Technical Memorandum ECO-1

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Subject: *Ecosystem Elements of the Fort Worth Central City Project*

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1.0 Executive Summary

The purpose of this technical memorandum is to present preliminary information regarding the environmental analysis of the Fort Worth Central City (FWCC) Project. The FWCC project involves flood channel improvements in the Clear Fork and West Fork segments of the Trinity River. This includes the creation of a quiescent river bypass channel adjacent to downtown Fort Worth to handle flood flows.

The USACE is assisting in the evaluation of the project and will produce a Draft and Final Environmental Impact Statement (EIS) for the project and will collaborate/review elements of the project related to flood control, ecosystem restoration, and recreation.

General urban development in the study area has resulted in impacts to wildlife and wildlife food resources. The project area is used by both resident and migratory wildlife species that are somewhat tolerant of human activity. Migratory waterfowl and shorebirds, and resident wood ducks use the river and its tributaries and local emergent wetlands. The woodlands are most likely to be used by a variety of migratory and resident passerine, owl, and hawk species. Mammal species utilize all habitat types in the project area.

The USFWS conducted a habitat and wildlife resources assessment in the study area, which was divided into five zones. Twenty-nine survey sites were randomly selected within four habitat types in the study area: riparian woodlands, grasslands, upland woodlands and emergent wetlands. The data were analyzed with the USFWS (1980) Habitat Evaluation Procedure (HEP) to describe the existing habitats in the study area.

Ten wildlife species were selected to represent the wildlife communities that use the four habitats evaluated: raccoon, fox squirrel, Carolina chickadee, barred owl, wood duck, red-tailed hawk, green heron, eastern meadowlark, eastern cottontail, and hairy woodpecker. The habitat for these species ranged from non-existent to very good. Due to the lack of suitable

habitat and the urbanized character of the project area, it is unlikely that any federally listed threatened or endangered species would utilize any of the study areas.

Five sites were selected on the Trinity River to sample fish, one site downstream, two sites upstream, and two sites within the project area. All five sites are with the portion of the Trinity River on the Texas 303(d) List as being an impaired water body as it does not meet the designated fish consumption use due to elevated chlordane in fish tissues (TCEQ 2002). A fish consumption advisory was issued for this portion of the Trinity River in 1990 (TDH 2003).

The aquatic habitats at the five sites sampled consisted of large, deep pools. These pools developed as a result of the construction of a series of in-stream low water dams within the study area in the late 80's which has resulted in the creation of pool habitat that functions more as lentic (lake) environment than as a true lotic (river) system. A total of 4,614 fish comprising 11 families and 30 species were collected from the five sites.

In general, the fish assemblages within the proposed project area can be characterized as high to exceptional. Overall community degradation was low and aquatic like values were high within the entire study area. The viable fish assemblage may be attributed to the in-stream modifications (i.e., low water dams) that have resulted in the creation of deep pools. These deep pools provide more aquatic habitat than shallow systems and they serve as a buffer against sediment contamination. The indices assess the overall fish community and do not account for the lethal and/or sub-lethal affects associated with chronic toxicity to individual fish species, nor do they address human health issues concerning the consumption of contaminated fish.

The Central City project area has been heavily impacted by urban development but the project area still provides some wildlife habitat value. Specific habitat restoration measures are proposed as a part of the Central City project to help restore some of the natural habitats that have been lost and improve habitat diversity and quality, benefiting a variety of resident and migratory wildlife species as well as the general public.

The ecosystem restoration areas proposed for the Central City project are tied to the areas proposed for valley storage mitigation (valley storage mitigation is required to maintain the hydraulic performance of the floodway). The extent of the areas included for valley storage mitigation/ecosystem restoration are located in three general areas: 1) the area generally referred to as Riverbend where the bulk of the ecosystem restoration activities will occur; 2) Rockwood Park where two oxbows will be reconstituted; and 3) the area generally referred to as Riverside (adjacent to Riverside Park).

Substantial discussion on ecosystem restoration activities was held with USACE, USFWS, and TRWD staff during the conceptual and preliminary design of the project. Input was provided regarding areas for ecosystem restoration, the type of ecosystem restoration appropriate for each area, the preferred hydroperiod for riparian woodlands, and the preferred species for planting as a part of ecosystem restoration. The fundamental goal of the ecosystem restoration activities is to create or enhance riparian woodlands/bottomland hardwood forests. The restoration activities proposed by the project include the preservation of existing high value trees, establishment of new riparian and upland woodlands, establishment of native grasslands, reestablishment of former oxbow stream channels, and creation of emergent wetlands.

Quantification of Habitat Units (HUs) is one method to evaluate the benefits (and impacts) provided by ecosystem restoration activities. HUs are determined by multiplying a habitat quantity (acres) by a habitat quality value. The habitat quality ranking for this project was based on the HEP performed by the USFWS in the study area and best professional judgment. Habitat quality ranking and HUs were first determined for each existing parcel in the ecosystem restoration areas. Habitat quality ranking and HUs were next determined for the ecosystem restoration areas in terms of the proposed ecosystem restoration activities. A summary of the results indicates that there will be a 17% overall increase (188 to 226) in HUs with implementation of the proposed ecosystem restoration activities as follows:

- Existing grasslands dominated by non-native species will be converted to native grasslands, upland and riparian woodlands, aquatic (oxbow) stream habitat, or emergent wetlands;
- Existing upland woodlands will be enhanced or converted to riparian woodlands or aquatic (oxbow) stream habitat;
- Existing riparian woodlands (2 locations) will be enhanced;
- Existing aquatic habitat will be reestablished as aquatic (oxbow) stream habitat or emergent wetlands; and
- Breaks in the existing levee will be used to create the large area of riparian woodlands that will be the major ecosystem restoration feature.

The recommended plan has minimal environmental impacts because 1) general urban development in the study area has resulted in impacts to wildlife and wildlife food resources i.e. there is not a great deal of optimal habitat, and 2) construction activities are limited to areas where there is limited habitat.

Temporary impacts to the aquatic habitat and the fish populations that use this habitat in the project area may occur due to construction activities but after construction is complete the aquatic habitat will improve because 1) project implementation will improve water quality in the river 2) construction of the river bypass channel and the control gates will result in additional deep pools that provide good fish habitat 3) enhancement and creation of riparian habitat will enhance fish habitat, and 4) reestablishment of historic stream channels in the form of oxbows and creation of emergent wetlands will enhance fish habitat. Preservation of existing habitat and establishment of new habitat is estimated to cost approximately $2.3 million with long-term operating costs of approximately $0.4 million per year.

2.0 Introduction and Background

The Trinity River Master Plan was started in August 2000 by the Tarrant Regional Water District (TRWD) in association with Streams and Valleys, the City of Fort Worth and the USACE. The Central City Segment was specifically described in the Master Plan to address the unique characteristics of the confluence area (confluence of the Clear and West Forks of the Trinity River). The confluence area is currently part of a joint federal-local flood control project which includes a levee system developed in the early 1950's. The USACE is the responsible federal agency and the TRWD is the local sponsor.

Tarrant Regional Water District (TRWD) is participating with the North Central Texas Council of Governments, the U.S. Army Corps of Engineers (USACE) and the City of Fort Worth in evaluating flood channel improvements in the Central City Segment of the Clear Fork and West Fork of the Trinity River. The Locally Preferred Plan (LPP) calls for creating a bypass channel to handle flood flows and to create a quiescent river segment on the Trinity adjacent to downtown Fort Worth. The quiescent river segment would begin at the confluence of the Clear Fork and the West Fork of the Trinity River to just upstream (south) of the Northside Drive Bridge (**Figure 1**). This area is within the Central City Segment of the Trinity River Vision Master Plan.

This technical memorandum (TM) has been produced during the development of the Central City concept that included preliminary design of the project and concurrent review and assessment by the USACE. Throughout this process urban designers were in collaboration with team members with technical and engineering input. The USACE is assisting in the evaluation of the project and will produce a Draft and Final Environmental Impact Statement (EIS) for the project and will collaborate/review elements of the project related to flood control, ecosystem restoration, and recreation. The USACE document will also address study authority, purpose and scope, participants and coordination, and prior studies and reports. This TM will address the components of problem identification (environmental setting) and plan formulation.

2.1 Description of the Central City Project

The Fort Worth Central City (FWCC) project involves flood channel improvements in the Clear Fork and West Fork segments of the Trinity River. This includes the creation of a quiescent river bypass channel adjacent to downtown Fort Worth to divert flood flows from the West and Clear Forks of the Trinity River, including four structures to control water flow (one control dam and three isolation gates) shown in **Figure 1**.

The bypass channel and revised levee system will provide additional flood protection benefits, enhanced water quality, and environmental restoration opportunities. Project implementation will support redevelopment of the surrounding area. The design of the quiescent river bypass channel includes a constant water surface elevation higher than the existing condition along the waterfront area adjacent to downtown Fort Worth. To maintain the higher constant water surface elevation a stationary control dam will be constructed downstream of the Union Pacific Railroad bridge, currently know as the Samuels Avenue Dam.

The major hydraulic elements of the FWCC Project are the bypass channel, the three control gates and the Samuels Avenue Dam. The overall length of the bypass channel is 8,400 feet. The isolation gates are designed to protect the interior area east of the bypass channel during flood events. Water levels in the project area will be controlled by the Samuels Avenue Dam. The normal surface water elevation in the project area will be approximately 524.5 feet. The normal surface water elevation in the project area currently ranges approximately from 505 to 518 feet.

The proposed project would result in a loss of valley storage due to the diversion of flood flows through the bypass channel as the bypass channel is shorter than the existing river channel. To mitigate this loss in valley storage, mitigation storage sites have been included in the design. The mitigation storage sites will be located along the West Fork of the Trinity River upstream of the project area, in the vicinity of the Samuels Avenue Dam and slightly downstream of the dam next to Riverside Park. With this valley storage in place the proposed project neither increase downstream water surface elevations or downstream flows.

The FWCC Project will provide a change to the hydrologic and hydraulic characteristics to the confluence of the West and Clear Forks of the Trinity River. But the project design will result in no loss in the current level of flood protection either upstream or downstream of the immediate project area. Important and significant ecosystem restoration opportunities will be realized within the valley storage mitigation sites**.** Therefore, the FWCC Project represents a major advancement in community and federal goals for flood protection and ecosystem restoration.

2.2 Overview of Ecosystem Restoration Activities

The ecosystem restoration areas proposed for the Central City project are tied to the areas proposed for valley storage mitigation. Valley storage mitigation is required to maintain the hydraulic performance of the floodway and the specifics of the valley storage requirements and how the project will meet those requirements are discussed in other project submittals on hydrology and hydraulics.

The extent of the areas included for valley storage mitigation/ecosystem restoration is shown in **Figure 2.**. There are three general areas: 1) the area generally referred to as Riverbend where the bulk of the ecosystem restoration activities will occur (**Figure 3**), 2) Rockwood Park where two oxbows will be reconstituted (**Figure 4**), and 3) the area generally referred to as Riverside (adjacent to Riverside Park).

Substantial discussion on ecosystem restoration activities was held with USACE, USFWS, and TRWD staff during the conceptual and preliminary design of the project. Input was provided regarding areas for ecosystem restoration, the type of ecosystem restoration appropriate for each area, the preferred hydroperiod for riparian woodlands, and the preferred species for planting as a part of ecosystem restoration.

The fundamental goal of the ecosystem restoration activities is to create or enhance riparian woodlands/bottomland hardwood forests. This is generally defined as stands of trees that will experience inundation by floodwaters at least once every two years. Where such a frequency of inundation is not possible, creation or enhancement of upland woodlands will be undertaken. In addition to the creation and enhancement of riparian and upland woodlands, there is a general desire not to impact existing stands of hardwood trees if at all possible. Native grasslands will also be created to intersperse among the forest resources. These will be limited due the preference for forest resources and because of the difficulty in establishing and maintaining true native grasslands. Functional oxbows will also be recreated at three locations and a limited amount of emergent wetlands will also be established.

3.0 Problem Identification

3.1 Environmental Setting

The project study area is located within the floodplains of the West and Clear Forks of the Trinity River, which are located within the Upper Trinity River Basin, adjacent to the downtown Fort Worth business district, Tarrant County, Texas. The headwaters of the West Fork begin in Archer County and run southeast through Jack and Wise Counties to the northwest portion of Tarrant County. The river continues east to west through central Tarrant County into west-central Dallas County. The headwaters of the Clear Fork segment

flow southeast through the southeast portion of Parker County into the southwest portion of Tarrant County where it is impounded to create Benbrook Lake just south of the city of Benbrook. The Clear Fork then flows northeast through the southwest portion of the City of Fort Worth, to it's confluence with the West Fork approximately 1,600 feet northwest of the county courthouse. The specific project area is contained within the floodplains of the Clear Fork from the Botanical Gardens in Fort Worth to the confluence with the West Fork, and in the West Fork from Rockwood Park to Riverside Drive.

3.1.1 Vegetation and Wildlife

The terrain in Tarrant County consists of rolling hills ranging from 500 to 800 feet (150 to 240 meters) in elevation, generally sloping to the east and southeast. Tarrant County is located in the Cross Timbers and Prairies ecological region of Texas (Gould 1962). Climax vegetation in the Cross Timbers and Prairies ecological region is post oak (*Quercus stellata)* and blackjack oak (*Quercus marilandica*) woodlands mixed with native short to mid-grass prairie. More specifically, Tarrant County contains three natural vegetational areas: a portion of the West Cross Timbers in the northwest, the Fort Worth Prairie in the central and southwest, and the east cross Timbers on the east side of the county (Diggs et al., 1999). Historically the area was open prairie with a few scattered post oak (*Quercus stellata)* and live oak (*Quercus virginiana*). Ashe juniper (*Juniperus ashei*) and mesquite (*Prosopis grandulosa*) trees grow in some areas.

The bottomland woodlands in the county were predominantly pecan (*Carya illinoensis*), elms (*Ulmus sp.*), and oaks (*Quercus sp.*). The specific project area is located within the floodplain, which mostly contains the Frito-Trinity soil type and is nearly level, deep clayey soils. Trees that are suitable for this soil type are American elm (*Ulmus americana*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis sp.*), oaks, pecan, red bud (*Cercis canadensis*), and sweetgum (*Liquidambar styraciflua*). Black willow (*Salix nigra*), red mulberry (*Morus rubra*), and cottonwood (*Populus deltoides*) are also common.

Historically, little bluestem (*Schizachyrium scoparium*), silver bluestem (*Bothriochloa laguroides*), side-oats grama (*Bouteloua curtipendula*), tall grama (*Bouteloua pectinata*), and buffalograss (*Buchloe dactyloides*) were the predominant species. Most of these grasses have been eliminated through extensive livestock grazing and urban development. The predominate grasses that occur now are Texas wintergrass (*Nassella leucotricha*), Canada wildrye (*Elymus Canadensis*), Bermuda grass (*Cynodon dactylon*), and Johnsongrass (*Sorgum halepense*) and many other less common grasses.

General urban development in the study area has resulted in impacts to wildlife and wildlife food resources. The project area is used by both resident and migratory wildlife species that are somewhat tolerant of human activity (USFWS 2004). The USFWS (2004) describe the wildlife that occurs in the study area as follows. Migratory waterfowl and shorebirds, and

resident wood ducks (*Aix sponsa*) use the river and its tributaries and local emergent wetlands. The woodlands are most likely to be used by a variety of migratory and resident passerine, owl, and hawk species. Some common resident bird species that may be observed in the study area are sparrow, northern mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), common grackle (*Quiscalus quiscula*), scissor-tailed flycatcher (*Tyrannus forticatus*), common crow (*Corvus brachyrhynchos*), American kestrel (*Falco sparverius*) and red-tailed hawk (*Buteo jamaicensis*). Mammal species that may utilize all habitat types in the project area include raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), eastern cottontail (*Sylvilagus floridanus*), fox squirrel (*Sciurus niger*), and small rodents. Various species of frogs and turtles may be found in the river and wetlands, while lizards and snakes can be found throughout the study area.

3.1.2 Habitat and Wildlife Assessment

The USFWS (2004) conducted a habitat and wildlife resources assessment in the study area, which was divided into five zones. Twenty-nine survey sites were randomly selected within four habitat types in the study area: riparian woodlands (9), grasslands (10), upland woodlands (6) and emergent wetlands (4). The data were analyzed with the USFWS (1980) Habitat Evaluation Procedure (HEP) to describe the existing habitats in the study area. The HEP requires the use of Habitat Suitability Index (HSI) models developed for indicator species that best represent groups of species that use the habitats.

Ten wildlife species were selected to represent the wildlife communities that use the four habitats evaluated. The raccoon, fox squirrel, Carolina chickadee (*Parus carolinensis*), barred owl (*Strix varia*), wood duck, and red-tailed hawk were selected to represent species that use riparian woodlands/bottomland hardwood forests. The raccoon, green heron (*Butorides striatus*), and wood duck were selected to represent the wildlife community in emergent wetlands. The eastern meadowlark (*Sturnella magna*) eastern cottontail, red-tailed hawk were selected to represent the wildlife community in the grasslands. The red-tailed hawk, hairy woodpecker (*Picoides villosus*), raccoon, and fox squirrel were selected to represent the upland woodlands.

In the riparian woodlands the HSI values for barred owl ranged from good to poor and were good for Carolina chickadee. The HSI values for raccoon rated good except in one zone which rated poor. The HSI values for fox squirrel ranged from good to none. Except in one zone the HSI values for red-tailed hawk were high. The HSI values for wood duck were poor.

In the grasslands the HSI values for eastern meadowlark ranged from poor to very good. The HSI values for red-tailed hawk were high. The HSI values for eastern cottontail were low.

In the upland woodlands the HSI values for barred owl ranged from good in certain zones to non-existent in other zones. The HSI values for the raccoon were good or very good and for the Carolina chickadee they were very good. The HSI values for fox squirrel were poor. The HIS values for the downy woodpecker were good to very good except in one zone where it was poor. The HIS values for red-tailed hawk were high. The HIS values for eastern cottontail ranged from fair to good.

In the emergent wetlands the HIS values for raccoon were low. The HSI values for green heron were good. The HSI values for wood duck were poor.

3.1.3 Aquatic Resources

A fisheries survey was conducted by the USFWS, TPWD and the USACE on the Trinity River in the project area in July 2003 during summer low flow conditions. The purpose of the fisheries survey was to determine the baseline fish community structure within the Trinity River that could be potentially impacted by modification to the river or development and /or construction activities associated with project implementation.

Five sites were selected on the Trinity River to sample fish, one site downstream, two sites upstream, and two sites within the project area. All five sites are with the portion of the Trinity River on the Texas 303(d) List as being an impaired water body as it does not meet the designated fish consumption use due to elevated chlordane in fish tissues (TCEQ 2002). A fish consumption advisory was issued for this portion of the Trinity River in 1990 (TDH 2003).

Fish were collected from the five sites using a direct-current-boom electro-fishing boat and a seine. The data were used to calculate aquatic life use values for each site as well as the entire area sampled using both statewide and regional Indices of Biotic Integrity (IBI) and fish-community degradation indices. An IBI reflects aquatic life use in terms of multiple fish assemblage metrics that define species richness, trophic composition and abundance. The fish-community degradation index addresses four metrics; percent of pollution tolerant fish, omnivorous fish, non-native fish, and diseased fish.

The aquatic habitats at the five sites sampled consisted of large, deep pools. These pools developed as a result of the construction of a series of in-stream low water dams within the study area in the late 80's which has resulted in the creation of pool habitat that functions more as lentic (lake) environment than as a true lotic (river) system (USFWS 2004). A total of 4,614 fish comprising 11 families and 30 species were collected from the five sites. Inland silversides represented 35% of the total number of fish collected, followed by gizzard shad (21%), bluegill (15%), longear sunfish (11%), largemouth bass (7%), threadfin shad (2%), red shiners (2%) and bullhead minnows (2%).

In general, the fish assemblages within the proposed project area can be characterized as high to exceptional. Overall community degradation was low and aquatic life values were high within the entire study area. The viable fish assemblage may be attributed to the in-stream modifications (i.e., low water dams) that, as indicated above, have resulted in the creation of deep pools. These deep pools provide more aquatic habitat than shallow systems particularly during summer low flow conditions. In addition they serve as a buffer against sediment contamination if the contamination remains in place and is not re-suspended into the water column due to anthropogenic and/or natural causes (USFWS 2004). The indices assess the overall fish community and do not account for the lethal and/or sub-lethal affects associated with chronic toxicity to individual fish species, nor do they address human health issues concerning the consumption of contaminated fish.

3.1.4 Federal Threatened and Endangered Species

The only federally listed threatened or endangered species know to occur in Tarrant County are the endangered whooping crane (*Grus amenricana*), endangered interior least tern (*Sterna antillarum*), threatened bald eagle (*Haliaeetus leucocephalus*), and the candidate black-tailed prairie dog (*Cynomys ludovicianius*). Due to the lack of suitable habitat and the urbanized character of the project area, it is unlikely that these federally listed threatened or endangered species would utilize any of the study areas. Because natural nesting sites have become sparse for the interior least tern they have nested in atypical/non-natural areas, which provide similar habitat requirements. Should interior least terns arrive any at project sites during the breeding season, construction activities should cease immediately and the USFWS should be notified immediately. A list of bird species with the highest conservation priority was developed by the USFWS in 2002 (Birds of Conservation Concern 2002 list that may utilize the habitat types within the project area was provided by the USFWS (2004).

3.1.5 State of Texas Special Species and Critical Habitats

The only plant species listed on the Endangered, Threatened, and Watch List for Tarrant County, Texas, is the eared false-foxglove. Animals that are not federally listed but are on the Endangered, Threatened, and Watch List for Texas are the Texas horned lizard, milk snake, golden eagle, and the Merlin.

4.0 Project Goals and Objectives

4.1 Project Goals

Plans formulated under Federal directives will be consistent with enhancing the existing environment by the management, conservation, preservation, creation, restoration or improvement of the quality of natural and cultural resources and ecological systems in the proposed project area. Structural and nonstructural measures must be evaluated in accordance with guidelines established by the National Environmental Policy Act of 1969

(Public Law 91-190), as amended, the "Principles and Guidelines for Water and Related Land Resources Implementation Studies" as developed by the U.S. Water Resources Council, dated July 1983, and the U.S. Army Corps of Engineers Planning Guidance Notebook (ER 1105-2-100) dated April 2000. The following environmental and social criteria were considered in this project:

- Promote the development of areas of natural beauty and human enjoyment and protect areas of valuable natural resources along the Trinity River;
- Cost-effectively enhance the quality aspects of water, land, and air resources in the watershed;
- Protect against possible loss of life and hazards to health and safety;
- Preserve and enhance social, cultural, educational, and historical values along the Trinity River;
- The recommended plan must be compatible with the overall plan for water, and land related resources management and development of Tarrant County.

4.2 Project Objectives

Substantial discussion with USACE, USFWS, and TRWD staff was held during the conceptual design of the project regarding the objectives of ecosystem restoration associated with the project. Specific objectives to restore natural habitats within the project area are as follows:

- Plant mast producing trees and shrubs to widen riparian woodland corridors along the river (up to 150 feet on each side). Riparian zones stabilize eroding banks and filter pollutants in runoff and provide habitat for a variety of organisms including fish.
- Thin portions of the existing riparian corridor under mast producing trees to improve habitat for fox squirrel and woodpeckers.
- Plant mast producing trees in riparian zones where they are lacking. Thin and clear in riparian zones where necessary to improve growth of existing mast producing trees.
- Provide brush and log piles in the existing riparian habitat and grasslands to provide cover for small animals.
- Create off-stream emergent wetlands to enhance water quality, provide additional flood storage, and create habitat for species that visit or live in wetlands.

- Create native grasslands where possible within the project area to replace Bermuda and Johnson's grass communities, and develop a mowing schedule that does not interfere with tall-grass nesting birds (after July 15).

- Implement actions to provide the highest conservation priority for non-federally listed migratory and non-migratory bird species (USFWS Birds of Conservation Concern) in the project area.

- Evaluate, through an appropriate monitor program, the success of the ecosystem restoration activities within the valley storage mitigation sites and provide adaptive management if necessary to maximize their habitat potential.

- Develop a program to eradicate exotic plants in the project area and maintain valuable natural habitat.

5.0 Recommended Plan

5.1 Overview

The recommended plan was developed by the local sponsor (TRWD) as follows. The ecosystem restoration areas proposed for the Central City project are tied to the areas proposed for valley storage mitigation. Valley storage mitigation is required to maintain the hydraulic performance of the floodway. Substantial discussion on ecosystem restoration activities was held with USACE, USFWS, and TRWD staff during the conceptual and preliminary design of the project. Input was provided regarding areas for ecosystem restoration, the type of ecosystem restoration appropriate for each area, the preferred hydroperiod for riparian woodlands, and the preferred species for planting as a part of ecosystem restoration.

The two areas where ecosystem restoration activities will be performed are shown in **Figures 3 and 4**. **Figure 3** indicates the area generally referred to as the Riverbend area and is the area where the bulk of the ecosystem restoration activities will occur. Additional ecosystem restoration will occur at Rockwood Park (**Figure 4**) where two oxbows will be reconstituted. Finally, the most downstream area in the project used for valley storage mitigation (adjacent to Riverside Park) will likely have minimal ecosystem restoration activities as 1) it is possible that these areas may not be required for valley storage mitigation, 2) substantive tree plantings in the area may not be compatible with the predicted hydroperiod, and 3) it is the desire of the City of Fort Worth to use a large part of the area for programmed recreation (e.g., soccer fields).

The fundamental goal of the ecosystem restoration activities is to create or enhance riparian woodlands/bottomland hardwood forests. This is generally defined as stands of trees that will experience inundation by floodwaters at least once every two years. Where such a frequency of inundation is not possible, creation or enhancement of upland woodlands will be undertaken. Where existing trees are intended to be maintained, some additional plantings are included to enhance those stands. Where new stands of trees are planned, site preparation will be undertaken and new trees will be planted. Finally, native grasslands will be created to intersperse among the forest resources. Establishment of grasslands will also include site preparation and grass plantings. These will be limited due the preference for forest resources and because of the difficulty in establishing and maintaining true native grasslands. The reestablishment of historic stream channels in the form of oxbows is beneficial because they will provide increased habitat for both aquatic and wetland dependent species.

5.2 Ecosystem Restoration

A consensus list of species appropriate for planting to each type of habitat was developed between USACE, USFWS, and TRWD. These species are detailed in **Table 1.** The upland and riparian woodland areas will be planted with trees, shrubs and groundcover species. The trees and shrubs will be 90% containerized and 10% three-gallon material. Cupping, staking, and anchoring of the larger trees may be implemented to ensure survival. A simple irrigation system will be constructed to enhance the overall survivability of the wooded vegetation. The groundcover species will be planted in selected areas, either bare root or one-gallon material.

The characteristics of the parcels in the Central City Valley Storage/Ecosystem Restoration Areas are presented in **Table 2.** The existing habitat of each parcel and the proposed habitat for each parcel within the three ecosystem restoration areas are shown in **Figures 3 and 4** and described in **Table 2**. In general the three ecosystem restoration areas presently consist of grasslands dominated by non-native species, upland woodlands dominated by hardwoods, limited riparian woodlands and aquatic habitat, and levees adjacent to the river. The proposed ecosystem restoration activities include establishment of native grasslands, enhancement of upland woodlands where appropriate, enhancement of existing riparian woodlands, creation of a large area of riparian woodlands with breaks in existing levees, reestablishment of historic oxbow stream channels, and limited creation of emergent wetlands.

Table 3 provides a preliminary estimate of the costs to establish and maintain the ecosystems included in the recommended plan. The costs were developed on unit costs per acre per type of ecosystem (e.g., site preparation, plantings, and activities to preserve of existing habitats,

etc.). Overall, it is estimated that site preparation and planting costs will be approximately $2.3million and that initial operating and maintenance costs (first five years) will be approximately $0.4 million annually due in large part to the need to irrigate tree plantings in this period to enhance survivability. This will decline to approximately $0.2 million annually in subsequent years. All costs are presented in 2004 dollars. Each specific parcel identified for ecosystem restoration will undergo detailed design before implementation. Each area will be assessed in detail for existing habitat and for the best means to implement site preparation.

6.0 Environmental Impacts of the Recommended Plan

6.1 Upland and Wetland Habitat Resources

One method to evaluate the benefits (and impacts) provided by ecosystem restoration activities, is through the development of habitat units (HUs). HUs are determined by multiplying a habitat quantity (acres) by a habitat quality value. A habitat quality ranking reflects the quality of the resource, in this case habitat potential, and the values were developed as follows; poor (0.25), fair (0.50), good (0.75), and optimal (1.0). The habitat quality ranking for this project was based on the HEP performed by the USFWS in the study area and best professional judgment. Habitat quality ranking and HUs were first determined for each existing parcel in the ecosystem restoration areas and are presented in **Table 2**. Habitat quality ranking and HUs were next determined for each parcel in the ecosystem restoration areas in terms of the proposed ecosystem restoration activities and are presented in **Table 2**. The change in the HUs for each parcel (from existing to proposed) can be evaluated but a summary of the results indicates that there will be a 17% overall increase (188 to 226) in HUs with implementation of the proposed ecosystem restoration activities as follows.

The recommended plan has minimal environmental impacts because 1) general urban development in the study area has resulted in impacts to wildlife and wildlife food resources i.e. there is not a great deal of optimal habitat, and 2) construction activities are limited to areas where there is limited habitat. Except for five (of 57) parcels that will have a decrease in their quality ranking (3 grassland areas will be converted to recreation) and 15 (of 57) parcels that will maintain the same quality ranking, ecosystem restoration activities will improve habitat as follows:

- Existing grasslands dominated by non-native species will be converted to native grasslands, upland and riparian woodlands, aquatic (oxbow) stream habitat, or emergent wetlands;

- Existing upland woodlands will be enhanced or converted to riparian woodlands or aquatic (oxbow) stream habitat;

- Existing riparian woodlands (2 locations) will be enhanced;
- Existing aquatic habitat will be reestablished as aquatic (oxbow) stream habitat or emergent wetlands; and
- Breaks in the existing levee will be used to create the large area of riparian woodlands that will be the major ecosystem restoration feature.

6.2 Aquatic Habitat Resources

As indicated above, the fish assemblages within the proposed project area in general can be characterized as high to exceptional. The viable fish assemblage may be attributed to the in-stream modifications (i.e., low water dams) that have resulted in the creation of deep pools. These deep pools provide more aquatic habitat than shallow systems particularly during summer low flow conditions. Temporary impacts to the aquatic habitat and the fish populations that use this habitat in the project area may occur due to construction activities but after construction is complete the aquatic habitat will improve because 1) project implementation will improve water quality in the river 2) construction of the river bypass channel and the control gates will result in additional deep pools that provide good fish habitat 3) enhancement and creation of riparian habitat will enhance fish habitat, and 4) reestablishment of historic stream channels and in the form of oxbows and creation of emergent wetlands will enhance fish habitat.

7.0 References

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8.0 Attachments

8.1 Tables

Table 1 - Vegetation Species Recommended for Consideration in Central City Habitat Restoration Activities (Derived from USFWS 2004a)

Table 2 - Existing Habitat and Proposed Habitat for Each Parcel within the Ecosystem Restoration Areas

Table 3 - Preliminary Cost Estimate for Ecosystem Restoration Activities

8.2 Figures

Figure 1 - Overview of Central City Improvements

Figure 2 - Overview of Valley Storage Mitigation/Ecosystem Restoration Areas

Figure 3 - Riverbend Ecosystem Restoration Area

Figure 4 - Rockwood Park Ecosystem Restoration Area

cc: Larry Schwartz, CDM
Ginger Croom, CDM
Don Funderlic, CDM

Table 1 - Vegetation Species Recommended for Consideration in Central City Habitat Restoration Activities (Derived from USFWS 2004a)

TREES

Hard-mast Producers	Soft-mast Producers
Pecan	Red mulberry
Black walnut	Sweetgum
Bur oak	American elm
Live oak	Persimmon
Southern red oak	Honey locust
Shumard oak	
Overcup oak	
Post oak	
Texas red oak	

NOTES

1 A minimum 70 percent of woody stems should be trees, the remainder shurbs and vines
2 No more than 25 percent of total trees should be soft-mast producing
3 Approximately 30-100 stems per acre for block, corridor, and motte plantings
4 Approximately 6-10 stems per 100 linear feet for fencerow planting.

SHRUBS/VINES

Shrubs	Vines
Yaupon	Blackberry/dewberry
Deciduous holly	Peppervine
American holly	Virginia creeper
Hawthorns	Carolina snailseed
Corralberry	Yellow jassamine
Mexican plum	Grapes
Wild plums	
Sumacs	
Doqwood (roughleaf)	
Carolina cherry—laurel	
Redbud	
American beautyberry	
Waxmyrtle	
Carolina buckthorn	
Elderberry	
Huckleberries	
Elbowbush	

NOTES

1 Approximately 20-50 stems per acre for block, corridor, and motte plantings
2 Approximately 10 stems per 100 linear feet for fencerow planting.

GROUNDCOVERS

Grasses	Forbs/Legumes
Little bluestem	Coreopsis
Big bluestem	Illinois bundlef lower
Switchgrass	Purple prairieclover
Sideoats grama	Partridge peas
Blue grama	Sunflowers
Hairy grama	Conef lowers
Vine—mesquite	Crotons
Paspalums	Engelmann daisy
Wildryes	Yarrow
E. gamagrass	Native wildflower mixtures
Dropseeds	
Panicums	
Purpletop	
Green sprangletop	
Curlymesquite	

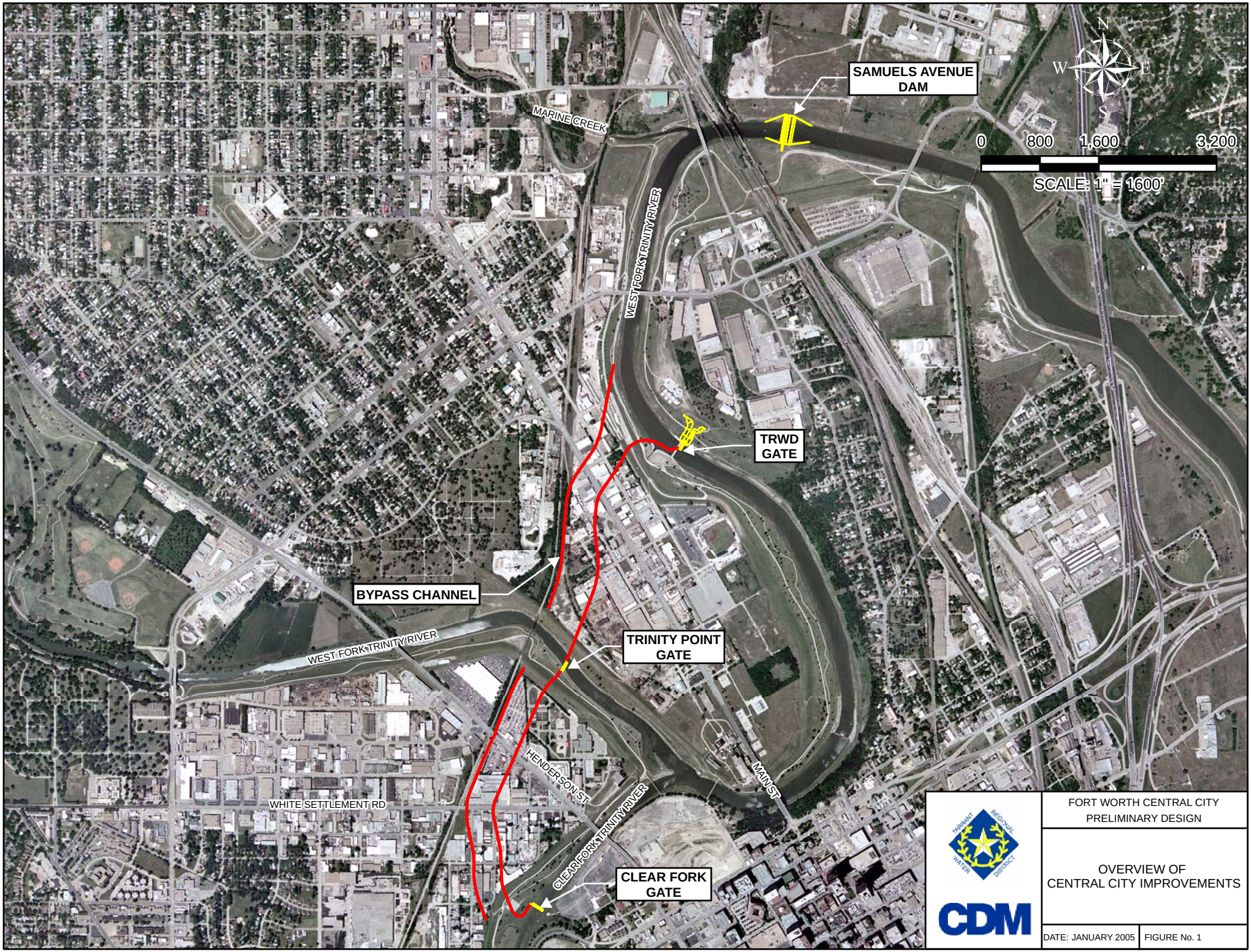
Table 2 - Existing Habitat and Proposed Habitat for Each Parcel within the Ecosystem Restoration Areas

Trinity River Central City Ecosystem Restoration							
Map ID	**Acres**	**Existing Habitat**	**Habitat Quality Ranking**	**Existing Habitat Units**	**Proposed Habitat**	**Habitat Quality Ranking**	**Proposed Habitat Units**
Riverbend							
1	9.54	grasslands/upland woodlands	0.75	7.15	grasslands	0.50	4.77
2	20.04	upland woodlands/grasslands	0.75	15.03	levee	0.50	10.02
3	2.53	levee	0.25	0.63	levee (floodway)	0.25	0.63
4	99.87	grasslands/upland woodlands	0.50	49.94	riparian woodlands	0.75	74.90
5	0.13	levee	0.25	0.03	aquatic-oxbow (floodway)	1.00	0.13
6	1.70	grasslands/upland woodlands	0.50	0.85	aquatic (oxbow)	1.00	1.70
7	0.39	levee	0.25	0.10	grasslands	0.75	0.29
8	8.49	grasslands/upland woodlands	0.50	4.25	riparian woodlands	0.75	6.37
9	2.51	levee	0.25	0.63	levee (floodway)	0.25	0.63
10	3.67	grasslands	0.50	1.84	upland woodlands	0.75	2.75
11	1.03	aquatic	0.50	0.52	aquatic (oxbow)	1.00	1.03
12	0.15	aquatic	0.50	0.07	aquatic-oxbow (floodway)	1.00	0.15
13	1.35	riparian woodlands	0.75	1.01	riparian woodlands (ex)	1.00	1.35
14	6.27	upland woodlands	0.50	3.13	upland woodlands (ex)	0.75	4.70
15	4.13	levee	0.25	1.03	levee (floodway)	0.25	1.03
16	8.53	grasslands	0.50	4.26	grasslands	0.75	6.40
17	1.75	levee	0.25	0.44	grasslands (floodway)	0.75	1.31
18	3.48	riparian woodlands	0.75	2.61	ripaian woodlands (ex)	1.00	3.48
19	3.88	levee	0.25	0.97	levee (floodway)	0.25	0.97
20	13.70	grasslands	0.50	6.85	graslands	0.75	10.28
21	26.70	grasslands	0.50	13.35	upland woodlands	0.75	20.03
22	3.40	grasslands	0.50	1.70	grasslands (sump)	0.50	1.70
23	1.04	levee	0.25	0.26	grasslands	0.75	0.78
24	3.68	levee	0.25	0.92	levee (floodway)	0.25	0.92
25	7.22	grasslands	0.50	3.61	grasslands	0.75	5.42
26	0.60	levee	0.25	0.15	grasslands (floodway)	0.75	0.45
27	1.67	upland woodlands	0.75	1.25	riparian woodlands (ex)	0.75	1.25
28	2.96	levee	0.25	0.74	levee (floodway)	0.25	0.74
29	4.80	grasslands	0.50	2.40	upland woodlands	0.75	3.60
30	6.43	upland woodlands	0.75	4.82	riparian woodland (ex)	0.75	4.82
31	0.88	aquatic	0.50	0.44	aquatic-emergent wetlands	1.00	0.88
32	18.71	upland woodland	0.75	14.04	upland woodlands (ex)	0.75	14.04
33	8.44	grasslands	0.50	4.22	upland woodlands	0.75	6.33
34	0.71	levee	0.25	0.18	emergent wetlands (floodway)	1.00	0.71
35	13.43	sump/grasslands	0.50	6.72	emergent wetlands	1.00	13.43
36	0.42	grasslands	0.50	0.21	upland woodlands	0.75	0.31
37	0.34	grasslands	0.50	0.17	upland woodlands	0.75	0.25
38	0.20	grasslands	0.50	0.10	upland woodlands	0.75	0.15
39	0.34	grasslands	0.50	0.17	upland woodlands	0.75	0.25
40	0.26	grasslands	0.50	0.13	upland woodlands	0.75	0.20
41	0.34	grasslands	0.50	0.17	upland woodlands	0.75	0.26
42	3.74	levee	0.25	0.94	levee (floodway)	0.25	0.94
	299.44			**158.02**			**210.34**
Riverside Park							
43	15.77	grasslands	0.50	7.89	recreation	0.00	0.00
44	11.68	grasslands	0.50	5.84	recreation	0.75	8.76
45	8.00	grasslands	0.50	4.00	recreation	0.75	6.00
	35.45			**17.73**			**14.76**
Rockwood Park							
46	0.70	grasslands	0.50	0.35	riparian woodlands	0.75	0.53
47	2.47	upland woodlands	0.75	1.85	riparian woodlands	0.75	1.85
48	1.16	upland woodlands	0.75	0.87	riparian woodlands	0.75	0.87
49	3.56	grasslands	0.50	1.78	riparian woodlands	0.75	2.67
50	1.63	grasslands	0.50	0.82	riparian woodlands	0.75	1.22
51	1.12	grasslands/upland woodlands	0.50	0.56	aquatic (oxbow)	1.00	1.12
52	2.17	grasslands	0.50	1.09	riparian woodlands	0.75	1.63
53	0.42	upland woodlands	0.75	0.32	riparian woodlands	0.75	0.32
54	3.30	grasslands	0.50	1.65	riparian woodlands	0.75	2.48
55	0.83	grasslands	0.50	0.42	riparian woodlands	0.75	0.62
56	2.19	upland woodland	0.75	1.64	riparian woodlands	0.75	1.64
57	0.96	grasslands	0.50	0.48	aquatic (oxbow)	1.00	0.96
	20.51			**11.82**			**15.90**
Total	**355.40**			**187.56**			**241.00**
Habitat Quality Ranking							
0.25	poor			* Map ID in reference to Figures 3-5			
0.50	fair						
0.75	good						
1.00	optimal						

Table 3 - Estimated Costs for Ecosystem Restoration Activities for the Central City Project

			Costs			
MAP ID	**Acreage**	**General Category**	*Site Prep*	*Plantings*	*Yr 1-5 Annual O&M*	*Yr 6+ Annual O&M*
	(Acres)		($)	($)	($)	($)
1	9.54	grasslands	-	-	4,768	4,768
2	20.04	levee	-	-	10,020	10,020
3	2.53	levee (floodway)	-	-	1,264	1,264
4	99.87	riparian woodlands	269,649	918,804	149,805	49,935
5	0.13	aquatic-oxbow (floodway)	-	-	66	66
6	1.70	aquatic (oxbow)	-	-	850	850
7	0.39	grasslands	-	-	194	194
8	8.49	riparian woodlands	22,923	78,108	12,735	4,245
9	2.51	levee (floodway)	-	-	1,256	1,256
10	3.67	upland woodlands	9,912	33,773	5,507	1,836
11	1.03	aquatic (oxbow)	-	9,476	1,545	515
12	0.15	aquatic-oxbow (floodway)	-	1,334	218	73
13	1.35	riparian woodlands (ex)	-	-	675	675
14	6.27	upland woodlands (ex)	-	-	3,135	3,135
15	4.13	levee (floodway)	-	-	2,066	2,066
16	8.53	grasslands	34,108	27,286	4,264	4,264
17	1.75	grasslands (floodway)	-	-	873	873
18	3.48	ripaian woodlands (ex)	-	-	1,742	1,742
19	3.88	levee (floodway)	-	-	1,938	1,938
20	13.70	graslands	54,816	43,853	6,852	6,852
21	26.70	upland woodlands	72,093	245,649	40,052	13,351
22	3.40	grasslands (sump)	-	-	1,702	1,702
23	1.04	grasslands	-	-	518	518
24	3.68	levee (floodway)	-	-	1,838	1,838
25	7.22	grasslands	28,896	23,117	3,612	3,612
26	0.60	grasslands (floodway)	-	-	300	300
27	1.67	riparian woodlands (ex)	4,512	15,373	2,507	836
28	2.96	levee (floodway)	-	-	1,481	1,481
29	4.80	upland woodlands	12,952	44,132	7,196	2,399
30	6.43	riparian woodland (ex)	-	-	3,216	3,216
31	0.88	aquatic-emergent wetlands	3,536	2,829	442	442
32	18.71	upland woodlands (ex)	-	-	9,357	9,357
33	8.44	upland woodlands	22,783	77,630	12,657	4,219
34	0.71	emergent wetlands (floodway)	2,828	2,262	354	354
35	13.43	emergent wetlands	53,732	42,986	6,717	6,717
36	0.42	upland woodlands	1,131	3,855	629	210
37	0.34	upland woodlands	915	3,119	509	170
38	0.20	upland woodlands	537	1,831	299	100
39	0.34	upland woodlands	905	3,082	503	168
40	0.26	upland woodlands	710	2,420	395	132
41	0.34	upland woodlands	918	3,128	510	170
42	3.74	levee (floodway)	-	-	1,872	1,872
43	15.77	recreation	-	-	7,885	7,885
44	11.68	recreation	-	-	5,840	5,840
45	8.00	recreation	-	-	4,000	4,000
46	0.70	riparian woodlands	1,890	6,440	1,050	350
47	2.47	riparian woodlands	6,669	22,724	3,705	1,235
48	1.16	riparian woodlands	3,132	10,672	1,740	580
49	3.56	riparian woodlands	9,612	32,752	5,340	1,780
50	1.63	riparian woodlands	4,401	14,996	2,445	815
51	1.12	aquatic (oxbow)	-	-	560	560
52	2.17	riparian woodlands	5,859	19,964	3,255	1,085
53	0.42	riparian woodlands	-	-	210	210
54	3.30	riparian woodlands	-	-	1,650	1,650
55	0.83	riparian woodlands	-	-	415	415
56	2.19	riparian woodlands	-	-	1,095	1,095
57	0.96	aquatic (oxbow)	-	-	480	480
Totals			$ 629,418	$ 1,691,594	$ 346,099	$ 177,701

		Planting Unit Costs (per Acre)			**O&M Unit Costs (per Acre)**	
		Site Prep Trees			Yr 1-5 O&M Trees	1500
		Site Prep Grassland/Wetland			O&M Grassland	500
		Planting Trees			O&M Other	500
		Planting Grassland/Wetland				
				*	Map ID in reference to Figures 3-4	

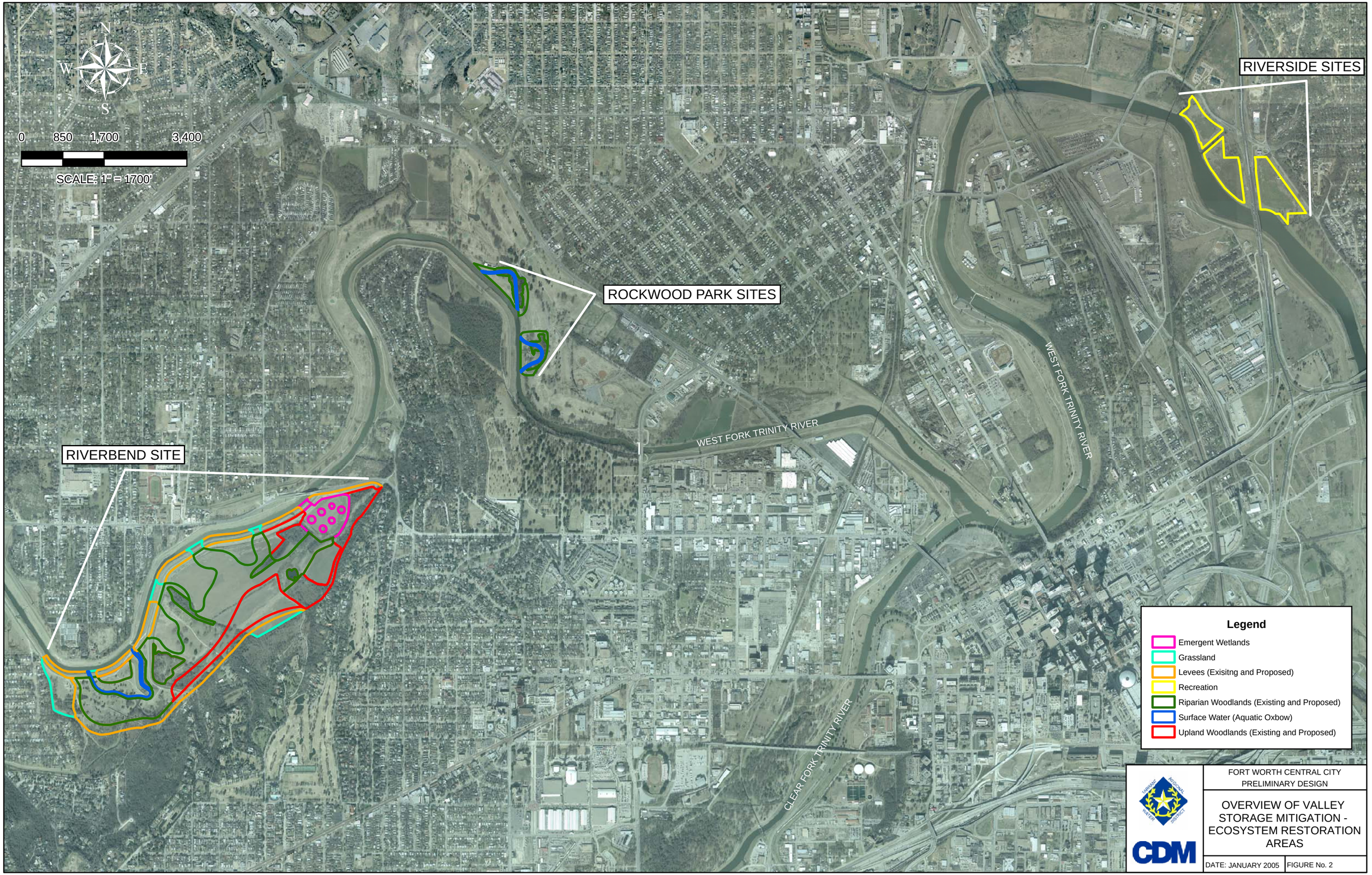


FORT WORTH CENTRAL CITY
PRELIMINARY DESIGN

OVERVIEW OF
CENTRAL CITY IMPROVEMENTS

DATE: JANUARY 2005

FIGURE No. 1


N
W
E
S
0
850
1,700
3,400
SCALE: 1" = 1700'
ROCKWOOD PARK SITES
RIVERSIDE SITES
RIVERBEND SITE
WEST FORK TRINITY RIVER
WEST FORK TRINITY RIVER
CLEAR FORK TRINITY RIVER
Legend
Emergent Wetlands
Grassland
Levees (Exisitng and Proposed)
Recreation
Riparian Woodlands (Existing and Proposed)
Surface Water (Aquatic Oxbow)
Upland Woodlands (Existing and Proposed)
TARRANT REGIONAL WATER DISTRICT
CDM
FORT WORTH CENTRAL CITY
PRELIMINARY DESIGN
OVERVIEW OF VALLEY STORAGE MITIGATION - ECOSYSTEM RESTORATION AREAS
DATE: JANUARY 2005
FIGURE No. 2

N
W E
S

0 300 600 1,200

SCALE: 1" = 600'

WEST FORK TRINITY RIVER

Legend

- Emergent Wetlands
- Grassland
- Levees (Exisitng and Proposed)
- Recreation
- Riparian Woodlands (Existing and Proposed)
- Surface Water (Aquatic Oxbow)
- Upland Woodlands (Existing and Proposed)

FORT WORTH CENTRAL CITY
PRELIMINARY DESIGN

RIVERBEND ECOSYSTEM RESTORATION AREA

DATE: JANUARY 2005 | FIGURE No. 3

N
W
E
S

0 300 600 1,200

SCALE: 1" = 600'

WEST FORK TRINITY RIVER

46
51
48
49
47
50
52
56
53
57
54
55

Legend

- Emergent Wetlands
- Grassland
- Levees (Exisitng and Proposed)
- Recreation
- Riparian Woodlands (Existing and Proposed)
- Surface Water (Aquatic Oxbow)
- Upland Woodlands (Existing and Proposed)

TRINITY RIVER AUTHORITY REGIONAL WATER DISTRICT

CDM

FORT WORTH CENTRAL CITY
PRELIMINARY DESIGN

ROCKWOOD PARK ECOSYSTEM RESTORATION AREA

DATE: JANUARY 2005 | FIGURE No. 4