	Goldenrod	Forb
Sorghastrum nutans	Indiangrass	Grass
Spartina pectinata	Prairie cordgrass	Grass
Symphyotrichum ericoides	Heath aster	Forb
Tecoma stans	Yellow bells	Shrub
Tripsacum dactyloides	Eastern gamagrass	Grass
Yucca constricta	Buckley's yucca	Shrub

Urban Forest. Urban Forest is grouped with grasslands because it has lower habitat value than native forests due to it being comprised of primarily nonnative trees in an urban setting.

Table 2. Canopy/Shade Trees

Scientific Name	*Common Name*
Acer grandidentatum	Bigtooth maple
Acer negundo	Box elder
Aesculus glabra var *arguta*	Texas buckeye
Carya illinoinensis	Pecan
Carya texana	Texas hickory
Catalpa bignonioides	Southern catalpa
Fraxinus texensis	Texas ash
Gleditsia triacanthos	Honey locust
Juglans nigra	Black walnut
Magnolia grandiflora	Magnolia
Magnolia virginiana	Sweetbay magnolia
Maclura pomifera 'white shield'	Osage orange
Nyssa sylvatica	Sourgum
Platanus occidentalis	American sycamore
Platanus acerfolium	London plane tree
Populus deltoides var *occidentalis*	Texas cottonwood
Quercus macrocarpa	Bur oak
Quercus muehlenbergii	Chinquapin oak
Ulmus americana	American elm
Ulmus crassifolia	Cedar elm
Ulmus parvifolia	Lace bark elm

Table 3. Ornamental Trees and Shrubs

Scientific Name	*Common Name*	*Vegetation Type*
Acer truncatum	Shatung maple	Tree
Cercis canadensis	Eastern redbud	Tree/shrub
Cercis canadensis var *texensis*	Texas redbud	Tree/shrub
Chilopsis catalpa	Chitalpa	Tree/shrub
Chilopsis linearis	Desert willow	Tree/shrub
Chionanthus virginicus	Fringe tree	Tree/shrub
Cornus drummondii	Roughleaf dogwood	Tree/shrub
Crataegus texana	Texas hawthorn	Tree/shrub
Ilex decidua	Possumhaw holly	Tree/shrub
Juniperus virginiana	Eastern redcedar	Tree
Lagerstroemia indica	Crape myrtle	Tree/shrub
Malus sp *prairie fire*	Crabapple	Tree/shrub
Malus ioensis	Prairie crabapple	Tree/shrub
Metasequoia glyptostroboides	Dawn redwood	Tree/shrub
Morus microphylla	Texas mulberry	Tree/shrub

Scientific Name	*Common Name*	*Vegetation Type*
Prunus mexicana	Mexican plum	Tree/shrub
Quercus polymorpha	Monterrey oak	Tree/shrub
Rhamnus caroliniana	Carolina buckthorn	Tree/shrub
Rhus copallinum	Flameleaf sumac	Tree/shrub
Rhus lanceolata	Prairie sumac	Tree/shrub
Sophora affinis	Texas sophora	Tree/shrub
Taxodium ascendens	Pond cypress	Tree
Taxodium distichum	Bald cypress	Tree
Ulmus parvifolia	Lace bark elm	Tree
Ulmus parvifolia 'bosque'	Elm 'bosque'	Tree
Ungnadia speciosa	Mexican buckeye	Tree
Viburnum rufidulum	Rusty blackhaw viburnum	Tree/shrub
Vitex agnus-castus	Chaste tree (Prairie crabapple)	Tree/shrub

Turf. Turf areas are to mowed at least twice a month ; certain areas would be irrigated while others will not. Turf species would be decided based on expected use and whether or not the area would be irrigated.

Table 4. Turf

Scientific Name	*Common Name*	*Vegetation Type*
Buchloe dactyloides	Buffalo grass	Ground cover
Cynodon dactylon	Bermuda	Ground cover
Zoysia japonica	Zoysia	Ground cover

Emergent Wetlands

Low Marsh. Low marsh areas would be planted with herbaceous and woody hydrophilic species, with appropriate plant species planted at appropriate inundation levels. Low marsh plants can handle being inundated with up to a foot and half of water.

Table 5. Low Marsh Species (Emergent Wetland)

Scientific Name	*Common Name*	*Vegetation Type*
Eleocharis palustris	Creeping spikerush	Sedge
Hemarthria altissima	Limpograss	Grass
Hibiscus laevis	Scarlet rose mallow	Shrub
Sagittaria spp.	Arrowhead	Forb
Schoenoplectus (Scirpus) acutus	Hardstem bulrush	Sedge
Scirpus cyperinus	Woolgrass	Sedge
Typha domingensis	Southern cattail	Forb
Zizaniopsis miliacea	Giant cutgrass	Grass

High Marsh. High marsh areas would be planted with herbaceous and woody hydrophilic species, with appropriate plant species planted at appropriate inundation levels. High marsh plants can handle being inundated with up to six inches of water.

Table 6. High Marsh Species (Emergent Wetland)

Scientific Name	*Common Name*	*Vegetation Type*
Carex cherokeensis	Cherokee sedge	Sedge
Elymus virginicus	Virginia wildrye	Grass
Juncus mexicanus	Mexican rush	Rush
Lobelia cardinalis	Cardinal flower	Forb
Panicum virgatum	Switch grass	Grass
Sorghastrum nutans	Indiangrass	Grass
Tripsacum dactyloides	Eastern gamagrass	Grass

Bottomland Hardwood

Riparian. Riparian areas would be planted with canopy, mid-canopy, and smaller trees, as well as, an understory of shrubs, saplings, and herbaceous vegetation. These areas would be densely planted with species adapted to wetter conditions at the river's edge and those less tolerant would be planted higher up the river's banks. Natural regeneration and successional processes would be allowed to proceed.

Table 7. Riparian Species

Scientific Name	*Common Name*	*Vegetation Type*
Acer negundo	Box elder	Canopy tree
Callicarpa americana	American beautyberry	Shrub
Carex cherokeensis	Cherokee sedge	Sedge
Chionanthus virginicus	Fringe tree	Understory tree
Cornus drummondii	Roughleaf dogwood	Understory tree
Crataegus texana	Texas hawthorne	Understory tree
Desmodium psilophyllum	clover	Forb
Diospyrus texana	Texas persimmon	Understory tree
Elymus virginicus	Virginia wildrye	Grass
Gleditsia triacanthos	Honey locust	Canopy tree
Hemarthria altissima	Limpograss	Grass
Ilex deciduas	Possumhaw holly	Understory tree
Ilex vomitoria	Yaupon holly	Understory tree
Juncus arcticus (balticus)	Baltic rush	Rush
Mahoia trifoliolata	Agarita	Shrub
Monarda citriodora	Horsemint	Forb
Muhlenbergia rigens	Deer grass	Grass
Nyssa sylvatica	Sourgum	Canopy tree
Panicum virgatum	Switch grass	Grass
Parthenocissus qu/nquefolia	Virginia creeper	Shrub (woody vine)
Paspalum distichum	Knotgrass	Grass
Platanus occidentalis	American sycamore	Canopy tree
Poa autumnalis	Autumn bluegrass	Grass
Populus deltoides var *occidentalis*	Texas cottonwood	Canopy tree
Sambucus nigra	Common elderberry	Shrub

Scientific Name	*Common Name*	*Vegetation Type*
Schoenoplectus (Scirpus) acutus	Hardstem bulrush	Sedge
Spartina pectinata	Prairie cordgrass	Grass
Ulmus americana	American elm	Canopy tree
Viburnum acerifolium	Mapleleaf viburnum	Shrub

Floodplain Forests. These groves would include canopy and understory tree species that can withstand being occasionally flooded. With the exception of invasive species control, these areas would receive very limited management. Natural regeneration and successional processes would be allowed to proceed.

Table 8. Floodplain Trees

Scientific Name	*Common Name*
Acer negundo	Box elder
Aesculus glabra var *arguta*	Texas buckeye
Carya illinoinensis	Pecan
Chionanthus virginicus	Fringe tree
Cornus drummondii	Roughleaf dogwood
Crataegus texana	Texas hawthorne
Diospyrus texana	Texas persimmon
Gleditsia triacanthos	Honey locust
Ilex decidua	Possumhaw holly
Ilex vomitoria	Yaupon holly
Magnolia virginiana	Sweetbay magnolia
Maclura pomifera 'white shield'	Osage orange
Nyssa sylvatica	Sourgum
Rhamnus caroliniana	Carolina buckthorn
Rhus copallina	Flameleaf sumac
Taxodium ascendens	Pond cypress
Taxodium distichum	Bald cypress
Tripsacum dactyloides	Eastern gamagrass
Ulmus americana	American elm
Ulmus crassifolia	Cedar elm

Plant Palette

The following tree palette was chosen after an extensive processes. A possible list of appropriate tree species was created based on research and feedback from WRT, URS, and CH2MHill representatives. This list was then further edited based on comments from a wide array of team members and city officials, including the city forester, and the local availability of the specie. Tree species that were not chosen and reasons why remain in the list below so that the reader can see all species that were considered.

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not Acceptable

Canopy Trees


Bigtooth Maple
Acer grandidentatum

- Readily available
- Native to Texas, adapted to Dallas County
- Grows best in thin soils


Caddo Maple
Acer barbatum

- Readily available
- Native to Texas, adapted to Dallas County
- Grows best in more acidic soils


Box Elder
Acer negundo

- Not available
- Native to Dallas County area, riverbed
- Good flodplain option


Bowhall Maple
Acer rubrum "Bowhall"

- Somewhat available
- Hybridized upright form, adapted to Dallas County
- Grows best in more acidic soils


Red Maple
Acer rubrum "Red Super Sonic"

Somewhat available

- Hybridized upright form, adapted to Dallas County
- Grows best in more acidic soils


Drummond Red Maple
Acer rubrum var drummondii

- Readily available
- Native to Texas, adapted to Dallas County
- Grows best in more acidic soils


Shantung Maple
Acer truncatum

- Readily available
- Not native, adapted to Dallas County
- Very adaptable tree
- Small size could allow it in median


Texas Buckeye
Aesculus Glabra var arguta

- Somewhat available
- Native to Dallas County area
- One of the first to bloom and drop leaves
- Difficult to transplant


Hornbeam
Carpinus betulus "Columnaris"

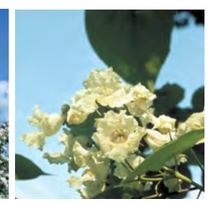
- Somewhat available
- Hybridized upright form
- May have trouble with heat, not a good choice for parkway


Pecan
Carya illinoinensis

- Readily available
- Native to Dallas County area
- Very adaptable
- References Texas heritage


Texas Hickory
Carya texana

- Somewhat available
- Native to Dallas County area
- Native Hickory
- Heat tolerant

Southern Catalpa
Catalpa bignonioides

- Not available
- Native to Texas, adapted to Dallas County
- Good floodplain choice

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not acceptable

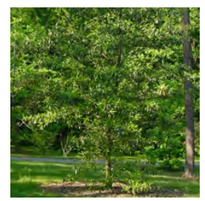
Canopy Trees


Texas Ash
Fraxinus texenis

- Readily available
- Native to Dallas County area
- Specify Texas Ash, not white or green
- Smaller, more drought tolerant


Sweetgum "Rotundifolia"
Liquidambar styraciflua "Rotundifolia"

- Readily available
- Hybridized form, no seeds
- Adapted to Dallas County
- More suited to East Texas




Sweetbay Magnolia
Magnolia virginiana

- Readily available
- Native to East Texas, adapted to Dallas County area
- Fragrant, adaptable tree


Honey Locust
Gleditsia triacanthos

- Readily available
- Native to Texas, adapted in Dallas County
- Very adaptable, found in existing forest
- Plant thornless variety


Fastigiate Sweetgum
Liquidambar styraciflua "Slender Silhouette"

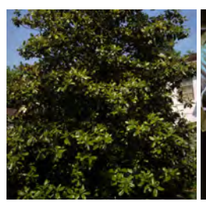
- Somewhat available
- Hybridized form, adapted to Dallas County
- More suited to East Texas


Osage Orange
Maclura pomifera "White Shield"

- Somewhat available
- Native to Dallas County area
- Good floodplain/bioengineering choice

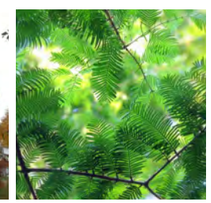

Black Walnut
Juglans nigra

- Readily available
- Native to Texas, adapted to Dallas County, riverbed
- Alliopathic



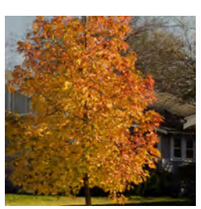
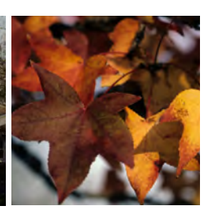

Magnolia
Magnolia grandifolia

- Readily available
- Native to Texas, adapted to Dallas County
- Good cultivar choice "Claudia Wanamaker"
- Lovely grand tree

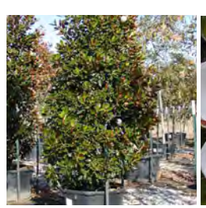
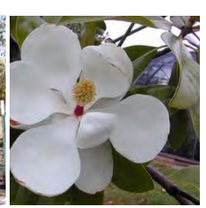
Dawn Redwood
Metasequoia glyptostroboides

- Readily available
- Not native, adapted to Dallas County
- Strong tap root

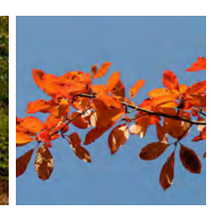
Sweetgum
Liquidambar styraciflua

- Readily available
- Native to Texas, adapted to Dallas County
- More suited to East Texas

Magnolia "Little Gem"
Magnolia grandifolia

- Readily available
- Hybridized form, adapted to Dallas County
- Smaller, more pyramidal form

Sourgum
Nyssa sylvatica

- Somewhat available
- Native to Dallas County area
- Not drought tolerant, but can stand wet feet

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not acceptable

Canopy Trees

Chinese Pistache
Pistacia chinensis

- Readily available
- Not native, adapted to Dallas County
- Very heat tolerant and adaptive
- Great Fall color

American Sycamore
Plantanus occidentalis

- Somewhat available
- Native Dallas County area, riverbed
- Likes floodplain, adaptable

London Plane Tree
Platanus acerifolium

- Readily available
- Not native, adapted to Dallas County
- Provides lots of shade, adaptable

Texas Cottonwood
Populus deltoids var occidentales

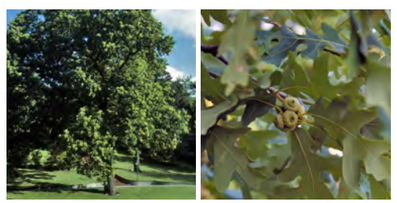
- Somewhat available
- Native Dallas County area, riverbed
- Native Texas floodplain tree
- Seedless variety preferred

Lacey Oak
Quercus laceyi

- Readily available
- Native to Texas, adapted to Dallas County
- More suited to Central Texas

Overcup Oak
Quercus lyrata

- Somewhat available
- Native to Texas, adapted to Dallas County, riverbed
- More suited farther East



Bur Oak
Quercus macrocarpa

- Readily available
- Native to Dallas County area
- Good choice, not susceptible to oak wilt

Chinkapin Oak
Quercus muhlenbergii

- Readily available
- Native to Dallas County area
- Good choice, not susceptible to oak wilt

Water Oak
Quercus nigra

- Somewhat available
- Native to Texas, adapted to Dallas County, riverbed
- Needs more water

Willow Oak
Quercus phellos

- Somewhat available
- Native to Texas, adapted to Dallas County, riverbed
- Needs more water

Monterrey Oak
Quercus polymorpha

- Readily available
- Not native, adapted to Dallas County
- Good choice, not susceptible to oak wilt

Post Oak
Quercus stellata

- Somewhat available
- Native to Dallas County area
- Cannot be transplanted

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not acceptable

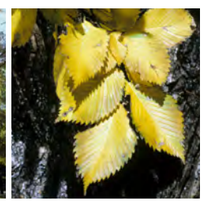
Canopy Trees


Pond Cypress
Taxodium ascendens

- Readily available
- Not native, adapted to Dallas County
- Very adaptable
- Smaller/more columnar than Bald Cypress


Bald Cypress
Taxodium distichum

- Readily available
- Native to Texas, adapted in Dallas County
- Very adaptable

American Elm
Ulmus americana

- Somewhat available
- Native to Dallas County area
- Good floodplain choice


Cedar Elm
Ulmus crassifolia

- Readily available
- Native to Texas, adapted to Dallas County
- Part of the existing Trinity forest


Lace Bark Elm
Ulmus parvifolia

- Readily available
- Not native, adapted to Dallas County
- Very adaptable


Elm "Bosque"
Ulmus parvifolia "Bosque"

- Readily available
- Not native hybridized upright form, adapted to Dallas County
- Adaptable columnar form

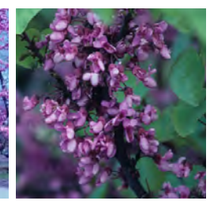
Understory Trees


Huisache
Acacia farnesiana

- Somewhat available
- Native to East Texas, adapted to Dallas County area
- More suited to West Texas


Scarlet Buckeye
Aesculus pavia var pavia

- Somewhat available
- Native to Dallas County area

Eastern Redbud
Cercis canadensis

- Readily available
- Native to East Texas, adapted to Dallas County area
- Very adaptable, early blooms, nice Fall color


Texas Redbud
Cercis canadensis var texensis

- Readily available
- Native to Dallas County area
- Very adaptable, early blooms, nice Fall color

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not acceptable

Understory Trees


Chitalpa
Chilopsis catalpa

- Readily available
- Hybridized form, adapted to Dallas County
- Very hardy, fast growing


Desert Willow
Chilopsis linearis

- Readily available
- Native to Texas, adapted to Dallas County
- Great summer flowering tree
- Best on parkway only, not floodway


Fringe Tree
Chionanthus virginicus

- Readily available
- Native to North Central Texas, riverbed
- Good for parkway and bio-engineering near river/lakes


Roughleaf Dogwood
Cornus drummondii

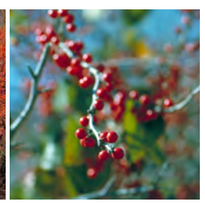
- Readily available
- Native to Dallas County area
- Native dogwood, high wildlife value
- Drought tolerant, bioengineering value with root suckering


Texas Hawthorne
Crataegus texana

- Readily available
- Native to Texas, adapted to Dallas County
- Explore thornless varieties
- Native variety is especially hear resistant

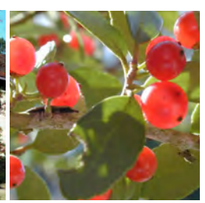

Texas Persimmon
Diospyrus texana

- Readily available
- Native to Dallas County
- Very hardy, high wildlife value

Possumhaw Holly
Ilex decidua

- Readily available
- Native to Dallas County area
- Hardy, winter interest

Yaupon Holly
Ilex vomitoria

- Readily available
- Native to Dallas County area
- Hardy, winter interest
- Not on parkway due to toxic berries


Eastern Redcedar
Juniperus virginia

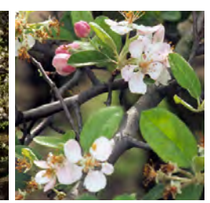
- Readily available
- Native to Dallas County area
- Use in limited numbers, can be invasive
- High wildlife value, evergreen


Golden Leadball Tree
Leucaena retusa

- Readily available
- Native to Texas, adapted to Dallas County
- More adapted to West Texas


Crape Myrtle
Lagerstroemia indica

- Readily available
- Native to Texas, adapted to Dallas County
- Very hardy, blooms in Summer

Crab Apple
Malus sp Prairie Fire

- Readily available
- Hybridized form, adapted to Dallas County
- Prairie Fire has excellent resistance to rust, mildew and fireblight

Key

- Parkway
- Parkway Median
- Trinity River Forest
- Non-native Ornamentals
- Groves
- Not acceptable

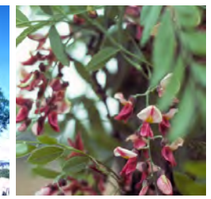
Understory Trees


Prairie Crabapple
Malus ioensis

- Readily available
- Hybridized form, adapted to Dallas County
- Native species


Carolina Buckthorn
Rhamnus caoliniana

- Readily available
- Native to Dallas County area
- Adaptable to many growing conditions

Texas Sophora
Sophora affinis

- Readily available
- Native to Dallas County area
- Hardy, very attractive


Texas Mulberry
Morus microphylla

- Readily available
- Native to Dallas County area
- Easily grown adaptable native tree
- Too messy for parkway


Flameleaf Sumac
Rhus copallina

- Readily available
- Native to Dallas County area
- Easily grown
- High habitat/wildlife value


Mexican Buckeye
Ungnadia speciosa

- Readily available
- Native to Dallas County area
- Hardy, attractive trees


Texas Pistache
Pistacia texana

- Readily available
- Native to Texas, adapted to Dallas county
- Needs good drainage
- More adapted to Central or West Texas


Prairie Sumac
Rhus lanceolata

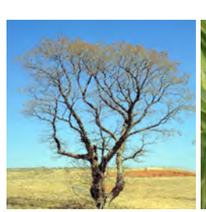
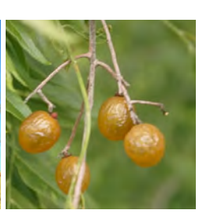
- Readily available
- Native to Dallas County area
- Easily grown
- High habitat/wildlife value


Rusty Blackhaw Viburnum
Viburnum rufidulum

- Readily available
- Native to Dallas County area
- Grows on nearly all soil
- Needs to be fairly well drained

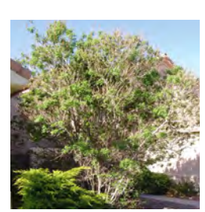

Mexican Plum
Prunus mexicana

- Readily available
- Native to Dallas County area
- Hardy, very attractive

Western Soapberry
Sapindus drummondii

- Readily available
- Native to Dallas County area
- Too weedy, possibly invasive




Chaste Tree
Vitex agnus-castus

- Readily available
- Not native, adapted to Dallas County
- Easily grown and adaptable, heat tolerant
- Needs decent drainage, summer flowers

The following shrub, grasses, and forbs species are all native to Texas, with many native to the Dallas area. Not all are suited to conditions in the floodway and instead are intended to be used in the parkway, in raised areas in the floodway, or other areas adjacent to the floodway. The included key denotes which areas they are best suited for each specie.

Key

- Parkway
- Trinity River Forest
- Meadow
- Wetland
- Riparian

Shrubs

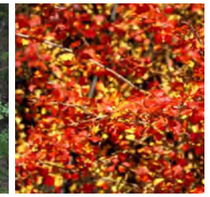

Flame Acanthus
Anisacanthus quadrifidus var wrightii


Texas Star Hibiscus
Hibiscus coccineus


Rock Rose
Pavonia lasiopetala


American Beautyberry
Callicarpa americana


Texas Sage
Leucophyllum frutescens

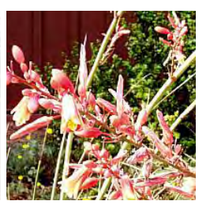



Fragrant Sumac
Rhus aromatica

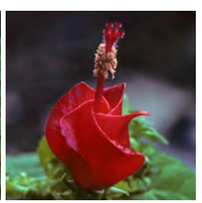

Texas Sotol
Dasylirion texanum


Agarita
Mahonia trifoliolata

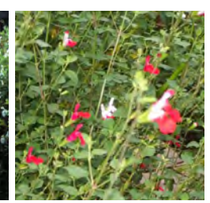

Black Willow
Salix nigra

Red Yucca
Hesperaloe parviflora

Turk's Cap
Malvaviscus arboreus var drummondii

Autumn Sage
Salvia greggii

Key

- Parkway
- Trinity River Forest
- Meadow
- Wetland
- Riparian

Shrubs


Mexican Bush Sage
Salvia leucantha


Common Elderberry
Sambucas nigra

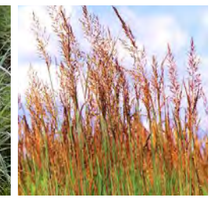

Yellow Bells
Tecoma stans


Mapleleaf Viburnum
Viburnum acerifolium


Southern Arrowwood
Viburnum dentatum

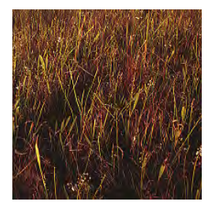
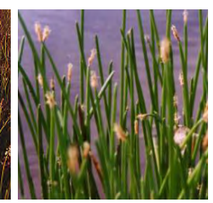

Buckley's Yucca
Yucca constricta

Grasses

Big Bluestem
Andropogon gerardii


Cherokee Sedge
Carex cherokeensis

Creeping Spikerush
Eleocharis palustris


Virginia Wildrye
Elymus virginicus

Key

- Parkway
- Trinity River Forest
- Meadow
- Wetland
- Riparian

Grasses

Limpograss
Hermarthria altissima

Deer Grass
Muhlenbergia rigens

Autumn Bluegrass
Poa autumnalis

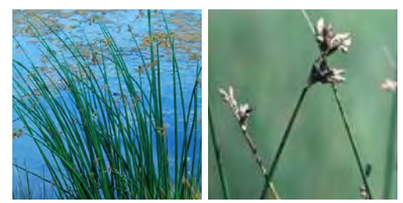
Baltic Rush
Juncus balticus

Mexican Feather Grass
Nassella tenuissima

Little Bluestem
Schizachyrium scaparium

Purple Muhly
Muhlenbergia capillaris

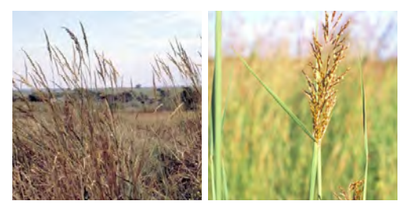
Switch Grass
Panicum virgatum



Hard-stem Blurush
Scirpus acutus

Big Muhly
Muhlenbergia lindheimeri

Knotgrass
Paspalum distichum



Indiangrass
Sorghastrum nutrans

Key

- Parkway
- Trinity River Forest
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Grasses


Prairie Cordgrass
Spartina pectinata

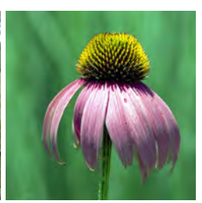

Eastern Gamagrass
Tripsacum dactyloides

Herbaceous / Forbs


Indian Paintbrush
Castilleja spp


Large Flower Tickseed
Coreopsis grandiflora


Tick clover
Desmodium psilophyllum

Purple Coneflower
Echinacea purpurea


Indian Blanket
Gaillardia pulchella


Prairie Verbena
Glandularia bipinnatifida


Maximilian Sunflower
Helianthus maximiliani


Lespedezas
Elymus virginicus

Key

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Herbaceous / Forbs


Gay-feather
Liatris mucronata


Virginia Creeper
Parthenocissus quinquefolia


Goldenrod
Solidago spp


Prairie Blazing Star
Liatris pycnostachya


Prairie Phlox
Phlox andicola


Heath Aster
Symphyotrichum ericoides


Red Lobelia
Lobelia cardinalis


Mexican Hat
Ratibida columnaris


Horsemint
Monarda citriodora


Blue Sage
Salvia azurea

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Texas Parks & Wildlife Department
Aquatic Resources Relocation Plan

Dewatering activities in streams, ponds, reservoirs, stilling basins, and other flood control structures may negatively impact fish communities and habitat statewide. These activities can impact fisheries management, contribute to losses of State assets, and violate game laws. The Texas Parks and Wildlife Department (TPWD) requires a responsible party (RP) to formulate a written Aquatic Resources Relocation Plan to control and limit the impacts of dewatering.

The written plan must be received by the Regional TPWD Kills and Spills (KAST) biologist at the earliest possible convenience, but no less than four weeks prior to the beginning of the dewatering process. The regional KAST biologist will share the document and seek approval of the local TPWD Fisheries Division Management Office and the Law Enforcement Division local game warden. The RP must receive formal approval of the plan prior to initiating the dewatering activities. Each plan must include the following elements:

1. Exact location.
2. Purpose of the activity.
3. Notification to the regional KAST biologist of the expected start date or any changes to the start date of fish recovery activities.
4. Method of collecting and removing fish.
5. Types and sizes of containers to be used.
6. Transportation method and destination.
7. How the documentation and disposal of dead and non-native fishes will be handled.
8. The best management practices (BMPs) to be used to ensure that relocated fish and fish awaiting relocation have the best possible water quality and have adequate carrying capacity for additional biomass (i.e. aerators), and water depth at which fish relations activities will begin.
9. Provide an estimation of the time expected to complete the fish removal operation.
10. Identify any state or federally threatened or endangered species that may occur. Explain what methods will be used to protect these species.
11. Identify all fresh water mussels that may become stranded due to the operation. Explain what methods will be used to protect the mussels.

A TPWD representative may be present during some or all proposed activity. Additionally pursuant to the Texas Parks and Wildlife Department Code, Section 12.301, the RP may be liable for the replacement costs of all mortalities to fish and wildlife species resulting from the dewatering activities.

Please do not hesitate to contact me if you have any questions or require additional assistance.

Sincerely,

Greg Conley
Pollution Biologist
TPWD-Kills and Spills Team
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