# EXISTING HABITAT CONDITIONS PLANNING AID REPORT
# FOR THE
# CENTRAL CITY INTERIM FEASIBILITY STUDY, TEXAS

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# EXECUTIVE SUMMARY

This planning aid report describes existing fish and wildlife resources within the proposed Central City Interim Feasibility Study area in Fort Worth, Tarrant County, Texas and is intended to assist the U.S. Army Corps of Engineers (Corps) in their planning efforts. A list of preliminary resource protection recommendations are included. The feasibility study was initiated at the request of Tarrant Regional Water District to find a means to reduce flood damage and ecosystems, and provide additional and improved recreational opportunities along the West and Clear Forks of the Trinity River and its tributaries in Tarrant County. U.S. Fish and Wildlife Service (Service), Texas Parks and Wildlife Department (TPWD), and Corps personnel cooperated in collecting the habitat field data required to complete this report.

The project area encompasses approximately 4506 acres along approximately 2.4 miles of the Clear Fork of the Trinity River and 8.5 miles of the West. It is divided into five zones of the river for project planning convenience: Clear Fork West, Clear Fork East, North Main, West Fork North, West Fork South.

The terrestrial data collected were analyzed according to each river zone using the Service's *Habitat Evaluation Procedures* (HEP) to describe the various existing habitats in the project area. The fisheries data were used to calculate aquatic life use values for each collection site as well as the entire area sampled using both statewide and regional Indices of Biotic Integrity and fish-community degradation indices.

The project area contains 248.6 acres ( 5.5 %) of open water, 1671.1 acres (35.5 %) of urban development, and four terrestrial wildlife habitats: riparian woodlands, grasslands, upland woodlands, and emergent wetlands. These habitats cover 4.5, 42.2, 10.1, and 0.12 percent of the project area, respectively. All have habitat values for each river zone ranging from fair to good, except the emergent wetlands have poor values overall. 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.

Results of the baseline fisheries survey characterized the fish assemblages within the proposed project area as high to exceptional. A total of 4,614 fish comprising 11 families and 30 species were collected at five sites. Overall, community degradation was low and aquatic life use 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, providing more aquatic habitat and serving as a buffer against sediment contamination. The indices assess the overall fish community and do not account for the lethal and/or sublethal 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 there are still some wildlife habitat values contained therein. The specific recommended habitat restoration measures could 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.

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# EXISTING HABITAT CONDITIONS PLANNING AID REPORT FOR THE CENTRAL CITY INTERIM FEASIBILITY STUDY

## INTRODUCTION

The purpose of this report is to describe existing fish and wildlife resources within the proposed Central City Interim Feasibility Study area and to recommend preliminary measures for resource protection. This planning assistance is provided, pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq). This information does not represent a final report of the Secretary of the Interior within the meaning of Section 2(b) of the Act. A complete Fish and Wildlife Coordination Act report will be prepared by the U.S. Fish and Wildlife Service (Service), for consideration by the U.S. Army Corps of Engineers (Corps) to accompany the feasibility report, after all available pertinent information has been reviewed, including review comments from the Texas Parks and Wildlife Department (TPWD) during the planning process.

Authority for the investigations on the Upper Trinity River is contained in the *Programmatic Environmental Impact Statement* (PEIS)*, Upper Trinity River Basin, Trinity River, Texas*, dated June 13, 2000. The Corps initiated this study at the request of Tarrant Regional Water District to reduce flood damage, restore ecosystems, and provide additional and improved recreational opportunities along the West and Clear Forks of the Trinity River and its tributaries within Tarrant County, Texas. An interagency team comprised of Service, TPWD, and Corps personnel cooperated in collecting the habitat field data required to complete this report.

## STUDY AREA

### Location

The study area is located within the flood plains of the West and Clear Forks of the Trinity River, which lie within the Upper Trinity River Basin, adjacent to the downtown Fort Worth business district, Tarrant County, Texas (Figure 1). The headwaters of the West Fork begin in Archer County run southeast through the counties of Jack and Wise, to the northwest corner of Tarrant County. It continues to run east to west through central Tarrant County into west-central Dallas County. The headwaters of the Clear Fork segment run southeast through the southeast portion of Parker County into the southwest corner of Tarrant County where it is impounded to create Benbrook Lake just south of the City of Benbrook. The Clear Fork then runs northeast through the southwest portion of the City of Fort Worth, to it's confluence with the West Fork about 1,600 feet northwest of the county courthouse. The 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 the West Fork from Rockwood Park to Riverside Drive.

Figure 1: Trinity River Habitat Evaluation Sites for the Central City Project, Fort Worth, Texas

## Climate, Topography, and Ecology

The Tarrant County climate is humid subtropical with hot summers and mild winters, with an occasional front of extremely cold temperatures. The average high and low temperatures range from 37°F in January to 98°F in August. The lowest minimum recorded temperature is -1°F and the highest maximum 113°F. Annual precipitation also varies considerably, ranging from less than 20 inches to more than 50 inches, with an average of 33.7 inches (NOAA, 2001). The terrain consists of rolling hills ranging from 500 to 800 feet (150 to 240 m) in elevation, generally sloping to the east and southeast.

Tarrant County is located in the Cross Timbers and Prairies ecological area of Texas (Gould, 1962). It contains three natural vegetational areas: a portion of the West Cross Timbers in the northwest, the Fort Worth Prairie through the central and southwest, and the East Cross Timbers on the eastside 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*) motts. Ashe juniper (*Juniperus ashei*) and mesquite (*Prosopis grandulosa*) trees grow in some areas (Soil Conservation Service, 1981). The bottomland woodlands were predominately pecan (*Carya illinoensis*), elms (*Ulmus sp.*), and oaks (*Quercus sp.*). The project area is located within the floodplain, which mostly contains the Frio-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*). The tree species noted most often in the project area during the study were pecan, American elm, cedar elm, hackberry, black willow (*Salix nigra*), red mulberry (*Morus rubra*), and cottonwood (*Populus deltoides*). Historically, little bluestem (*Schizachyrium scoparium*), silver bluestem (*Bothriochloa laguroides*), side-oats grama (*Bouteloua curtipendula*), tall grama (*Bouteloua pectinata*), and buffalograss (*Buchloe dactyloides*) were the predominate grass species (Soil Conservation Service 1973). Most of these grasses have been eliminated through extensive livestock grazing and urban development. The predominate grasses are now Texas wintergrass (*Nassella leucotricha*), Canada wildrye (*Elymus canadensis*), Bermudagrass (*Cynodon dactylon*), and Johnsongrass (*Sorghun halepense*), with many other less common grasses, such as common sandbur (*Cenchrus spinifex)*, crabgrass (*Digitaria sp.*), dallisgrass *(Paspalum dilatatum*), Hall's panicum (*Panicum hallii*), purple lovegrass (*Erogrostis spectabilis*), lovegrass *(Eragrostis sp.*), old field threeawn (*Aristida oligantha*), panic grass (*Panicum sp.*), silver bluestem (*Bothriochloa laguroides*), stinkgrass (*Eragrostis cilianensis*), Texas panicum (*Panicum texanum*), white tridens (*Tridens albescens*), wild oats *(Chasmanthium latifolium*), windmill grass (*Chloris verticillata*), and wooly rosette grass *(Panicum acuminatum*).

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 (*Aix sponsa*), use the river and its tributaries and local emergent wetlands. The woodlands are most likely 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 forficatus*), common crow (*Corvus brachyrhynchos*), American kestrel (*Falco sparverius*), and red-tailed hawk (*Buteo jamaicensis*). Mammal species that may utilize all habitat types in the study area include raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), eastern cottontail (*Sylvilagus floridanus*), fox squirrel (*Sciurus niger*), and small rodents. Various species of frogs and turtles may be found in the river and wetlands, while lizards and snakes can be found throughout the study area. A list of faunal species that were observed during field investigations in the project area is included on each site observation sheet in Appendix B. Fish species within the project area are discussed in the aquatics section of this report.

## EXISTING FISH AND WILDLIFE RESOURCES

The project area encompasses approximately 4506 acres along approximately 2.4 miles of the Clear Fork of the Trinity River from Interstate Highway 30 to the confluence of the West Fork and 8.5 miles of the West Fork from Rockwood Park to Riverside Drive. The project area was divided into five zones of the river for project planning convenience (Figure 1). The Clear Fork West (CFW) zone is located west of the confluence, between the south shore of the West Fork and the north shore of the Clear Fork. The Clear Fork East (CFE) zone is located along the southeast shore of the Clear Fork between I-30 and the confluence. The North Main (NM) zone is located along the north shore of the West Fork between Rockwood Park and Samuels Avenue. The West Fork North (WFN) zone is located along the north shore of the West fork between Samuels Avenue and Riverside Drive. The West Fork South (WFS) zone is located along the south shore if the West Fork between the confluence and Riverside Drive.

### Terrestrial Habitats and Wildlife Resources

#### Habitat Evaluation Methods

An interagency biologist team collected field data for this project on May 21 and 22, June 2, October 23, 2003, and March 23, 2004. Some of the data was collected during fieldwork completed as part of the Clear and West Forks of the Trinity River Interim Feasibility Study on April 10, 11, and 17, 2001.

Twenty-nine survey sites were randomly selected within the four terrestrial habitat types in the project area: riparian woodlands, grasslands, upland woodlands and emergent wetlands. Utilizing Geographic Information System (GIS) information obtained from the Corps, Figure 1 displays the different habitat types within the project area. These sites are located in four of the river zones. Five sites are located in the WFN zone, eleven in the NM zone, ten in the WFS zone, and three in the CFW zone. There are no survey sites in the CFE zone. The locations of the survey sites were recorded using a Garmin Personal Navigator GPS III Plus unit and are depicted in red on Figure 1. Geographical locations of these sites are listed in Appendix D.

Habitat measurements were collected at nine sites in the riparian woodlands (Sites 104, 124, 128, 132, 136, 137, 138, 175, and 176), four sites in emergent wetlands (Sites 130, 133, 134, and

135), ten sites in grassland (Sites 106, 111, 112, 113, 123, 125, 126, 127, 131, and 161), and six sites in upland woodlands (Sites 024, 025, 026, 027, 028, and 029). A complete list of plant species observed during the surveys is included in Appendix A. Appendix B includes the individual site observation sheets that contain a description of each site and a list of plants and animals observed there. Incidental wildlife sightings were recorded during the surveys (Appendix B). Photographs were taken in each compass direction from the center of each survey site (Appendix C).

The data were analyzed according to each river zone using the U.S. Fish and Wildlife Service *Habitat Evaluation Procedures* (HEP) (U.S. Fish and Wildlife Service 1980) to describe the various existing habitats in the project 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 indicator 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 those species that use riparian/bottomland hardwoods. 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, and 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 forest community.

The HEP model for each indicator species contains a list of structural habitat composition variables that are contained in optimum habitat. Eighteen variables were compiled for the riparian woodland species (Appendix E, Table E-1). There were eleven variables measured for the emergent wetland habitat (Appendix E, Table E-2), nine variables for the grassland habitat (Appendix E, Table E-3), and eighteen variables for the upland forest habitat (Appendix E, Table E-4). These variables were measured or estimated within a tenth-acre data site during the field surveys in the habitat they represent. They are used as indicators of habitat condition or value. Baseline habitat conditions are expressed as a numeric function (HSI value) ranging from 0.0 to 1.0, where 0.0 represents no suitable habitat for an indicator species and 1.0 represents optimum conditions for the species. Habitat units are calculated by multiplying the HSI by the amount of acres of habitat available for each species.

## Habitat Descriptions and Suitability Index Values

Open water, including the aquatic habitat, covers 248.6 acres ( 5.5 %) of the project area and urban development covers 1671.1 acres (35.5 %). The rest of the project area is covered by the four terrestrial wildlife habitat types described below:

**1) Riparian Woodlands** (204.9 acres) - In optimum conditions, this cover type provides food, cover, nesting habitat, and living space to forest dependent species. Large trees are important as nesting habitat for the fox squirrel and red-tailed hawk, and escape cover for raccoons, wood ducks, and passerines. Large mast producing trees and shrubs provide food for the fox squirrel.

Brush piles and snags provide necessary food, cover, and shelter for the raccoon and passerines. The close proximity to water is important for the raccoon and wood duck. Riparian forest habitats are essential in maintaining biodiversity and providing important wildlife travel corridors.

Riparian woodlands make up 4.5 percent of the project area, consisting of mature hard-mast producing trees along the floodway and its tributaries, or areas that are periodically flooded. It is fragmented into small, scattered bottomland hardwood stands on public and private lands along tributaries of the Clear and West Forks of the Trinity River and in Trinity Park, which is the largest stand of this habitat type. Many of these woodlands are periodically flooded and are predominately composed of cedar elm, American elm, pecan, Chinaberry (*Melia azedarach*), cottonwood, bur oak (*Quercus macrocarpa*), and sugar hackberry (*Celtis laevigata*). Other trees species found were gum bumelia (*Sideroxylon lanuginosum*), red mulberry, and green ash (*Fraxinus pennsylvanica*).

Table 1 displays the HSI values and habitat units for riparian woodlands within each river zone in the project area per indicator species. The CFE zone is not included in the table because there are no riparian woodlands in that zone. Sites 104 and 132 are located in the WFN river zone. Sites 124 and 128 are located within the NM zone. Sites 136, 137, and 138 are located in the CFW zone. Sites 175 and 176 are located in the WFS zone. The HSI values per species range from poor to very good. The HSI values per river zone range from fair to good.

**Table 1. HSI Values for the Existing Riparian Woodland Habitat per Indicator Species within the Central City Project Area.**

| Indicator Species | River Zones | | | |
|---|---|---|---|---|
| | WFN (3.2 ac) | NM (11.6 ac) | CFW (187.5 ac) | WFS (2.6 ac) |
| Barred owl | 0.64 | 0.63 | 0.87 | 0.12 |
| Carolina Chickadee | 0.90 | 0.87 | 0.82 | 0.88 |
| Raccoon | 0.76 | 0.80 | 0.80 | 0.23 |
| Wood Duck[1] | 0.20 | 0.10 | 0.10 | 0.03 |
| Red-tailed Hawk[1] | 0.51 | 0.98 | 0.86 | 1.00 |
| Fox Squirrel | 0.60 | 0.66 | 0.28 | 0.00 |
| **HSI Totals** | **0.60** | **0.67** | **0.62** | **0.38** |
| **Habitat Units** | **1.92** | **7.77** | **116.25** | **0.99** |

[1] Multi-habitat species

The most limiting factors for the riparian woodland habitat are the low number of trees with potentially suitable nest cavities, the percent of water surface covered by potential brood and winter cover for the wood duck, and the lack of large trees utilized by the fox squirrel and the barred owl.

**Barred owl:** The HSI values for the barred owl range from very good to poor between the river zones. Most of the riparian sites are dominated by overstory trees that are too small (less than 20 inches dbh) and immature to provide high quality barred owl habitat. However, the number of trees large enough to provide possible nest cavities was optimal in all of the data plots, and the percent canopy cover of overstory trees was optimal at four of the seven data plots. The overstory canopy cover for Sites 124 (NM) and 137 (CFW) were too open to provide optimum barred owl habitat. The stand in Trinity Park where Site 137 is located, is considered parkland characterized by short mowed grass with large trees and no understory. There were no large trees in the WFS zone survey sites.

**Carolina Chickadee:** The riparian HSI values for the Carolina chickadee all depict very good habitat. The average canopy closure was too open for optimum chickadee habitat.

**Raccoon:** The HSI values for the raccoon were rated very good, except for the WFS river zone, which rated poor. The average distance to water is ideal for excellent raccoon habitat in all of the river zones. The permanence of water and the number of refuge sites are good for raccoon habitat in all the river zones, except for the WFS zone. The average overstory tree size was too small in most of the data plots for optimum raccoon habitat. Limited water availability and the number of refuge sites are the two main factors for the low HSI value for the WFS zone.

**Fox Squirrel:** The fox squirrel HSI ranged from good in the WFN and NM zones to none in the WFS zone. The required number of mast producing trees greater than 10 inches dbh needed for optimum fox squirrel habitat was too low in 8 out of 9 data plots, and too high in the other plot. The data plots within the WFS zone yielded no fox squirrel habitat due to the lack of mast producing trees and the small average tree size. However, there could be a few small areas of fox squirrel habitat scattered within that zone.

**Red-tailed Hawk:** The red-tailed hawk is a multi-habitat use indicator species. The three habitats within the project boundary that this species may utilize are riparian woodland, upland woodland, and grassland. The HSI for all but the WFN zones depicts very high valued habitat. The cover requisite based upon the number of large trees suitable for perching and nesting was very good in all of the zones, except the WFS zone, which was poor. The shrub and tree layers are too dense and the percent canopy closure of overstory trees was too high making it poor hunting for the red-tailed hawk in riparian forest habitat in all of the zones. The HSI values remained high due to the high valued food requisite in the adjoining grasslands. The number of trees available throughout the zones is sufficient to maintain average to very good red-tailed hawk habitat.

**Wood Duck:** The wood duck is a multi-habitat species. Wood duck habitat within the project area is the riparian woodlands and emergent wetlands. The HSI values for both cover types throughout the project area was poor due to the low number of potentially suitable nest cavity trees and the lack of brood and winter cover.

**2) Grasslands (**1900.4 acres) - Grasslands provide open space, a food source for passerines and the eastern cottontail, and cover for escape and nesting by means of tall grass, scattered brush piles, and shrubs for a variety of animals. Red-tailed hawks hunt for prey in open grasslands. Grasslands make up 42.2 percent of the project area and are generally located in parks or in the floodway zone on and along the levees, and in the sump areas along the main channel of the river. A few acres are located on private lands. There are two types of grasslands in the study area. Managed grasslands are located in lawns, parks, and along the levees that are routinely mowed. They are comprised of short native and introduced grasses and forbs, and sometimes scattered trees. Unmanaged grasslands are fallow fields also containing a combination of native and introduced grasses, forbs, and trees, but the composition is different from those in the short grass areas. The grass species found in the data plots were Bermuda, dallisgrass, crabgrass, johnson, rescue, rye, wild oats, little barley, Texas wintergrass, foxtail, white tridens, and brome.

Table 2 displays the HSI values and habitat units for grasslands within each river zone in the project area per indicator species. No grassland data was collected in the CFE and CFW river zones, therefore the HSI values for the NM zone was used for the CFW zone and the HSI values for the WFS zone was used for the CFE zone, because the habitats were similar to those zones.

**Table 2. HSI Values for the Existing Grassland Habitat per Indicator Species within the Central City Project Area.**

| Indicator Species | River Zones | | | | |
|---|---|---|---|---|---|
| | WFN (308.1 ac) | CFE (102.2 ac) | NM (421.9 ac) | CFW (402.5 ac) | WFS (665.7 ac) |
| Eastern Meadowlark | 0.50 | 0.16 [4] | 0.85 | 0.85 [2] | 0.16 |
| Eastern Cottontail[1] | 0.43 (0.33) [3] | 0.57 [4] (0.47) [3] | 0.75 (0.65) [3] | 0.75 [2] (0.65) [3] | 0.57 (0.47) [3] |
| Red-tailed Hawk[1] | 0.51 | 1.00 [4] | 0.98 | 0.86 | 1.00 |
| **HSI Totals** | **0.48** | **0.58 [4]** | **0.86** | **0.82** | **0.58** |
| **Habitat Units** | **147.89** | **59.27** | **362.83** | **330.05** | **386.12** |

[1] Multi-habitat species
[2] No data was collected in this zone. Use HSI for NM.
[3] HSI adjustment
[4] No data was collected in this zone. Use HSI for WFS.

There are 10 survey sites in grasslands. Sites 106 and 131 are located in the WFN river zone. Sites 113, 123, 125, 126, and 127 are located within the NM zone. Sites 111, 112, and 161 are located in the WFS zone. Three indicators species represent the grassland guilds: eastern meadowlark, red-tailed hawk, and the eastern cottontail. The HSI values per species range from poor to optimum. The HSI values per river zone range from fair to very good. The limiting factors for grasslands throughout the project area is the insufficient cover for meadowlarks and cottontails, and insufficient number of large nest and perch trees for the red-tailed hawk.

**Eastern Meadowlark:** The HSI for the eastern meadowlark ranged from poor in the WFS zone to very good in the NM zone. The percent herbaceous canopy cover is very low in the grassland due to mowing. Meadowlarks need tall, dense grassland for cover, feeding, and nesting.

**Red-tailed Hawk:** The HSIs remained high considering the hawk is a multi-habitat species. The grasslands have no nest trees available for hawks, however, the trees in the adjacent woodlands provide roosting and nesting habitat. All habitats utilized by the red-tailed hawk are present in the project area. The food requisite is met by the grasslands and the number of trees available throughout the zones is sufficient to maintain average to optimum red-tailed hawk habitat.

**Eastern Cottontail:** The eastern cottontail is a multi-habitat species with an overall HSI of 0.66 for the upland forest and grassland habitats. The HSI in the grassland is low due to the lack of cover, such as shrubs, trees, or persistent herbaceous plants, because it is continuously mowed short. The HSI values may not reflect the true habitat quality for the cottontail because there is almost no winter cover or food throughout most of grassland, which is the majority of cottontail habitat. Therefore, all the HSI values for the cottontail should be reduced by 0.1 to reflect a more accurate habitat value for that guild. Table 2 shows these adjustments in parentheses in each of the river zone columns.

**3) Deciduous Upland Forest (**476.2acres) - Upland forests provide food, cover, nesting habitat, and living space to forest dependent species. Large trees are important as nesting habitat for the fox squirrel and red-tailed hawk. Deer (*Odocoileus virginianus*), small mammals, turkey (*Meleagris gallopavo*), bobwhite quail (*Colinus virginianus*), and many other species of birds utilize these stands for food and/or cover. Seven species represent the upland forest guild: barred owl, raccoon, Carolina chickadee, fox squirrel, downy woodpecker, red-tailed hawk, and eastern cottontail.

The upland forest habitat makes up 10.1 percent of the project area. Cedar elm and sugar hackberry dominate this cover type. Other tree species associated with this forest type include green ash, American elm, post oak, black locust, pecan, and box elder. The shrub layer consists of wooly bumelia, soapberry, privet, cedar elm, Chinaberry, black locust, and sugar hackberry.

Table 3 displays the HSI and habitat units for the upland forests within each river zone in the project area per indicator species. The HSI values for each species for this habitat range from nonexistent for the barred owl and fox squirrel in the WFN zone to very good in most of the

other zones. The HSI values per river zone range from fair in the WFN zone to good in all the others. No upland forest data were collected in the CFE and CFW river zones, therefore the HSI values for the NM zone was used for the CFW zone and the HSI values for the WFS zone was used for the CFE zone, because the habitats were similar to those zones.

There are six survey sites located in upland forest habitat. Sites 25, 26, and 27 are located in the NM zone. Site 28 is located in the WFN zone. Sites 24 and 29 are located just outside on the WFS zone. The most limiting factor in this habitat was the lack of large trees required by the fox squirrel and the barred owl and mast producing trees required by the fox squirrel. The WFS zone lacked snags large enough to provide habitat for the downy woodpecker.

**Table 3. HSI Values for the Existing Upland Forest Habitat per Indicator Species within the Central City Project Area.**

| Indicator Species | River Zones | | | | |
|---|---|---|---|---|---|
| | **WFN (77.1 ac)** | **CFE (41.9 ac)** | **NM 150.4 ac)** | **CFW (80.80 ac)** | **WFS (126.0 ac)** |
| Downy Woodpecker | 0.94 | 0.00 [4] | 0.67 | 0.67[2] | 0.00 |
| Carolina Chickadee | 0.79 | 0.88 [4] | 0.90 | 0.90[2] | 0.88 |
| Raccoon | 0.55 | 0.80 [4] | 0.58 | 0.58[2] | 0.80 |
| Red-tailed Hawk[1] | 0.51 | 1.00 [4] | 0.98 | 0.86 | 1.00 |
| Barred Owl | 0.00 | 0.68 [4] | 0.56 | 0.56 [2] | 0.68 |
| Eastern Cottontail[1] | 0.43 (0.33) [3] | 0.57 [4] (0.47) [3] | 0.75 (0.65) [3] | 0.75 [2] (0.65) [3] | 0.57 (0.47) [3] |
| Fox Squirrel | 0.00 | 0.22 [4] | 0.08 | 0.08[2] | 0.22 |
| **HSI Totals** | **0.46** | **0.59 [4]** | **0.65** | **0.63 [2]** | **0.59** |
| **Habitat Units** | **35.47** | **24.72** | **97.76** | **50.90** | **74.34** |

[1] Multi-habitat species
[2] No data was collected in this section. Use HSI for North Main.
[3] HSI adjustment
[4] No data was collected in this zone. Use HSI for WFS.

**Barred owl:** The barred owl upland forest HSI values range from good in the NM zone to non-existent in the WFN zone. None of the upland forest sites contained enough large

trees per acre to yield optimum barred owl habitat. Most of the stands are not mature enough to be considered good habitat.

**Raccoon:** All of the river zones have HSI values that indicate good or very good raccoon habitat. The average overstory tree size was too small for optimum raccoon habitat.

**Carolina Chickadee:** The Carolina chickadee upland forest HSI in every zone was valued as very good.

**Fox Squirrel:** The fox squirrel upland forest HSI in every zone was rated poor. The percent canopy closure of mast producing trees greater than 10 inches dbh as required by the squirrel was extremely low in all of the plots, if present at all. The average dbh and height of the overstory trees was, also, too low for good fox squirrel habitat.

**Downy Woodpecker:** The HSI values for the downy woodpecker upland forest habitat are rated as good to very good, except in the WFS zone where it is non-existent. Large snags required for woodpecker feeding and nesting were absent and the average basal area was too large for optimum woodpecker habitat. The downy woodpecker prefers a more open stand with a basal area between 43.6 and 87.2 $ft.^2/ac$.

**Red-tailed Hawk:** The canopy closure of overstory trees and shrubs were too dense to allow red-tailed hawks to hunt for prey in the upland forest habitat. However, the HSIs remained high considering the hawk is a multi-habitat species. All habitats utilized by the red-tailed hawk are in the project area. The food requisite is met by the grasslands and the number of trees available throughout the zones is sufficient to maintain average to optimum red-tailed hawk habitat.

**Eastern Cottontail:** The eastern cottontail is a multi-habitat species. The HSI values of the river zones range fair to good. The upland forest in all the zones lack enough persistent herbaceous plants for good cottontail cover. Zone WFN lacked the shrub canopy cover needed to provide cover. As stated above in the grassland section, the HSI values may not reflect the true habitat quality for the cottontail because there is almost no winter cover or food throughout most of grassland, which is the majority of cottontail habitat. All the HSI values for the cottontail should be reduced by 0.1 to reflect the habitat value for that guild better.

**4) Emergent Wetlands** (5.5 acres) - Wetlands provide food and cover for fish, resident and migratory birds, small mammals, invertebrates, and the predators that feed on these species. Wetlands are important nesting habitat for waterfowl.

This cover type makes up only 0.12 percent of the project area. It is comprised of rushes, sedges, wetland grasses, and aquatic plants located along the edges of the river and creeks, small impoundments, and seasonally flooded areas. Some of these wetlands are permanent, but most are seasonal. The emergent wetlands in the sump areas along the floodway have the potential of providing relatively good habitat for wildlife species.

Emergent wetland survey sites were located in only two river zones. There are no wetlands in CFW, CFE, or CFN zones. Site 130 is located at the north end of the NM zone. Sites 133, 134, and 135 are located in the WFS zone. The three species representing the emergent wetland habitat are the raccoon, green heron, and wood duck. The HSI values for the species ranged from poor to good, but the overall HSI value of this habitat is poor. Poor cover for the wood duck and the raccoon were the limiting factors in this habitat.

**Table 4. HSI Values for the Existing Emergent Wetlands per Indicator Species within the Central City Project Area.**

| Indicator Species | River Zones | |
|---|---|---|
| | NM (2.9 ac) | WFS (2.6 ac) |
| Green Heron | 0.55 | 0.55 |
| Raccoon | 0.26 | 0.00 |
| Wood Duck[1] | 0.10 | 0.03 |
| **HSI Totals** | **0.30** | **0.19** |
| **Habitat Units** | **0.87** | **0.49** |

[1] Multi-habitat Species

**Raccoon:** The raccoon emergent wetland HSI values are low, indicating poor habitat. The number of refuge sites was low because the peripheries of the wetlands are routinely cleared of brush and vegetative debris.

**Green Heron:** The green heron HSI values for the emergent wetland habitat is good. However, the wetlands included in the HEP analysis are ephemeral; they do not hold water for long and have very little water surface covered by logs, limbs, or woody vegetation for good cover.

**Wood Duck:** The wood duck is a multi-habitat species. The riparian woodland and emergent wetland habitats within the project area have poor HSI values, because the number of potentially suitable nest cavities was very low in both habitats. The percent of water surface covered by potential brood and winter cover (shrub cover and over-hanging tree crowns within 1 meter of the surface of the surface water, woody downfall and herbaceous vegetation) was very low.

**Threatened and Endangered Species and Birds of Conservation Concern**

The only federally listed threatened or endangered species known to occur in Tarrant County are the endangered whooping crane (*Grus americana*), endangered interior least tern (*Sterna antillarum*), threatened bald eagle (*Haliaeetus leucocephalus*), and the candidate black-tailed prairie dog (*Cynomys ludovicianius*).

Endangered whooping cranes may be encountered in any county in north central Texas during migration, including Tarrant County. 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. Due to the lack of suitable habitat and it=s urbanized nature, it is unlikely that this species would utilize any of the study area.

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

Bald eagles are considered winter and possible spring residents of Tarrant County. Bald eagles nest, roost, and perch in tall trees near water and feed primarily on fish and waterfowl. Winter habitat includes reservoirs, lakes, playas, rivers, and marshes. The project areas and/or adjacent lands contain large trees suitable for perching and nesting by bald eagles. Wintering bald eagles have been documented at Lake Worth. Most wintering bald eagles migrate north February through March and migrate late in the summer. Due to the development and disturbance in the study area, it is also unlikely that this area would be used by eagles.

The historical range of the black-tailed prairie dog, includes the western half of Texas, including parts of Tarrant County. Typically, prairie dogs inhabit short grass prairies where they feed on grasses and forbs. They are fossorial and locate their colonies in friable soil, usually avoiding areas of heavy brush and tall grass. There are no prairie dog colonies in the project area.

The Service published the *Birds of Conservation Concern 2002* (BCC) in December 2002. "The overall goal of the BCC is to accurately identify the migratory and non-migratory bird species (beyond those already designated as Federally threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action" (U.S. Fish and Wildlife Service 2002).

The following are 23 species on the BCC lists that may utilize the habitat types within the project area:

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

## Aquatic Resources

A fisheries survey was conducted on the Trinity River in the project area in July 2003, during summer low flow conditions by the Service, TPWD, and the Corps. The purpose of this survey was to determine baseline fish-community structure within the area of the Trinity River that could be potentially impacted by stream modifications, development, and/or construction activities associated with the Central City project. Photographs related to the fish survey are on pages C-20 and C-21 in Appendix C.

### Methods and Materials

Five sites were selected on the Trinity River to sample fish (Table 5 and Figure 2). One site was

**Table 5. Central City Project sample sites with general descriptions.**

| Sample Site | General Description |
|---|---|
| Site 1 | Trinity River adjacent to Riverside Park at Oakhurst Scenic Drive and Belknap Street, Ft. Worth (Tarrant County), Texas. |
| Site 2 | Trinity River at Samuel Avenue and confluence with Marine Creek, Ft. Worth (Tarrant County), Texas. |
| Site 3 | Trinity River after confluence with West and Clear Forks, below North Main Street, Ft. Worth (Tarrant County), Texas. |
| Site 4 | Clear Fork Trinity River between confluence with West Fork Trinity River and 7th Street, Ft. Worth (Tarrant County), Texas. |
| Site 5 | West Fork Trinity River between confluence with Clear Fork Trinity River and Henderson Street, Ft. Worth (Tarrant County), Texas. |

immediately downstream of the proposed project area (Site 1), while two sites were upstream of the project area (Sites 4 and 5) and two sites were within the project area (Sites 2 and 3). Site 4 is located in a portion of the Trinity River that can classified as a fourth order stream, while the remaining four sites are situated in a section of the Trinity that can be classified as a fifth order stream. The drainage basin for Sites 1 and 2 encompasses approximately 6,837 square kilometers ($km^2$) [2,640 square miles ($miles^2$)], while the basin area for Site 3 is approximately 6,759 $km^2$ (2,610 $miles^2$). The drainage basin for Site 4 is approximately 1,314 $km^2$ (500 $miles^2$) and the drainage area for Site 5 is 5,445 $km^2$ (2,100 $miles^2$). All five sites fall within the portion of the Trinity River that has been placed on the State of Texas 303(d) List as being an impaired water body (TCEQ, 2002). This is because this section of the Trinity River is not meeting 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 premise of this advisory is that persons are prohibited from possessing any species of fish from this area because of elevated organochlorine contaminants (TDH, 2003).

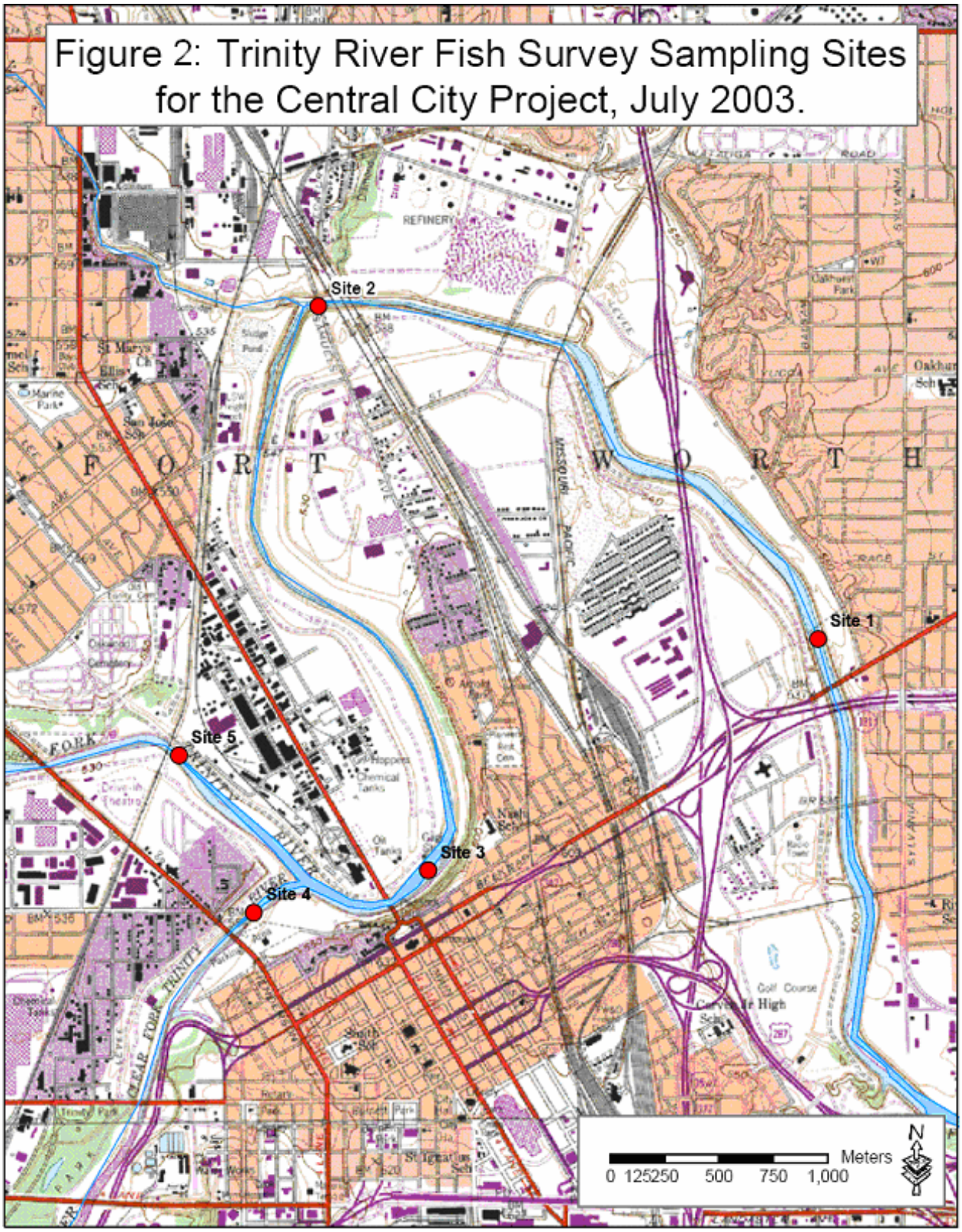


Figure 2: Trinity River Fish Survey Sampling Sites for the Central City Project, July 2003.
Site 1
Site 2
Site 3
Site 4
Site 5
F O R T
W O R T H
REFINERY
Meters
0 125250 500 750 1,000
N

Sediments collected between 1992 and 1993 by the U.S. Geological Survey on the Trinity River at Beach Street in Tarrant County, Texas, contained residual chlordane and dichloro-diphenyl-trichloroethane (DDT) metabolites (Moring, 1997). Beach Street is located approximately 3 miles (4.8 kilometers) downstream of Site 1.

Fish were collected from these five sites using a direct-current-boom electro-fishing boat and a 4 feet by 10 feet (1.2 by 3 meters) seine with ⊂ inch (0.32 centimeters) mesh. At each site, sampling consisted of electroshocking for a period of 60 minutes supported by eight seine hauls per site. After collection, fish were identified to species, counted, and any observed anomalies were recorded. All fish were then released back into the system with the exception of fish kept for voucher specimens and potential tissue analyses. The resulting fish 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 and fish-community degradation indices.

An Index of Biotic Integrity (IBI) is a type of biological monitoring that assess aquatic life use within a given water body using multiple metrics. The IBI, developed by the State of Texas for assessing fish assemblages, incorporates 12 metrics to define species richness, trophic composition, and abundance (Table 6). Each one of these metrics is scored with values ranging from low (1) to high (5). In turn, aquatic life use values are determined by adding each metric score for a total score.

**Table 6. Statewide index of biotic integrity scoring criteria for stream fish assemblages (Note - Total Score for Aquatic Life Use Subcategories: 58-60 = Exceptional; 48-52 = High; 40-44 = Intermediate; and #34 = Limited) (Armstrong, 1998).**

| Category | Metric | Scoring | | |
|---|---|---|---|---|
| | | 5 | 3 | 1 |
| Species | 1. Total number of species | ι | ι | ι |
| Richness and | 2. Total number of darter species | ∃3 | 1-2 | 0 |
| Composition | 3. Total number of sunfish species (excluding bass) | ∃2 | 1 | 0 |
| | 4. Total number of sucker species | ∃2 | 1 | 0 |
| | 5. Total number of intolerant species | ∃3 | 1-2 | 0 |
| | 6. Percentage of individuals as tolerants | <5 | 5-20 | >20 |
| Trophic | 7. Percentage of individuals as omnivores | <20 | 20-45 | >45 |
| Composition | 8. Percentage of individuals as insectivores | >80 | >40-80 | #40 |
| | 9. Percentage of individuals as piscivores | >5 | 1-5 | <1 |
| Fish | 10. Number of individuals in sample | >200 | >50-200 | #50 |
| Abundance and | 11. Percentage of individuals as hybrids | 0 | >0-1 | >1 |
| Condition | 12. Percentage of individuals with disease or other anomaly | #2 | >2-5 | >5 |

ιFirst-second order streams = ∃7(5), 4-6(3), #3(1) Third-fourth order streams = ∃10(5), 5-9(3), #4(1)
Fifth-sixth order streams = ∃16(5), 8-15(3), #7(1) Seventh-eighth order streams = ∃22(5), 11-21(3), #10(1)

Accounting for the high variability in fish assemblages in aquatic systems within various ecological regions (ecoregions) in Texas, Linam *et al.* (2002) developed regionalized IBIs. The area sampled corresponds to the region designated by Linam *et al.* (2002) as the Subhumid Agricultural Plains which incorporates the variability of fish species inhabiting aquatic systems

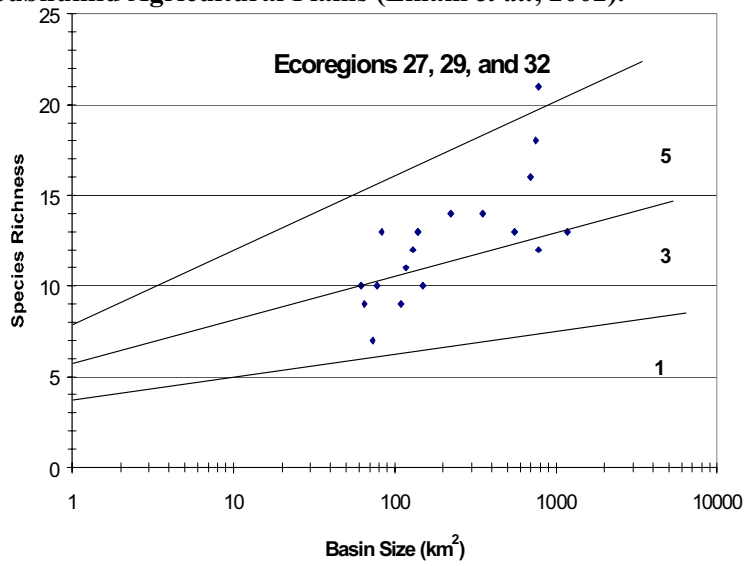
in Ecoregions 27 (Central Great Plains), 29 (Central Oklahoma/Texas Plains), and 32 (Blackland Prairies). The regionalized IBI for this area consists of 11 metrics and incorporates many of the same metrics as the statewide IBI, with the exceptions that it emphasizes the number of native cyprinid species, eliminates the consideration of darter species as a separate metric, and breaks down the total number of individual fish sampled into individuals collected per effort (Table 7 and Figure 3).

**Table 7. Regional index of biotic integrity scoring criteria for stream fish assemblages in the Subhumid Agricultural Plains-Ecoregions 27, 29, and 32 (Note - a score ∃49 = Exceptional; a score 41-48 = High; a score 35-40 = Intermediate; and a score <35 = Limited ) (Linam *et al.*, 2002).**

| Metric | Scoring Criteria | | |
|---|---|---|---|
| | **5** | **3** | **1** |
| 1. Total number of fish species | ι | ι | ι |
| 2. Number of native cyprinid species | >3 | 2-3 | <2 |
| 3. Number of benthic invertivore species | >1 | 1 | 0 |
| 4. Number of sunfish species | >3 | 2-3 | <2 |
| 5. % of individuals as tolerant species (excluding western mosquito fish) | <26% | 26-50% | >50% |
| 6. % of individuals as omnivores | <9% | 9-16% | >16% |
| 7. % of individuals as insectivores | >65% | 33-65% | <33% |
| 8. % of individuals as piscivores | >9% | 5-9% | <5% |
| 9. (a) Number of individuals/seine haul | >87 | 36-87 | <36 |
| 9. (b) Number of individuals/minute of electrofishing | >7.1 | 3.3-7.1 | <3.3 |
| 10. % of individuals as non-native species | <1.4% | 1.4-2.7% | >2.7% |
| 11. % of individuals with disease or other anomaly | <0.6% | 0.6-1% | >1% |

ιRefer to Figure 3 to obtain scoring criteria for Metric No.1.

**Figure 3. Fish species richness versus drainage basin size in Subhumid Agricultural Plains (Linam *et al.*, 2002).**



Still, another method of evaluating the fish assemblage within a given water body is by determining the fish-community degradation index. Four metrics are considered in calculating this index (Land *et al.*, 1998). These are the percent of tolerant individual fish species at the site; the percent of omnivorous fish at the site; the percent of non-native fish at the site; and the percent of fish with anomalies (disease) at the site (Moring, pers. comm., 2003). As with the IBIs, each one of these metrics is scored with values ranging from low (1) to moderate (3) to high (5) (Table 8). A low degradation rating is indicative of a fish community that is composed of species that are intolerant to physical and chemical disturbances and represent a balanced trophic structure (Moring, pers. comm., 2003). Moderate degradation indicates community degradation associated with the loss of intolerant species in conjunction with the increase of tolerant, omnivorous, and/or non-native species, whereas high degradation is indicative of an assemblage that is composed primarily of species that are omnivorous and tolerant to physical and chemical disturbances (Moring, pers. comm., 2003).

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

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

## Results

A total of 4,614 fish comprising 11 families and 30 species were collected during the combined seining and electrofishing sampling conducted at the five sites (Tables F-1 and F-2 and pages F-10 through F15 in Appendix F). The largest number of species collected at any site was 21 from Sites 1 and 4, while the fewest species collected, 17, were from Site 2 (Table F-2). The highest number of individual fish collected was 1,216 from Site 1, while the fewest were collected at Site 3 (642) (Table F-2). Twelve species from six families were collected at all five sites (Table F-2). 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%) (Table F-1).

In comparison, Kleinsasser and Linam (1989), employing the same collection methods, caught 7,894 fish from the Trinity River at Beach Street in August, 1987. The total number of fish reported by Kleinsasser and Linam (1989) may be higher than the individual number of fish collected in 2003; however, in the 1987 sampling, only seven species representing five families were reported. In addition, red shiners, representing 81% of the total number of fish sampled, were the dominant species collected in 1987

(Kleinsasser and Linam, 1989). Furthermore, Kleinsasser and Linam (1989) did not collect spotted suckers, green sunfish, warmouth, bluegill, largemouth bass, gizzard shad, threadfin shad, and big scale logperch from the Beach Street site, all of which were collected from each of the five sites on the Trinity River in 2003. The difference in species abundance between 1987 and 2003 may be attributed to habitat differences. Kleinsasser and Linam (1989) describe the 1987 sampling location at Beach Street as a series of shallow riffles, 2 to 11.8 inches (0.05 to 0.3 meters) in depth, with substrate consisting of clean gravel interrupted by pools with hard clay and bedrock substrate. Stream width ranged from 20 to 75 feet (6 to 23 meters) (Kleinsasser and Linam, 1989). In contrast, the aquatic habitats at the five sites sampled on the Trinity River in 2003 consisted of large, deep pools. The average depth at Sites 1 and 2 were 9.8 feet (3 meters) and 5.6 feet (1.7 meters), while the mean depths at Sites 3, 4, and 5 were 10.8 feet (3.3 meters), 6.9 feet (2.1 meters), and 10 feet (3 meters), respectively. Stream width ranged from 128 feet (40 meters) at Site 3 to over 300 feet (100 meters) at Sites 1 and 2. The difference in habitat can be attributed to the construction of a series of in-stream low water dams within the study area in the 1990s (Colbert, pers. comm., 2003) which has resulted in the creation of pool habitat that functions more as a lentic environment than as a true lotic system.

Designated tolerance levels and associated trophic guilds for the species collected were obtained from Linam *et al.* (2002) and are presented in Table F-3. Results of the statewide IBIs for the five sites, as well as the entire area sampled are included in Tables F-4, 7, 10, 13, 16, and 19; while results of the regionalized IBIs are included in Tables F-5, 8, 11, 14, 17, and 20. Results of the fish-community degradation indices are presented in Tables F-6, 9, 12, 15, 18, and 21.

The results of the statewide IBIs demonstrated high aquatic life use values for Sites 1 through 4 (a score of 48 at all four sites), while the fish assemblage at Site 5 was categorized as intermediate with a score of 46. The fish community within the overall study area was classified as high with a score of 50. Scoring of the regionalized IBIs yielded slightly different results. The aquatic life use values for Sites 2 through 5 and the overall study area were high, with scores ranging from 44 at Site 5 to 48 at Site 2 and the entire project area, whereas the aquatic life use value for Site 1 was exceptional with a score of 50. The fish assemblages at Sites 1 through 4 and the overall study area exhibited low community degradation (scores ranged from 6 at Site 1 to 8 at the remaining three sites and the entire study area), whereas the community at Site 5 demonstrated moderate degradation with a score of 10.

In comparison, the IBI results from 2003, were all higher than the values reported by Kleinsasser and Linam (1989) for fish collected from the Trinity River at Beach Street in August, 1987 (an intermediate score of 40) and August, 1988 (a high score of 42). All of the calculated fish-community degradation indices were less than 12, which was the value determined by the U.S. Geological Survey (USGS) from sampling conducted on the Trinity River at Beach Street between 1992 and 1995 (Land *et al.*, 1998). This difference can be attributed to the percent of non-native species and percent of individuals with external anomalies reported by the USGS (Land *et al.*, 1998). The

percent of non-native species collected by the USGS was 3%, while the percent of individuals with external anomalies was 2.8 % (Land *et al.*, 1998). In contrast, the percent of non-native species and percent of individuals with external anomalies were both less than 1% in the fish data collected in 2003.

### Discussion

Results of the baseline fisheries survey conducted on the Trinity River in July, 2003, characterized the fish assemblages within the proposed Central City Project area as high to exceptional. Site 5, located on the West Fork of the Trinity River upstream of the confluence with the Clear Fork and the project area, demonstrated moderate community degradation and a statewide intermediate aquatic life use value; however, on a regionalized basis, the fish community at this site was classified as high. Sites 2, 3, and 4 exhibited low degradation and high aquatic life use values in both the statewide and regional indices. Site 1 had the lowest community degradation value of any of the five sites and scored aquatic life values ranging from high using the statewide index to exceptional resulting from the regional index. Overall, community degradation was low and aquatic life use values were high within the entire study area. This is somewhat surprising, considering the documented organochlorine contamination within the project area coupled with the field observations that surficial waste from the sediments (i.e., plastic containers, paper, feminine hygiene products, glass bottles, contraceptives, oil filters, aluminum cans, etc.) was collected in every seine haul pulled at Sites 4 and 5 and at Site 3 near the confluence of the Clear and West Forks. The reason for the apparently viable fish assemblage within the proposed project area may be attributed to the in-stream modifications (i.e., low water dams) that have resulted in the creation of deep pools, which typically provide more aquatic habitat than shallow systems during summer low flow conditions and can serve as a buffer against sediment contamination, provided that the contamination remains in place and is not re-suspended into the water column due to anthropogenic and/or natural causes. It should be noted that the indices used in this study assess the overall fish community and do not account for the lethal and/or sublethal affects associated with chronic toxicity to individual fish species, nor do they address human health issues concerning the consumption of contaminated fish.

## RECOMMENDATIONS

### Terrestrial Habitats

Our habitat analysis indicates the following specific measures could restore natural habitats impacted by urban development within the project area.

1. Widen the riparian woodland corridors along the river as much as possible (up to 150 feet on each side) by planting native mast producing trees and shrubs. Riparian buffer zones provide several benefits for aquatic resources. First, riparian zones stabilize eroding banks by absorbing the erosive force of flowing water

while roots hold soil in place. Second, riparian zones filter sediment, nutrients, pesticides, and animal waste runoff. Finally, riparian zones provide shade, shelter, and food for fish and other aquatic organisms. Native mast producing trees and shrubs, such as pecan, bur oak, red oak, black walnut (*Juglans nigra*), wild plum (*Prunus mexicana*), sumac (*Rhus sp.*), hawthorne (*Crataegus sp.*), and coral-berry, should be planted in the expanded portion of the riparian woodland to improve canopy cover and food base. Plant 70 percent woody stems, with no more that 25 percent soft mast producers. Shrubs should be planted at no more than 30 percent stems. Maintain some scattered open spaces for fox squirrel movement.

2. Thin portions, not all, of the existing riparian corridor under mast producing trees where the understory is too dense to improve fox squirrel habitat and to open the stands as preferred by the woodpeckers.

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

4. Provide brush and log piles in the existing riparian habitat and grasslands to provide cover for small mammals.

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

6. More emergent wetlands can be created off stream. Wetlands constructed off stream could provide nonpoint source pollution control. In this role, wetlands would provide several benefits that contribute to water quality improvements. First, the wetlands provide water quality function through solids settling, nutrient transformation, and biological uptake. Second, because they provide a fairly large surface area, wetlands provide floodwater storage and serve to collect peak flood flows known to carry most of the polluted runoff from nonpoint sources. Finally, wetlands provide diversity in the landscape and supply a unique habitat for many plant and animal species.

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

8. Create native grasslands where possible throughout the project area to replace the Bermuda grass and johnsongrass. We recommend planting native grass and forb species appropriate for the soils. Little bluestem, big bluestem, Indian grass, side-oats grama, switch grass, vine-mesquite, Illinois bundle-flower (*Desmanthus illinoensis*), Maximilian sunflower (*Helianthus maximilian*), and Engelmann's daisy (*Engelmannia peristeri*) are excellent forage and seed producing species to consider. Plant a few shrub mottes and briar thickets in the grasslands, but maintain them to only about 5 percent canopy cover.

9. A mowing schedule should be developed that promotes tall grass growth, but does not interfere with tall-grass nesting birds. The grassland should not be mowed until after July 15.

10. We suggest that the direct, indirect, and cumulative impacts to and the conservation of the specific species listed in the Service's *Birds of Conservation Concern 2002* (BCC) published in December 2002, be considered in the Central City project planning. "The overall goal of the BCC is to accurately identify the migratory and non-migratory bird species (beyond those already designated as Federally threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action" (U.S. Fish and Wildlife Service 2002). Copies of the Birds of Conservation Concern 2002 may be obtained by writing to the Chief, Division of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Mail Stop 4107, Arlington, VA 22203-1610, ATTN: BCC 2002. It is also available for downloading on the Division of Migratory Bird Management's web page at http://migratorybirds.fws.gov.

11. We recommend that a biological analysis be conducted every few years using the same habitat evaluation technique to monitor and quantify habitat impacts of the restoration sites. Such an analysis would provide good information for adaptive management and for future habitat restoration planning projects.

The following are some general recommendations for improving and maintaining the lands in and adjacent to the project area for wildlife habitat:

1. Reduce mowing on City lands and along the rivers edge. Reseed and manage portions of these areas as native grasslands or wetland herbaceous plants.

2. Develop a program to eradicate exotic plants on City lands. Use only native plants during the restoration project.

3. Control bank erosion through use of biological engineering to the extent possible.

4. Develop a plan to eliminate the use of fertilizers, pesticides, and herbicides on public lands.

## SUMMARY

The Central City Project area has been heavily impacted by urban development, but there are still some wildlife habitat values contain therein. The specific habitat restoration measures recommended in this report could help restore some of the natural habitats that have been lost and improve habitat diversity and quality, benefitting a variety of resident and migratory wildlife species.

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# Appendices
for the
Central City Interim Feasibility Study
Draft Fish and Wildlife Coordination Act Report
June 18, 2004

A. Plant Lists by Common and Scientific Names

B. HEP Sites Observation Sheets

C. Photographs

D. HEP Sites Geographical Positions

E. HEP Structural Habitat Composition Parameters

F. Index of Biotic Integrity Data and Scoring

## Appendix A.
## Central City Project
**Plants by Common Name in Alphabetical Order**

| Common Name | *Scientific Name* |
|---|---|
| Alfalfa | *Medicago sativa* |
| Alumroot | *Heuchera americana* |
| American elm | *Ulmus americana* |
| Aster sp. | *Asteraceae sp.* |
| Beebalm | *Monarda sp.* |
| Bermudagrass | *Cynodon dactylon* |
| Betony noseburn | *Tragia betonicifolia* |
| Black mustard | *Brassica nigra* |
| Black-eyed susan | *Dracopis amplexicaulis* |
| Box elder | *Acer negundo* |
| Brome grass | *Bromus sp.* |
| Bundle-flower | *Desmanthus sp.* |
| Bur oak | *Quercus macrocarpa* |
| Butterfly-weed | *Gaura sp.* |
| California loosestrife | *Lythrum californicum* |
| Caltrop | *Tribulus terrestris* |
| Canada wildrye | *Elymus canadensis* |
| Caric sedge | *Carex sp.* |
| Carolina basswood | *Tilia americana* |
| Cedar elm | *Ulmus crassifolia* |
| Chinaberry | *Melia azedarach* |
| Clover sp. | *Lespedeza sp.* |
| Cocklebur | *Xanthium strumarium* |
| Common curly mesquite | *Hilaria belangeri* |
| Common sneezeweed | *Helenium autumnale* |
| Common balloonvine | *Cardiospermum halicacabum* |
| Cottonwood | *Populus deltoides* |
| Crab grass | *Digitaria sp.* |
| Croton | *Croton sp.* |
| Curly dock | *Rumex crispus* |
| Dallis grass | *Paspalum dilatatum* |
| Dandelion | *Taraxacum sp.* |
| Field ground cherry | *Physalis mollis* |
| Foxtail | *Setaria sp.* |
| Frogfruit | *Lippia sp.* |
| Giant ragweed | *Ambrosia trifida* |
| Green ash | *Fraxinus pennsylvanica* |

| | |
|---|---|
| Green pigweed | *Amaranthus sp.* |
| Gum bumelia | *Sideroxylon lanuginosum* |
| Hedge-parsley | *Torilis arvensis* |
| Honey locust | *Gleditsia tricanthos* |
| Indian blanket | *Gaillardia pulchella* |
| Japanese brome | *Bromus japonicus* |
| Japanese honey-suckle | *Lonicera japonica* |
| Japanese privet | *Ligustrum japonicum* |
| Johnsongrass | *Sorghun halepense* |
| Large-foot pepperwort | *Marsilea macropoda* |
| Large-spike spike-rush | *Eleocharis palustris* |
| Little barley | *Hordeum pusillum* |
| Live oak | *Quercus fusiformis* |
| Mesquite | *Prosopis grandulosa* |
| Mimosa | *Mimosa sp.* |
| Muscadine grape | *Vitis rotundifolia* |
| Pecan | *Carya illinoensis* |
| Pepperweed | *Lepidium sp.* |
| Pigeon-berry | *Rivina humilis* |
| Plantain | *Heteranthera dubia* |
| Poison ivy | *Toxicodendron radicans* |
| Prairie coneflower | *Ratibida columnifera* |
| Prairie parsley | *Polytaenia nuttallii* |
| Prickly poppy | *Argemone aurantiaca* |
| Privet | *Ligustrum sp.* |
| Prostrate lawnflower | *Calyptocarpus vialis* |
| Red oak | *Quercus shumardii* |
| Red cedar | *Juniperus virginiana* |
| Red mulberry | *Morus rubra* |
| Red-seeded plantain | *Plantago rhodosperma* |
| Rescue grass | *Bromus catharticus* |
| Rye grass | *Lolium perenne* |
| Saw greenbrier | *Smilax bona-nox* |
| Saw-tooth sunflower | *Helianthus grosseserratus* |
| Sedge sp. | *Cyperaceae Family* |
| Short caric sedge | *Carex brevior* |
| Showy evening-primrose | *Oenothera speciosa* |
| Silver-leaf nightshade | *Solanum elaeagnifolium* |
| Slender flat sedge | *Cyperus lupulinus* |
| Smartweed | *Polygonum sp.* |

| | |
|---|---|
| Soapberry | *Sapindus saponaria* |
| Spikerush | *Eleogrostis sp.* |
| Spurge sp. | *Euphorbia sp.* |
| Stork's-bill | *Erodium cicutarium* |
| Sugar hackberry | *Celtis laevigata* |
| Sunflower | *Helianthus sp.* |
| Sweetgum | *Liquidamber styraciflua* |
| Texas dandelion | *Pyrrhopappus pauciflorus* |
| Texas winter grass | *Nassella leucotricha* |
| Thistle | *Cirsium sp.* |
| Threeawn | *Aristida sp.* |
| Tick clover | *Desmodium sp.* |
| Toothed spurge | *Euphorbia dentata* |
| Unknown forb #1 | |
| Unknown forb #2 | |
| Venus' looking-glass | *Triodanis texana* |
| Vetch | *Vivia sp.* |
| Virginia wildrye | *Elymus virginicus* |
| Western ragweed | *Ambrosia psilostachya* |
| White avens | *Geum canadense* |
| White clover | *Trifolium repens* |
| White tridens | *Tridens albescens* |
| Wild oats | *Avena fatua* |
| Wild morning glory | *Ipomoea sp.* |
| Wild onion | *Allium canadense* |
| Woodland lettuce | *Lactuca floridena* |
| Woodsorrel | *Oxalis sp* |
| Yellow passion flower | *Passiflora lutea* |
| Yellow nut-grass | *Cyperus esculentus* |

**Plants by Scientific Name in Alphabetical Order**

| *Scientific Name* | Common Name |
|---|---|
| *Acer negundo* | Box elder |
| *Allium canadense* | Wild onion |
| *Amaranthus sp.* | Green pigweed |
| *Ambrosia psilostachya* | Western ragweed |
| *Ambrosia trifida* | Giant ragweed |
| *Argemone aurantiaca* | Prickly poppy |
| *Aristida sp.* | Threeawn |
| *Asteraceae sp.* | Aster sp. |
| *Avena fatua* | Wild oats |
| *Brassica nigra* | Black mustard |
| *Bromus japonicus* | Japanese brome |
| *Bromus catharticus* | Rescue grass |
| *Bromus sp.* | Brome grass |
| *Calyptocarpus vialis* | Prostrate lawnflower |
| *Cardiospermum halicacabum* | Common balloonvine |
| *Carex brevior* | Short caric sedge |
| *Carex sp.* | Caric sedge |
| *Carya illinoensis* | Pecan |
| *Celtis laevigata* | Sugar hackberry |
| *Cirsium sp.* | Thistle |
| *Croton sp.* | Croton |
| *Cynodon dactylon* | Bermudagrass |
| *Cyperaceae Family* | Sedge sp. |
| *Cyperus esculentus* | Yellow nut-grass |
| *Cyperus lupulinus* | Slender flat sedge |
| *Desmanthus sp.* | Bundle-flower |
| *Desmodium sp.* | Tick clover |
| *Digitaria sp.* | Crab grass |
| *Dracopis amplexicaulis* | Black-eyed susan |
| *Eleocharis palustris* | Large-spike spike-rush |
| *Eleogrostis sp.* | Spikerush |
| *Elymus virginicus* | Virginia wildrye |
| *Elymus canadensis* | Canada wildrye |
| *Erodium cicutarium* | Stork's-bill |
| *Euphorbia sp.* | Spurge sp. |
| *Euphorbia dentata* | Toothed spurge |
| *Fraxinus pennsylvanica* | Green ash |
| *Gaillardia pulchella* | Indian blanket |
| *Gaura sp.* | Butterfly-weed |

| | |
|---|---|
| *Geum canadense* | White avens |
| *Gleditsia tricanthos* | Honey locust |
| *Helenium autumnale* | Common sneezeweed |
| *Helianthus sp.* | Sunflower |
| *Helianthus grosseserratus* | Saw-tooth sunflower |
| *Heteranthera dubia* | Plantain |
| *Heuchera americana* | Alumroot |
| *Hilaria belangeri* | Common curly mesquite |
| *Hordeum pusillum* | Little barley |
| *Ipomoea sp.* | Wild morning glory |
| *Juniperus virginiana* | Red cedar |
| *Lactuca floridena* | Woodland lettuce |
| *Lepidium sp.* | Pepperweed |
| *Lespedeza sp.* | Clover sp. |
| *Ligustrum japonicum* | Japanese privet |
| *Ligustrum sp.* | Privet |
| *Lippia sp.* | Frogfruit |
| *Liquidamber styraciflua* | Sweetgum |
| *Lolium perenne* | Rye grass |
| *Lonicera japonica* | Japanese honey-suckle |
| *Lythrum californicum* | California loosestrife |
| *Marsilea macropoda* | Large-foot pepperwort |
| *Medicago sativa* | Alfalfa |
| *Melia azedarach* | Chinaberry |
| *Mimosa sp.* | Mimosa |
| *Monarda sp.* | Beebalm |
| *Morus rubra* | Red mulberry |
| *Nassella leucotricha* | Texas winter grass |
| *Oenothera speciosa* | Showy evening-primrose |
| *Oxalis sp* | Woodsorrel |
| *Paspalum dilatatum* | Dallis grass |
| *Passiflora lutea* | Yellow passion flower |
| *Physalis mollis* | Field ground cherry |
| *Plantago rhodosperma* | Red-seeded plantain |
| *Polygonum sp.* | Smartweed |
| *Polytaenia nuttallii* | Prairie parsley |
| *Populus deltoides* | Cottonwood |
| *Prosopis grandulosa* | Mesquite |
| *Pyrrhopappus pauciflorus* | Texas dandelion |
| *Quercus macrocarpa* | Bur oak |

| | |
|---|---|
| *Quercus fusiformis* | Live oak |
| *Quercus shumardii* | Red oak |
| *Ratibida columnifera* | Prairie coneflower |
| *Rivina humilis* | Pigeon-berry |
| *Rumex crispus* | Curly dock |
| *Sapindus saponaria* | Soapberry |
| *Setaria sp.* | Foxtail |
| *Sideroxylon lanuginosum* | Gum bumelia |
| *Smilax bona-nox* | Saw greenbrier |
| *Solanum elaeagnifolium* | Silver-leaf nightshade |
| *Sorghun halepense* | Johnsongrass |
| *Taraxacum sp.* | Dandelion |
| *Tilia americana* | Carolina basswood |
| *Torilis arvensis* | Hedge-parsley |
| *Toxicodendron radicans* | Poison ivy |
| *Tragia betonicifolia* | Betony noseburn |
| *Tribulus terrestris* | Caltrop |
| *Tridens albescens* | White tridens |
| *Trifolium repens* | White clover |
| *Triodanis texana* | Venus' looking-glass |
| *Ulmus crassifolia* | Cedar elm |
| *Ulmus americana* | American elm |
| *Vitis rotundifolia* | Muscadine grape |
| *Vivia sp.* | Vetch |
| *Xanthium strumarium* | Cocklebur |
| | Unknown forb #1 |
| | Unknown forb #2 |

**HEP Site Observations for the Central City Project**

**Site:** West Fork Floodway

**Date:** 4/11/01 & 7/10/01

**GPS/ HEP sites #:** 104

**Photos:** See page/s C-5

**General Description and Observations:** Narrow riparian zone in Riverside Park on the east side of the river.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| bur oak - dominate | | Canada wildrye | hedge-parsley |
| sugar hackberry - dominate | | crab grass | saw greenbrier |
| pecan - dominate | | Bermuda grass | balloon vine |
| cedar elm | | | white clover |
| chinaberry | | | poison ivy |
| American elm | | | |
| | | | |
| | | | |
| | | | |

**Wildlife Species Observed:**

wood duck
belted kingfisher
northern cardinal
common crow

**HEP Site Observations for the Central City Project**

**Site:** West Fork Floodway

**Date:** 4/11/01 & 7/10/01

**GPS/ HEP sites #:** 106

**Photos:** See page/s C-5 and C-6

**General Description and Observations:** Grassland in Riverside Park on the east side of the river adjacent to pecan grove. Mowed frequently throughout year.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | chinaberry | Bermuda grass | caltrop |
| | | crab grass | white clover |
| | | | wild morning glory |
| | | | |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** West Fort Worth Floodway

**Date:** 4/17/01 & 7/10/01

**GPS/ HEP sites #:** 111

**Photos:** See page C-6

**General Description and Observations:** Grassland between the floodway and Samuels Ave. this area is mowed periodically.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Bermuda grass | curly dock |
| | | | caltrop |
| | | | wild morning glory |
| | | | thistle |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** West Fort Worth Floodway

**Date:** 4/17/01 & 7/10/01

**GPS/ HEP sites #:** 112

**Photos:** See page C-7

**General Description and Observations:** Grassland between the floodway and Samuels Ave. along the levee. This area is mowed periodically.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Johnson grass | silver-leaf nightshade |
| | | | wild morning glory |
| | | Bermuda grass | caltrop |
| | | | pepperweed |
| | | | cocklebur |
| | | | yellow nut-grass |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Marine Creek

**Date:** 4/17/01

**GPS/ HEP sites #:** 113

**Photos:** See pages C-7 and C-8

**General Description and Observations:** Grassland along Marine Creek near Samuels Ave.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Brome sp. | black mustard - dominate |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** West Fork at University Drive

**Date:** 5/21/03

**GPS/ HEP sites #:** 123

**Photos:** See page C-8

**General Description and Observations:** Grassland (probably seeded) old field, pecan trees along edge on the river .

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | rescue grass | Alfalfa |
| | | wild oats | prickly poppy |
| | | rye grass | curly dock |
| | | Johnsongrass | Venus' looking glass |
| | | | hedge parsley |
| | | | field ground cherry |

**Wildlife Species Observed:**

dickcissel
downy woodpecker
scissor-tailed flycatcher
kingbirds

**HEP Site Observations for the Central City Project**

**Site:** University Drive

**Date:** 5/21/03

**GPS/ HEP sites #:** 124

**Photos:** See page C-9

**General Description and Observations:** Woodland with open understory. Trees are young. The cottonwoods are about 20 years old. and between 10 and 15 years old. Lot of leaf litter.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| cottonwood (D) | American elm | | poison ivy |
| green ash | green ash | | Carex sp. |
| American elm | gum bumelia | | |
| | e. red cedar | | |
| | | | |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Trinity R. and Jacksboro Hwy.

**Date:** 5/22/03

**GPS/ HEP sites #:** 125

**Photos:** See pages C-9 and C-10

**General Description and Observations:** Mowed grassland in floodplain south of cemetary.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Bermuda grass | dandelion |
| | | Dallis grass | showy primrose |
| | | crabgrass | hedge parsley |
| | | little barley | Desmanthus sp. |
| | | Rye grass | tick clover |
| | | | frogfruit |
| | | | red-seeded plantain |
| | | | Venus' looking glass |
| | | | vetch (Vicia sp.) |
| | | | unknown forb sp. #1 |
| | | | unknown forb sp. #2 |

**Wildlife Species Observed:**

swallows
northern cardinal
great blue heron

**HEP Site Observations for the Central City Project**

**Site:** West end of 5th Street

**Date:** 5/22/03

**GPS/ HEP sites #:** 126

**Photos:** See page C-10

**General Description and Observations:** Groomed grassland along the east side of the river north of downtown.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| sweetgum | | Bermuda grass | wood sorrel |
| live oak | | Dallis grass | storksbill |
| red oak | | Rye grass | nightshade |
| | | | hedge parsley |
| | | | red-seeded plantain |
| | | | dandelion |
| | | | curly dock |
| | | | unknown forb |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** North Main

**Date:** 5/22/03

**GPS/ HEP sites #:** 127

**Photos:** See page C-11

**General Description and Observations:** Grassland inside the woodland circle east of Main Street, adjacent to the old power plant, between North Main and the river.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Johnson grass | hedge parsley |
| | | Bermuda grass | morning glory |
| | | Texas winter grass | night shade |
| | | | wood sorrel |
| | | | storksbill |
| | | | prostrate lawnflower |

**Wildlife Species Observed:**

grackles

**HEP Site Observations for the Central City Project**

**Site:** North Main

**Date:** 5/22/03

**GPS/ HEP sites #:** 128

**Photos:** See pages C-11 and C-12

**General Description and Observations:** Hackberry forest surrounding site 127, between North Main and the river. Open understory.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| sugar hackberry | gum bumelia | | hedge parsley |
| | sugar hackberry | | Aster (sunflower) |
| | privet | | pidgeonberry |
| | Chinaberry | | greenbrier |
| | | | |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Marine Creek Pond

**Date:** 5/22/03

**GPS/ HEP sites #:** 129

**Photos:** See pages C-12 and C-13

**General Description and Observations:** Wetland pond. Mesquite hanging over the waters edge. The pond is about 1/4 ac. large. Water is green color. Did not collect HEP information.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| mesquite | mesquite | Texas winter wheat | curly dock |
| | soapberry | foxtail | hedge parsley |
| | | Bermuda grass | wild onion |
| | | Johnson grass | sedge |
| | | | tiny hackberry |
| | | | cocklebur |
| | | | grapevine |

**Wildlife Species Observed:**

2 pair of wood ducks with young
swallows
kingbird

**HEP Site Observations for the Central City Project**

**Site:** Marine Creek

**Date:** 5/22/03

**GPS/ HEP sites #:** 130

**Photos:** See pages C-13

**General Description and Observations:** Emergent wetland surrounded by mesquite and hackberry trees. There is an open water pond to the south.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | mesquite | Bermuda grass | slender flat sedge |
| mesquite | | switchgrass | large spike rush |
| | | Japanese brome | aster sp. |
| | | | |
| | | | |
| | | | |

**Wildlife Species Observed:**

swallows

**HEP Site Observations for the Central City Project**

**Site:** Northside Drive

**Date:** 5/22/03

**GPS/ HEP sites #:** 131

**Photos:** See pages C-14

**General Description and Observations:** Upland groomed grassland by road on Northside Drive bridge across river. The grass is maintained at 4 inches. Scattered trees present.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | | Bermuda grass | nightshade |
| | | white tridens | storksbill |
| | | | wood sorrel |
| | | | Euphorbia sp. |
| | | | Aster sp. |
| | | | noseburn |
| | | | clover sp. |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Northside Drive

**Date:** 5/22/03

**GPS/ HEP sites #:** 132

**Photos:** See pages C-14 and C-15

**General Description and Observations:** Riparian area along old oxbow of river along Northside Drive and railroad track.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| mulberry | Chinaberry | Texas winter wheat | poison ivy |
| Chinaberry | box elder | | hedge parsley |
| cottonwood | mulberry | | white avens |
| pecan | | | alumroot |
| | | | pidgeonberry |
| | | | |

**Wildlife Species Observed:**

Carolina wren - 3
downy woodpecker

**HEP Site Observations for the Central City Project**

**Site:** Delga Street

**Date:** 5/22/03

**GPS/ HEP sites #:** 133

**Photos:** See page C-15

**General Description and Observations:** Ephemeral wetland near Delga Park. A depression surrounded by grassland. There are cottonwoods to the west, river to the east, fill dirt to the north with a storage construction area, and a residential area to the south.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | rye grass | small sedge in low area |
| | | foxtail | Indian blanket |
| | | white tridens | hedge parsley |
| | | | black-eyed susan |
| | | | curly dock |
| | | | beebalm |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** 4th Street
**Date:** 6/2/03
**GPS/ HEP sites #:** 134
**Photos:** See page C-16
**General Description and Observations:** Wetland, dry flats between channel and radio station. mowed all around on three sides. Small creek just to the west.
**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | hackberry | Johnsongrass | curly dock |
| | ash | common curly mesquite | balloonvine |
| | honey locust | Virginia wildrye | short caric sedge |
| | | Japanese brome | croton sp. |
| | | | toothed spurge |
| | | | plaintain |
| | | | cut-leaf ground cherry |
| | | | black-eyed susan |
| | | | western ragweed |
| | | | showy primrose |
| | | | large-foot pepperwort |
| | | | prairie parsley |
| | | | smartweed |
| | | | Eleogrostis spikerush |
| | | | pigweed |
| | | | gaura? |
| | | | hedge parsley |
| | | | pepperweed |
| | | | noseburn |
| | | | Mimosa sp. |

**Wildlife Species Observed:**
red-tailed hawk
Northern mockingbird
mourning dove
northern flicker

**HEP Site Observations for the Central City Project**

**Site:** I - 35 and Belknap

**Date:** 6/2/03

**GPS/ HEP sites #:** 135

**Photos:** See pages C-16 and C-17

**General Description and Observations:** West of Trinity River, north of Belknap. Possible sump area, not mowed, adjacent to the maintained sump area. It is surrounded by old field, Johnsongrass dominated with scattered trees, mainly cottonwood and hackberry and poison ivy.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | hackberry | Johnsongrass | prairie coneflower |
| | | | curly dock |
| | | | evening primrose |
| | | | plaintain |
| | | | bundleflower |
| | | | unknown sedge |
| | | | giant ragweed |
| | | | beebalm |
| | | | frogfruit |
| | | | California loosestrife |
| | | | common sneezeweed |

**Wildlife Species Observed:**
fox squirrel
northern mockingbird
swallow
western kingbird
scissor-tailed flycatcher

**HEP Site Observations for the Central City Project**

**Site:** Trinity Park

**Date:** 6/2/03

**GPS/ HEP sites #:** 136

**Photos:** See page C-17

**General Description and Observations:** Wooded area west of the Clear Fork, east of University Drive.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| cedar elm | American elm | Canada wildrye | giant ragweed |
| Chinaberry | Carolina basswood | | woodland lettuce |
| pecan | gum bumelia | | poison ivy |
| bur oak | hackberry | | Aster sp. |
| gum bumelia | privet (non-native) | | yellow passion flower |
| hackberry | bur oak | | white avens |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Trinity Park

**Date:** 6/2/03

**GPS/ HEP sites #:** 137

**Photos:** See page C-18

**General Description and Observations:** Mowed parkland under large trees.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| Pecan | | Bermuda grass | |
| Cedar elm | | ryegrass | |
| bur oak | | | |
| | | | |
| | | | |
| | | | |

**Wildlife Species Observed:**

fox squirrel
northern mockingbird
grackle
downey woodpecker

**HEP Site Observations for the Central City Project**

**Site:** Trinity Park

**Date:** 6/2/03

**GPS/ HEP sites #:** 138

**Photos:** See pages C-18 and C-19

**General Description and Observations:** Trinity Park south of abandoned picnic area. Vegetation was thick, devoid of mast producing trees. Behind park maintenance facility and Crestline Ave.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| mulberry | privet | Canada wildrye | Japanese honeysuckle |
| basswood | ligustrum | | saw-toothed greenbrier |
| hackberry | soapberry | | poison ivy |
| American elm | boxelder | | ragweed |
| cedar elm | | | white avens |
| Chinaberry | | | |

**Wildlife Species Observed:**

northern cardinal

**HEP Site Observations for the Central City Project**

**Site:** Fort Worth Floodway

**Date:** 4/10/01

**GPS/ HEP sites #:** 161

**Photos:** See page C-19

**General Description and Observations:** Grassland on the north side of railroad crossing, south of the floodway near Samuels Ave. Mowed periodically.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| | | Bromus sp. | pepperweed |
| | | foxtail | Texas dandelion |
| | | | saw-tooth sunflower |
| | | | silver-leaf nightshade |
| | | | stork's bill |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site: Harmon Field Park**

**Date: 3/23/04**

**GPS/ HEP sites #:** 175

**Photos:** See photo page/s C-23

**General Description and Observations:** Riparian Woodland. Dry creek in Harmon Field Park along West I-35 just east of downtown Fort Worth. The creek has a lot of trash. No fish or invertebrates were found. A power line runs above the creek. Many of the trees are dead. We suspected that an herbicide had been used along the power line. Shrubs had been cleared. The understory was open with grass up to the cut of the slope leading down along the edge of the creek.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | Bois d'arc (dead) | Canada wild rye | beggertick |
| red mulberry | cherry laurel | | wild onion |
| black willow | | | ragweed |
| Chinaberry | | | greenbrier |
| | | | dandelion |
| | | | wild mustard |

**Wildlife Species Observed:**

mourning dove
northern cardinal

**HEP Site Observations for the Central City Project**

**Site: North Cold Springs**

**Date: 3/23/04**

**GPS/ HEP sites #:** 176

**Photos:** See photo page/s C-23 & 24

**General Description and Observations:** Riparian woodland along a small drainage between the railroad track and Delga Road. There were very large 60 ft. tall cottonwoods and large snags. The honeysuckle is thick groundcover.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | hackberry | Canada wild rye | beggertick |
| willow | | ? | hensbit |
| Chinaberry | | | ragweed |
| boxelder | | | dandelion |
| | | | Japonese honeysuckle |
| | | | greenbrier |

**Wildlife Species Observed:**

Northern cardinal

**HEP Site Observations for the Central City Project**

**Site:** Arnold Park

**Date:** 10/23/03

**GPS/ HEP sites #:** 024

**Photos:** See page C-1

**General Description and Observations:** Parkland, east of railroad tracks, surrounded by residents on other 3 sides.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| post oak | hackberry | Bermuda grass | greenbrier |
| cedar elm | | Johnsongrass | wood sorrel |
| sugar hackberry | | rosette paspalum | toothed spurge |
| | | | grapevine |
| | | | curly dock |
| | | | prostrate lawnflower |
| | | | nightshade |
| | | | Carolina moonseed |
| | | | Aster sp. |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Jones North Street

**Date:** 10/23/03

**GPS/ HEP sites #:** 025

**Photos:** See pages C-1 and C-2

**General Description and Observations:** Upland woodland, south of LaGrave Field. Open understory.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| Hackberry (dominate) | wooly bumelia | Canada ryegrass (sparce) | stork's bill |
| cedar elm | Chinaberry | Bermuda grass | peppervine |
| | sumac | | yucca |
| | | | dandelion |
| | | | Aster sp. |
| | | | |

**Wildlife Species Observed:**

White-winged dove
Crow

**HEP Site Observations for the Central City Project**

**Site:** Oakwood Cemetery

**Date:** 10/23/03

**GPS/ HEP sites #:** 026

**Photos:** See page C-2

**General Description and Observations:** Upland woodland between the railroad tracks and private land just east of the Oakwood Cemetery. The river is just south.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | soapberry | | poison ivy |
| American elm | cedar elm | | greenbrier |
| black locust | black locust | | Carolina moonseed |
| | privet | | |
| | catelpa? | | |
| | | | |

**Wildlife Species Observed:**
mockingbird
bluejay

**HEP Site Observations for the Central City Project**

**Site:** Rockwood Park

**Date:** 10/23/03

**GPS/ HEP sites #:** 027

**Photos:** See pages C-3

**General Description and Observations:** Upland parkland (looks riparian near river) understory open, grass ~ 2-3" tall with bear ground.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| green ash (dominate) | | Bermuda grass | wood sorrel |
| pecan (2nd dominate) | | paspalum sp. | dandelion |
| cedar elm | | | prostrate lawnflower |
| hackberry | | | |
| post oak (1) | | | |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** Neal Street, Trail Driver's Park

**Date:** 10/23/03

**GPS/ HEP sites #:** 028

**Photos:** See pages C-3 and C-4

**General Description and Observations:** Upland woodland

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| hackberry | hackberry | Canada ryegrass | poison ivy |
| box elder | bumelia | | Carolina moonseed |
| American elm | soapberry | | pigeonberry |
| | Japanese privet | | greenbrier |
| | cedar elm | | |
| | | | |

**Wildlife Species Observed:**

**HEP Site Observations for the Central City Project**

**Site:** **Bluff Street**

**Date:** 10/23/03

**GPS/ HEP sites #:** 029

**Photos:** See pages C-4

**General Description and Observations:** Upland woodland, south of River Downtown. Slope ~45 degrees, ground cover is leaf litter, understory is open.

**Plant Species:**

| Tree: | Shrub: | Grass: | Vine or Forb: |
|---|---|---|---|
| cedar elm | Chinaberry | Canada ryegrass | Virginia creeper |
| sugarberry | gum bumelia | | |
| | privit | | |
| | hickory type | | |
| | | | |
| | | | |

**Wildlife Species Observed:**

Site 024, east view. Parkland in Arnold Park west of railroad tracks.

Site 024, south view.

Site 024, north view.

Site 024, west view.

Site 025, east view. Upland woodland south of river Downtown.

Site 025, south view.

Site 025, north view.

Site 025, west view.

Site 026, east view. Upland woodland between the railroad tracks and private land just east of the Oakwood Cemetery.

Site 026, south view.

Site 026, north view.

Site 026, west view.

Site 027, east view. Upland parkland in Rockwood Park.

Site 027, south view.

Site 027, north view.

Site 027, west view.

Site 028, east view. Upland woodland near Neal Street.

Site 028, south view.

Site 028, north view.

Site 028, west view.

Site 029, east view. Upland woodland south of river near Bluff Street.

Site 029, south view.

Site 029, north view.

Site 029, west view.

Site 104, west view. Tributary to the West Fork of the Trinity River in Riverside Park.

Site 104, east view.

Site 104.

Site #106, east view. Grassland in Riverside Park.

Site #106, south view.

Site #106, north view.

Site #106, west view.

Site #111, east view. Grassland west of Samuels Avenue.

Site #111, south view.

Site #111, north view.

Site #111, west view.

Site #112, east view. Grassland along the banks of the floodway levee near Samuels Avenue.

Site #112, south view.

Site #112, north view.

Site #112, west view.

Site #113, east view. Grassland along the banks of Marine Creek.

Site #113, south view.

Site #113, north view.

Site #113, west view.

Site 123, east view. Grassland/ old field along the edge of river near University Drive.

Site 123, south view.

Site 123, north view.

Site 123, west view.

Site 124, east view. Woodland east of University Drive, just north of the river.

Site 124, south view.

Site 124, north view.

Site 124, west view.

Site 125, east view. Grassland in floodway south of Oakwood Cemetery.

Site 125, south view.

Site 125, north view.

Site 125, west view.

Site 126, east view. Grassland along the east side of the river at the west end of 5th Street.

Site 126, south view.

Site 126, north view.

Site 126, west view.

Site 127, east view. Grassland inside the woodland east of Main Street adjacent to the old power plant.

Site 127, south view.

Site 127, north view.

Site 127, west view.

Site 128, east view. Hackberry forest surrounding Site 127, between North Main and the river.

Site 128, south view.

Site 128, north view.

Site 128, west view.

Site 129, southeast view. Pond south of Marine Creek west of river between railroad tracks.

Site 129, south view.

Site 129, south view continued.

Site 129, southwest view.

Site 129, west view.

Site 129. A pair of wood ducks with young at west side of pond.

Site 130, east view. Emergent wetland north of Site 129.

Site 130, south view.

Site 130, north view.

Site 130, west view.

Site 131, east view. Upland grassland by Northside drive bridge north of river.

Site 131, south view.

Site 131, north view.

Site 131, west view.

Site 132, east view. Riparian woodland along old oxbow south of Northside Drive, between railroad and I-35.

Site 132, south view.

Site 132, north view.

Site 132, west view.

Site 133, east view. Wetland near Delga Park.

Site 133, south view.

Site 133, north view.

Site 133, west view.

Site 134, east view. Wetland between river channel and the radio station.

Site 134, south view.

Site 134, north view.

Site 134, west view.

Site 135, east view. Wetland, possible sump area, west of river and north of Belknap Drive.

Site 135, south view.

Site 135, north view.

Site 135, west view.

Site 136, east view. Woodland area west of the Clear Fork, east of University Drive.

Site 136, south view.

Site 136, north view.

Site 136, west view.

Site 137, east view. Parkland in Trinity Park.

Site 137, south view.

Site 137, north view.

Site 137, west view.

Site 138, east view. Woodland in Trinity Park south of abandoned picnic area.

Site 138, south view.

Site 138, north view.

Site 138, west view.

Site 161, east view. Grassland on the north side of railroad, south of floodway near Samuels Avenue.

Site 161, south view.

Site 161, north view.

Site 161, west view.

Warning sign near IBI Site #1.

Electrofishing in the Trinity River at IBI Site #1.

Channel catfish collected at IBI Sitie #1,

Largemouth bass collected at IBI Site #1.

Juvenile largemouth bass collected at Site #1.

Big scale logperch collected at IBI Site #1.

Largemouth bass.

Largemouth bass collected at IBI Site #1 with tumor above lower jaw.

Closeup of tumor.

Low water dam in the main channel just east of the Main Street bridge.

Wetland at the Clear and West Forks of the Trinity River confluence.

Wetland at the Clear and West Forks of the Trinity River confluence.

Wetland at the Clear and West Forks of the Trinity River confluence.

Old Power Plant north of the Main Street Bridge.

Levee along the north side of the river east of the Main Street Bridge.

River bank in Trinity Park

Low water dam at Trinity Park.

Confluence of Marine Creek

Site 175, east view.

Site 175, south view.

Site 175, north view.

Site 175, west view.

Site 176, east view.

Site 176, north view.

Site 176, south view.

Site 176, west view.

**Geographical Positions of the HEP Sites in the Central City Ecosystem Restoration Project on the West Fork of the Trinity River**

| Site # | Latitude | Longitude | Site # | Latitude | Longitude |
|---|---|---|---|---|---|
| **024** | 32° 46' 05.0" N | 97° 19' 42.4" W | **127** | 32° 45' 50.0" N | 97° 20' 02.3" W |
| **025** | 32° 45' 48.2" N | 97° 20' 04.3" W | **128** | 32° 45' 50.9" N | 97° 20' 04.3" W |
| **026** | 32° 46' 00.1" N | 97° 20' 40.1" W | **130** | 32° 47' 02.0" N | 97° 20' 35.3" W |
| **027** | 32° 45' 54.3" N | 97° 21' 48.8" W | **131** | 32° 47' 02.3" N | 97° 19' 35.1" W |
| **028** | 32° 47' 15.5" N | 97° 20' 09.9" W | **132** | 32° 47' 00.5" N | 97° 19' 26.3" W |
| **029** | 32° 45' 35.9"N | 97° 19' 51.2" W | **133** | 32° 46' 29.3" N | 97° 19' 23.9" W |
| **104** | 32° 46' 34.8"N | 97° 18' 59.6" W | **134** | 32° 45' 38.6" N | 97° 18' 48.8" W |
| **106** | 32° 46' 31.1"N | 97° 18' 56.5" W | **135** | 32° 46' 13.1" N | 97° 18' 55.7" W |
| **111** | 32° 46' 57.6"N | 97° 20' 14.8" W | **136** | 32° 44' 22.5" N | 97° 21' 34.2" W |
| **112** | 32° 46' 58.2"N | 97° 20' 16.8" W | **137** | 32° 44' 30.5" N | 97° 21' 18.6" W |
| **113** | 32° 47' 02.1"N | 97° 20' 24.2" W | **138** | 32° 44' 29.2" N | 97° 21' 35.1" W |
| **123** | 32° 45' 54.7" N | 97° 21' 27.1" W | **161** | 32° 47' 00.9" N | 97° 20' 04.6" W |
| **124** | 32° 45' 54.2" N | 97° 21' 30.3" W | **175** | 32° 45' 19.2" N | 97 18' 35.1" W |
| **125** | 32° 45' 57.1" N | 97° 20' 57.6" W | **176** | 32° 46' 10.3" N | 97° 19' 17.8" W |
| **126** | 32° 45' 48.4" N | 97° 20' 29.2" W | | | |

**Table E-1. Structural habitat composition parameters estimated at each Riparian/ Bottomland Hardwood survey site.**

| Parameter | Survey sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **104** | **124** | **128** | **132** | **136** | **137** | **138** | **175** | **176** |
| Percent tree canopy closure (%) | 40 | 40 | 80 | 70 | 80 | 30 | 80 | 45 | 85 |
| Percent tree canopy closure of mast producers ≥ 6 in. dbh (%) | 20 | 0 | 80 | 25 | 15 | 15 | 0 | 0 | 0 |
| Percent canopy closure deciduous trees in stand (%) | 40 | 40 | 80 | 70 | 80 | 30 | 80 | 45 | 85 |
| Ave. dbh of overstory trees (in.) | 15 | 10 | 12 | 11 | 17 | 21 | 11 | 6 | 8 |
| Ave. height of overstory trees (ft.) | 40 | 35 | 40 | 55 | 50 | 45 | 40 | 35 | 40 |
| Overstory forest size class: (**A** =<6”dbh, **B** =6-10”dbh, **C** =10-20”dbh, **D** =>20”dbh) | D | B | C | C | C | D | C | B | B |
| # of snags <19 in. dbh per acre **(#)** | 1 | 20 | 8-10 | 50 | 50 | 0 | ND | 20 | 10 |
| Percent shrub crown cover (%) | 10 | 80 | 25 | 40 | 60 | 0 | 50 | 10 | 10 |
| Number refuge sites per acre (#) | 1 | 10 | 10 | 5 | 40 | 0 | 40 | 1 | 1 |
| Distance to water (ft.) | 25 | 300 | 900 | 20 | 50 | 200 | 30 | 15 | 30 |
| Water regime: (**A**=Permanent, **B**=Semi-Permanent, **C**=None/Ephemeral) | A | A | A | A | A | A | A | A | C |
| # potential nest cavities per acre | 1 | 0 | 1 | ND | 10 | 0 | 1 | 1 | 1 |
| % water surface covered by logs, trees, or woody veg. within 1m | ND | 5 | ND | 10 | 10 | 0 | 5 | 0 | 5 |
| % herb. canopy cover in littoral zone | ND | 0 | ND | 0 | 0 | 0 | 0 | 0 | 5 |
| % water area <2m deep | ND | 25 | ND | 100 | 100 | 100 | 100 | 100 | 100 |
| Water current: **A)**Still to slow (6 in/sec **B)**Mod. Slow (6 to 24 in/sec) **C)** Mod. fast (24 to 40 in/sec) **D)** Fast ( 40 in/sec) | A | A | A | A | A | A | A | A | A |
| # of woody stems (≥ 1m tall)/ac | ND | 7000 | 1000 | 1960 | 1600 | 80 | 6800 | 740 | 500 |
| # of trees ≥ 20 in. dbh/ac | ND | 0 | 10 | 10 | 40 | 28 | 20 | 0 | 0 |

ND = No Data

**Table E-2. Structural habitat composition parameters estimated at each Emergent Wetland survey site.**

| Parameter | Survey sites | | | |
|---|---|---|---|---|
| | **130** | **133** | **134** | **135** |
| Distance to water (ft.) | 75 | 300 | 75 | 300 |
| Water regime: (**A**=None/Ephemeral, **B**=Semi. Permanent, **C**= Permanent) | C | C | C | C |
| Water current: (**A**=still-slow, **B**=mod-slow, **C**=mod-fast, **D**=fast) | A | A | A | A |
| Number refuge sites per acre (no.) | 1 | 0 | 0 | 1 |
| Percent water area < 10 in. deep (ave. summer cond.) (%) | 100 | 100 | 100 | 100 |
| Percent emergent herbaceous cover in littoral zone (%) | 60 | 70 | 100 | 80 |
| Percent water surface covered by logs, overhang veg., etc. (%) | 5 | 0 | 0 | 0 |
| Aquatic substrate composition: (**A**=muddy, **B**=sandy, **C**=rocky) | A | A | A | A |
| Distance to forested/shrub wetland (large trees) (ft.) | 0 | 900 | 90 | ∞ |
| Number potential nest cavities per acre | 1 | 1 | 0 | 0 |
| Percent water area < 6 feet deep (%) | 100 | 100 | 100 | 100 |

**Table E-3. Structural habitat composition parameters estimated at each Grassland survey site.**

| Parameter | Survey sites | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **106** | **111** | **112** | **113** | **123** | **125** | **126** | **127** | **131** | **161** |
| % herb. canopy cover | 80 | 100 | 80 | 90 | 80 | 92 | 95 | 95 | 56 | 80 |
| Ave. height herb. canopy in summer (inches) | 2 | 12 | 12 | 12 | 26 | 8 | 6 | 30 | 6 | 6 |
| % shrub canopy cover | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| % herb. canopy 6-24 in./ac. | 0 | 60 | 70 | 90 | 60 | 10 | 0 | 40 | 0 | 0 |
| # trees $\geq$ 12 in. dbh/ acre | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distance to perch site (m) | 20 | 16 | 300 | 2.5 | 30 | 33 | 33 | 15 | 60 | 100 |
| % tree canopy closure | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % cc of persistent herb. veg. | 40 | 50 | 40 | 70 | 60 | 50 | 45 | 50 | 20 | 10 |
| % herb. cc that is grass | 40 | 65 | 25 | 10 | 80 | 65 | 70 | 65 | 65 | 15 |

**Table E-4. Structural habitat composition parameters estimated at each Upland Forest survey site.**

| Parameter | Survey sites | | | | | |
|---|---|---|---|---|---|---|
| | **024** | **025** | **026** | **027** | **028** | **029** |
| % tree canopy closure | 35 | 80 | 75 | 70 | 80 | 95 |
| % tree canopy closure of mast producers ≥10"dbh | 15 | 0 | 0 | 5 | 0 | 0 |
| % canopy closure deciduous trees in stand | 35 | 80 | 75 | 70 | 80 | 95 |
| % canopy closure of overstory trees | 35 | 80 | 60 | 70 | 80 | 95 |
| Ave. dbh of overstory trees | 16 | 7 | 6 | 16 | 5 | 8 |
| Ave. height of overstory trees | 40 | 35 | 35 | 45 | 30 | 35 |
| # snags <10"dbh/ ac. | 0 | 20 | 0 | 0 | 10 | 10 |
| # snags > 6"dbh/ ac. | 0 | 10 | 0 | 0 | 20 | 0 |
| % shrub crown cover | 5 | 15 | 45 | 0 | 50 | 60 |
| # refuge sites per ac. | 10 | 0 | 10 | 0 | 10 | 10 |
| Distance to water (feet) | 1200 | 500 | 800 | 50 | 100 | 200 |
| Water regime: **A**-Perm. **B**-Semi-perm.(3 mos. April-Sept.) **C**-Semi-perm.(3-5mos.April-Sept.) **D**-None/ephemeral | A | A | A | A | C | A |
| % canopy cover of persistent herb vegetation | 50 | 60 | 20 | 75 | 20 | 0 |
| # of woody stems (≥1m tall)/ac. | 80 | 80 | 1800 | 140 | 3360 | 2640 |
| # of trees ≥ 20 in. dbh/ ac | 20 | 1 | 0 | 20 | 10 | 0 |
| Overstory forest size class: **A**-Saplings (<6 in dbh) **B**- Pole timber (≥ 6 in to 10in dbh) **C**- Sawtimber (≥ 10 in to 20 in dbh) **D**- Mature tress (≥ 20in dbh) | D | B | A | C | A | B |
| Distance to grain | NA | NA | NA | NA | NA | NA |
| Ave. dbh of all stems | 16 | 3 | 2.6 | 16 | 1.5 | 4 |

| **Table F-1. Species list and total number of fish collected during Central City - Trinity River Fishery Survey July 14 - 16, 2003.** | | |
|---|---|---|
| **Family** | **Species** | **Total Number** |
| Atherinidae | *Menidia beryllina* - Inland Silverside | 1,613 |
| Catostomidae | *Carpiodes carpio* - River Carpsucker | 3 |
| | *Ictiobus bubalus* - Smallmouth Buffalo | 1 |
| | *Minytrema melanops* - Spotted Sucker | 12 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | 38 |
| | *Lepomis gulosus* - Warmouth | 13 |
| | *Lepomis humilis* - Orangespotted Sunfish | 5 |
| | *Lepomis macrochirus* - Bluegill | 678 |
| | *Lepomis megalotis* - Longear Sunfish | 526 |
| | *Lepomis microlophus* - Redear Sunfish | 2 |
| | *Micropterus punctulatus* - Spotted Bass | 2 |
| | *Micropterus salmoides* - Largemouth Bass | 333 |
| | *Morone chrysops* - White Bass | 11 |
| | *Pomoxis annularis* - White Crappie | 2 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | 987 |
| | *Dorosoma petenense* - Threadfin Shad | 95 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | 89 |
| | *Cyprinus carpio* - Common Carp | 9 |
| | *Pimephales promelas* - Fathead Minnow | 2 |
| | *Pimephales vigilax* - Bullhead Minnow | 70 |
| Fundulidae | *Fundulus notatus* - Blackstripe Topminnow | 61 |
| Ictaluridae | *Ictalurus punctatus* - Channel Catfish | 3 |
| | *Pylodictis olivaris* - Flathead Catfish | 2 |
| Lepisosteidae | *Lepisosteus oculatus* - Spotted Gar | 4 |
| | *Lepisosteus osseus* - Longnose Gar | 2 |
| Percidae | *Etheostoma chlorosomum* - Bluntnose Darter | 5 |
| | *Etheostoma spectabile* - Orangethroat Darter | 1 |
| | *Percina macrolepida* - Big Scale Logperch | 40 |
| Poeciliidae | *Gambusia affinis* - Mosquitofish | 4 |
| Sciaenidae | *Aplodinotus grunniens* - Freshwater Drum | 1 |
| | | 4,614 |

| Table F-2. Species list by site of fish collected during Central City - Trinity River Fishery Survey July 14 - 16, 2003. | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Site 1** | **Site 2** | **Site 3** | **Site 4** | **Site 5** | **Total** |
| Inland Silverside* | 653 | 435 | 199 | 112 | 214 | 1,613 |
| River Carpsucker | - | 1 | 1 | 1 | - | 3 |
| Smallmouth Buffalo | - | - | - | 1 | - | 1 |
| Spotted Sucker* | 1 | 2 | 4 | 4 | 1 | 12 |
| Green Sunfish* | 3 | 7 | 2 | 13 | 13 | 38 |
| Warmouth* | 2 | 4 | 4 | 1 | 2 | 13 |
| Orangespotted Sunfish | 2 | - | 1 | - | 2 | 5 |
| Bluegill* | 111 | 139 | 122 | 112 | 194 | 678 |
| Longear Sunfish* | 105 | 130 | 76 | 135 | 80 | 526 |
| Redear Sunfish | 2 | - | - | - | - | 2 |
| Spotted Bass | - | - | 2 | - | - | 2 |
| Largemouth Bass* | 66 | 70 | 61 | 66 | 70 | 333 |
| White Bass | - | 11 | - | - | - | 11 |
| White Crappie | 1 | - | - | 1 | - | 2 |
| Gizzard Shad* | 222 | 261 | 121 | 137 | 246 | 987 |
| Threadfin Shad* | 6 | 6 | 13 | 37 | 33 | 95 |
| Red Shiner* | 3 | 36 | 4 | 30 | 16 | 89 |
| Common Carp | 1 | - | 1 | 6 | 1 | 9 |
| Fathead Minnow | - | - | - | 2 | - | 2 |
| Bullhead Minnow* | 18 | 19 | 2 | 20 | 11 | 70 |
| Blackstripe Topminnow | - | - | 22 | 35 | 4 | 61 |
| Channel Catfish | 1 | 2 | - | - | - | 3 |
| Flathead Catfish | 1 | - | - | 1 | - | 2 |
| Spotted Gar | - | - | 2 | 1 | 1 | 4 |
| Longnose Gar | 1 | - | - | 1 | - | 2 |
| Bluntnose Darter | 1 | - | 2 | - | 2 | 5 |
| Orangethroat Darter | - | 1 | - | - | - | 1 |
| Big Scale Logperch* | 14 | 11 | 3 | 10 | 2 | 40 |
| Mosquitofish | 2 | - | - | - | 2 | 4 |
| Freshwater Drum | - | 1 | - | - | - | 1 |
| Total | 1,216 | 1,136 | 642 | 726 | 894 | 4,614 |

*12 species from 6 families collected at all five sites.

**Table F-3. Fish species and their associated tolerance levels and trophic guilds collected from five sites on the Trinity River, Tarrant County, Texas, 2003 (Note - I = intermediate; N = intolerant; and T = tolerant) (Linam *et al.*, 2002).**

| Family | Species | Tolerance Level | Trophic Guild |
|---|---|---|---|
| Atherinidae | Inland Silverside | I | invertivore |
| Catostomidae | River Carpsucker | T | omnivore |
| | Smallmouth Buffalo | I | omnivore |
| | Spotted Sucker | I | benthic invertivore |
| Centrarchidae | Green Sunfish | T | piscivore |
| | Warmouth | T | piscivore |
| | Orangespotted Sunfish | I | invertivore |
| | Bluegill | T | invertivore |
| | Longear Sunfish | I | invertivore |
| | Redear Sunfish | I | invertivore |
| | Spotted Bass | I | piscivore |
| | Largemouth Bass | I | piscivore |
| | White Bass | I | piscivore |
| | White Crappie | I | piscivore |
| Clupeidae | Gizzard Shad | T | omnivore |
| | Threadfin Shad | I | omnivore |
| Cyprinidae | Red Shiner | T | invertivore |
| | Common Carp* | T | omnivore |
| | Fathead Minnow | T | omnivore |
| | Bullhead Minnow | I | invertivore |
| Fundulidae | Blackstripe Topminnow | I | invertivore |
| Ictaluridae | Channel Catfish | T | omnivore |
| | Flathead Catfish | I | piscivore |
| Lepisosteidae | Spotted Gar | T | piscivore |
| | Longnose Gar | T | piscivore |
| Percidae | Bluntnose Darter | I | benthic invertivore |
| | Orangethroat Darter | I | benthic invertivore |
| | Big Scale Logperch | N | benthic invertivore |
| Poecillidae | Mosquitofish | T | invertivore |
| Sciaenidae | Freshwater Drum | T | invertivore |

*Non-nativespecies.

| Table F-4. Statewide IBI Metric Calculations (IBI Score) for Site 1. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 21(5) | **7.) % of individuals as omnivores:** | 19(5) |
| **2.) Total # of darter species:** | 2(3) | **8.) % of individuals as insectivores:** | 75(3) |
| **3.) Total # of sunfish species:** | 7(5) | **9.) % of individuals as piscivores:** | 6(5) |
| **4.) Total # of sucker species:** | 1(3) | **10.) # of individuals in sample:** | 1216(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 28(1) | **12.) % of individuals with disease or other anomaly:** | 0.2(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-5. Regional IBI Metric Calculations (IBI Score) for Site 1. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 21(5) | **7.) % of individuals as invertivores:** | 75(5) |
| **2.) # of native cyprinid species:** | 2(3) | **8.) % of individuals as piscivores:** | 6(3) |
| **3.) # of benthic invertivore species:** | 3(5) | **9a.) # of individuals/seine haul:** | 88(5) |
| **4.) # of sunfish species:** | 7(5) | **9b.) # of individuals/minute of electrofishing:** | 8(5) |
| **5.) % of individuals as tolerant species:** | 28(3) | **10.) % of individuals as non-native species:** | 0.08(5) |
| **6.) % of individuals as omnivores:** | 19(1) | **11.) % of individuals with disease or other anomaly:** | 0.2(5) |
| **IBI Total Score: 50 (Exceptional)** | | | |

| Table F-6. Fish-Community Degradation Index Metric Calculations (FDI score) for Site 1. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | 28(3) | - |
| **2. Percent omnivores at site:** | 19(1) | - | - |
| **3. Percent non-native individuals at site:** | 0.08(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0.2(1) | - | - |
| **FDI Total Score: 6 (Low Degradation)** | | | |

| Table F-7. Statewide IBI Metric Calculations (IBI Score) for Site 2. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 17(5) | **7.) % of individuals as omnivores:** | 24(3) |
| **2.) Total # of darter species:** | 2(3) | **8.) % of individuals as insectivores:** | 68(3) |
| **3.) Total # of sunfish species:** | 5(5) | **9.) % of individuals as piscivores:** | 8(5) |
| **4.) Total # of sucker species:** | 2(5) | **10.) # of individuals in sample:** | 1136(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 40(1) | **12.) % of individuals with disease or other anomaly:** | 0.3(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-8. Regional IBI Metric Calculations (IBI Score) for Site 2. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 17(5) | **7.) % of individuals as invertivores:** | 68(5) |
| **2.) # of native cyprinid species:** | 2(3) | **8.) % of individuals as piscivores:** | 8(3) |
| **3.) # of benthic invertivore species:** | 3(5) | **9a.) # of individuals/seine haul:** | 67(3) |
| **4.) # of sunfish species:** | 5(5) | **9b.) # of individuals/minute of electrofishing:** | 10(5) |
| **5.) % of individuals as tolerant species:** | 40(3) | **10.) % of individuals as non-native species:** | 0(5) |
| **6.) % of individuals as omnivores:** | 24(1) | **11.) % of individuals with disease or other anomaly:** | 0.3(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-9. Fish-Community Degradation Index Metric Calculations (FDI score) for Site 2. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | 40(3) | - |
| **2. Percent omnivores at site:** | - | 24(3) | - |
| **3. Percent non-native individuals at site:** | 0(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0.3(1) | - | - |
| **FDI Total Score: 8 (Low Degradation)** | | | |

| Table F-10. Statewide IBI Metric Calculations (IBI Score) for Site 3. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 19(5) | **7.) % of individuals as omnivores:** | 21(3) |
| **2.) Total # of darter species:** | 2(3) | **8.) % of individuals as insectivores:** | 68(3) |
| **3.) Total # of sunfish species:** | 5(5) | **9.) % of individuals as piscivores:** | 11(5) |
| **4.) Total # of sucker species:** | 2(5) | **10.) # of individuals in sample:** | 642(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 40(1) | **12.) % of individuals with disease or other anomaly:** | 0.2(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-11. Regional IBI Metric Calculations (IBI Score) for Site 3. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 19(5) | **7.) % of individuals as invertivores:** | 68(5) |
| **2.) # of native cyprinid species:** | 2(3) | **8.) % of individuals as piscivores:** | 11(5) |
| **3.) # of benthic invertivore species:** | 3(5) | **9a.) # of individuals/seine haul:** | 33(1) |
| **4.) # of sunfish species:** | 5(5) | **9b.) # of individuals/minute of electrofishing:** | 6(3) |
| **5.) % of individuals as tolerant species:** | 40(3) | **10.) % of individuals as non-native species:** | 0.16(5) |
| **6.) % of individuals as omnivores:** | 21(1) | **11.) % of individuals with disease or other anomaly:** | 0.2(5) |
| **IBI Total Score: 46 (High)** | | | |

| Table F-12. Fish-Community Degradation Index Metric Calculations (FDI score) for Site 3. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | 40(3) | - |
| **2. Percent omnivores at site:** | - | 21(3) | - |
| **3. Percent non-native individuals at site:** | 0.16(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0.2(1) | - | - |
| **FDI Total Score: 8 (Low Degradation)** | | | |

| Table F-13. Statewide IBI Metric Calculations (IBI Score) for Site 4. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 21(5) | **7.) % of individuals as omnivores:** | 25(3) |
| **2.) Total # of darter species:** | 1(3) | **8.) % of individuals as insectivores:** | 63(3) |
| **3.) Total # of sunfish species:** | 5(5) | **9.) % of individuals as piscivores:** | 12(5) |
| **4.) Total # of sucker species:** | 3(5) | **10.) # of individuals in sample:** | 726(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 42(1) | **12.) % of individuals with disease or other anomaly:** | 0(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-14. Regional IBI Metric Calculations (IBI Score) for Site 4. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 21(5) | **7.) % of individuals as invertivores:** | 63(3) |
| **2.) # of native cyprinid species:** | 3(3) | **8.) % of individuals as piscivores:** | 12(5) |
| **3.) # of benthic invertivore species:** | 2(5) | **9a.) # of individuals/seine haul:** | 25(1) |
| **4.) # of sunfish species:** | 5(5) | **9b.) # of individuals/minute of electrofishing:** | 9(5) |
| **5.) % of individuals as tolerant species:** | 42(3) | **10.) % of individuals as non-native species:** | 0.8(5) |
| **6.) % of individuals as omnivores:** | 25(1) | **11.) % of individuals with disease or other anomaly:** | 0(5) |
| **IBI Total Score: 46 (High)** | | | |

| Table F-15. Fish-Community Degradation Index Metric Calculations (FDI score) for Site 4. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | 42(3) | - |
| **2. Percent omnivores at site:** | - | 25(3) | - |
| **3. Percent non-native individuals at site:** | 0.8(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0(1) | - | - |
| **FDI Total Score: 8 (Low Degradation)** | | | |

| Table F-16. Statewide IBI Metric Calculations (IBI Score) for Site 5. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 18(5) | **7.) % of individuals as omnivores:** | 31(3) |
| **2.) Total # of darter species:** | 2(3) | **8.) % of individuals as insectivores:** | 59(3) |
| **3.) Total # of sunfish species:** | 5(5) | **9.) % of individuals as piscivores:** | 10(5) |
| **4.) Total # of sucker species:** | 1(3) | **10.) # of individuals in sample:** | 894(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 53(1) | **12.) % of individuals with disease or other anomaly:** | 0(5) |
| **IBI Total Score: 46 (Intermediate)** | | | |

| Table F-17. Regional IBI Metric Calculations (IBI Score) for Site 5. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 18(5) | **7.) % of individuals as invertivores:** | 59(3) |
| **2.) # of native cyprinid species:** | 2(3) | **8.) % of individuals as piscivores:** | 10(5) |
| **3.) # of benthic invertivore species:** | 3(5) | **9a.) # of individuals/seine haul:** | 34(1) |
| **4.) # of sunfish species:** | 5(5) | **9b.) # of individuals/minute of electrofishing:** | 10(5) |
| **5.) % of individuals as tolerant species:** | 53(1) | **10.) % of individuals as non-native species:** | 0.11(5) |
| **6.) % of individuals as omnivores:** | 31(1) | **11.) % of individuals with disease or other anomaly:** | 0(5) |
| **IBI Total Score: 44 (Intermediate)** | | | |

| Table F-18. Fish-Community Degradation Index Metric Calculations (FDI score) for Site 5. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | - | 53(5) |
| **2. Percent omnivores at site:** | - | 31(3) | - |
| **3. Percent non-native individuals at site:** | 0.11(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0(1) | - | - |
| **FDI Total Score: 10 (Moderate Degradation)** | | | |

| Table F-19. Statewide IBI Metric Calculations (IBI Score) for Overall Study Area. | | | |
|---|---|---|---|
| **1.) Total # of species:** | 30(5) | **7.) % of individuals as omnivores:** | 24(3) |
| **2.) Total # of darter species:** | 3(5) | **8.) % of individuals as insectivores:** | 67(3) |
| **3.) Total # of sunfish species:** | 8(5) | **9.) % of individuals as piscivores:** | 9(5) |
| **4.) Total # of sucker species:** | 3(5) | **10.) # of individuals in sample:** | 4614(5) |
| **5.) Total # of intolerant species:** | 1(3) | **11.) % of individuals as hybrids:** | 0(5) |
| **6.) % of individuals as tolerants:** | 40(1) | **12.) % of individuals with disease or other anomaly:** | 0.1(5) |
| **IBI Total Score: 50 (High)** | | | |

| Table F-20. Regional IBI Metric Calculations (IBI Score) for Overall Study Area. | | | |
|---|---|---|---|
| **1.) Total # of fish species:** | 30(5) | **7.) % of individuals as invertivores:** | 67(5) |
| **2.) # of native cyprinid species:** | 3(3) | **8.) % of individuals as piscivores:** | 9(3) |
| **3.) # of benthic invertivore species:** | 4(5) | **9a.) # of individuals/seine haul:** | 50(3) |
| **4.) # of sunfish species:** | 8(5) | **9b.) # of individuals/minute of electrofishing:** | 9(5) |
| **5.) % of individuals as tolerant species:** | 40(3) | **10.) % of individuals as non-native species:** | 0.19(5) |
| **6.) % of individuals as omnivores:** | 24(1) | **11.) % of individuals with disease or other anomaly:** | 0.1(5) |
| **IBI Total Score: 48 (High)** | | | |

| Table F-21. Fish-Community Degradation Index Metric Calculations (FDI score) for Overall Study Area. | | | |
|---|---|---|---|
| **Metric** | **Scoring Criteria** | | |
| | **Low** | **Moderate** | **High** |
| **1. Percent tolerant individuals at site:** | - | 40(3) | - |
| **2. Percent omnivores at site:** | - | 24(3) | - |
| **3. Percent non-native individuals at site:** | 0.19(1) | - | - |
| **4. Percent anomalies of individuals at site:** | 0.1(1) | - | - |
| **FDI Total Score: 8 (Low Degradation)** | | | |

**Central City - Trinity River Fishery Survey (IBI) Data Sheet:**
**Sample Site: 1 (Trinity River at Riverside Park - Belknap and Oakhurst) Sample Date:** July 14, 2003

| Family | Species | Number of individuals by seine | Number of individuals by electroshock | Total |
|---|---|---|---|---|
| Atherinidae | *Menidia beryllina* - Inland Silverside | 638 | 15 | 653 |
| Catostomidae | *Minytrema melanops* - Spotted Sucker | - | 1 | 1 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | - | 3 | 3 |
| | *Lepomis gulosus* - Warmouth | - | 2 | 2 |
| | *Lepomis humilis* - Orangespotted Sunfish | 2 | - | 2 |
| | *Lepomis macrochirus* - Bluegill | 5 | 106 | 111 |
| | *Lepomis megalotis* - Longear Sunfish | 4 | 101 | 105 |
| | *Lepomis microlophus* - Redear Sunfish | - | 2 | 2 |
| | *Micropterus salmoides* - Largemouth Bass | 33 | 33 | 66 |
| | *Pomoxis annularis* - White Crappie | - | 1 | 1 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | - | 222 | 222 |
| | *Dorosoma petenense* - Threadfin Shad | - | 6 | 6 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | 1 | 2 | 3 |
| | *Cyprinus carpio* - Common Carp | - | 1 | 1 |
| | *Pimephales vigilax* - Bullhead Minnow | 18 | - | 18 |
| Ictaluridae | *Ictalurus punctatus* - Channel Catfish | - | 1 | 1 |
| | *Pylodictis olivaris* - Flathead Catfish | - | 1 | 1 |
| Lepisosteidae | *Lepisosteus osseus* - Longnose Gar | - | 1 | 1 |
| Percidae | *Etheostoma chlorosomum* - Bluntnose Darter | - | 1 | 1 |
| | *Percina macrolepida* - Bigscale Logperch | 4 | 10 | 14 |
| Poeciliidae | *Gambusia affinis* - Western Mosquitofish | 2 | - | 2 |
| | Total | 707 | 508 | 1,216 |

**Observations:** 1 crawfish netted while shocking; 1 common carp, 2 largemouth bass, and 1 channel catfish were retained for chemical analysis; the channel catfish retained for possible tissue analysis had lesions on top of head; 1 of the largemouth bass retained for possible tissue analysis had lesions.

**Notes:** 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, G. Linam, C. Hoagland, and C. Giggleman;
Depth (in feet) 11.4 - 13.7 - 12.0 - 7.0 - 4.7; 0 = 9.8;
Stream width 100 meters; stream habitat pool; substrate clay to silt with sands in the margin; **21 species from 9 families**

**Central City - Trinity River Fishery Survey (IBI) Data Sheet:**

**Sample Site: 2 (Trinity River at confluence with Marine Creek)** **Sample Date:** July 15, 2003

| Family | Species | Number of individuals by seine | Number of individuals by electroshock | Total |
|---|---|---|---|---|
| Atherinidae | *Menidia beryllina* - Inland Silverside | 434 | 1 | 435 |
| Catostomidae | *Carpiodes carpio* - River Carpsucker | - | 1 | 1 |
| | *Minytrema melanops* - Spotted Sucker | - | 2 | 2 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | - | 7 | 7 |
| | *Lepomis gulosus* - Warmouth | - | 4 | 4 |
| | *Lepomis macrochirus* - Bluegill | 15 | 124 | 139 |
| | *Lepomis megalotis* - Longear Sunfish | 3 | 127 | 130 |
| | *Micropterus salmoides* - Largemouth Bass | 44 | 26 | 70 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | - | 261 | 261 |
| | *Dorosoma petenense* - Threadfin Shad | 1 | 5 | 6 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | 28 | 8 | 36 |
| | *Pimephales vigilax* - Bullhead Minnow | 19 | - | 19 |
| Ictaluridae | *Ictalurus punctatus* - Channel Catfish | - | 2 | 2 |
| Percichthyidae | *Morone chrysops* - White Bass | - | 11 | 11 |
| Percidae | *Etheostoma spectabile* - Orangethroat Darter | 1 | - | 1 |
| | *Percina macrolepida* - Bigscale Logperch | 4 | 7 | 11 |
| Sciaenidae | *Aplodinotus grunniens* - Freshwater Drum | - | 1 | 1 |
| | Total | 549 | 587 | 1,136 |

**Observations:** Site established at Samuels Avenue; 1 river carpsucker, 1 largemouth bass, and 1 channel catfish were retained for chemical analysis; the largemouth bass retained for possible tissue analysis had lesions; the river carpsucker retained for possible tissue analysis appeared to be diseased; 1 of the warmouths collected and released was missing half of its tail.

**Notes:** 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, G. Linam, C. Hoagland, and C. Giggleman;
Depth (in feet) 4.4 - 6.4 - 6.8 - 5.9 - 4.7; 0 = 5.6;
Stream width 100 meters; stream habitat pool; substrate clay to silt with sands in the margin;
**17 species from 9 families**

**Central City - Trinity River Fishery Survey (IBI) Data Sheet:**

**Sample Site: 3 (Trinity River after confluence with West and Clear Forks)** **Sample Date:** July 15, 2003

| Family | Species | Number of individuals by seine | Number of individuals by electroshock | Total |
|---|---|---|---|---|
| Atherinidae | *Menidia beryllina* - Inland Silverside | 199 | - | 199 |
| Catostomidae | *Carpiodes carpio* - River Carpsucker | - | 1 | 1 |
| | *Minytrema melanops* - Spotted Sucker | - | 4 | 4 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | 1 | 1 | 2 |
| | *Lepomis gulosus* - Warmouth | - | 4 | 4 |
| | *Lepomis humilis* - Orangespotted Sunfish | 1 | - | 1 |
| | *Lepomis macrochirus* - Bluegill | 5 | 117 | 122 |
| | *Lepomis megalotis* - Longear Sunfish | 3 | 73 | 76 |
| | *Micropterus punctulatus* - Spotted Bass | - | 2 | 2 |
| | *Micropterus salmoides* - Largemouth Bass | 21 | 40 | 61 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | - | 121 | 121 |
| | *Dorosoma petenense* - Threadfin Shad | - | 13 | 13 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | 4 | - | 4 |
| | *Cyprinus carpio* - Common Carp | - | 1 | 1 |
| | *Pimephales vigilax* - Bullhead Minnow | 2 | - | 2 |
| Cyprinodontidae | *Fundulus notatus* - Blackstripe Topminnow | 22 | - | 22 |
| Lepisosteidae | *Lepisosteus oculatus* - Spotted Gar | 1 | 1 | 2 |
| Percidae | *Etheostoma chlorosomum* - Bluntnose Darter | 2 | - | 2 |
| | *Percina macrolepida* - Bigscale Logperch | - | 3 | 3 |
| | Total | 261 | 381 | 642 |

**Observations:** Seined 1 giant floater mussel; this was the only site that macrobenthics (1 odonate) were seined; during shocking 1 unknown catfish observed but not collected; 1 common carp, 1 largemouth bass, and 1 giant floater mussel retained for chemical analysis; the largemouth bass retained for possible tissue analysis had lesions; waste (examples - paper, bottles, cans, plastic, contraceptives, paper, hygiene products, oil filters) in every seine haul at confluence with two forks.

**Notes:** 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, G. Linam, C. Hoagland, B. Fillmore, B. Colbert, and C. Giggleman;
Depth (in feet) 7.0 - 12.3 - 14.8 - 12.7 - 7.3; 0 = 10.8;
Stream width 40 meters; stream habitat pool; substrate bedrock below dam, silt to clay above dam;
**19 species from 8 families**

**Central City - Trinity River Fishery Survey (IBI) Data Sheet:**

**Sample Site: 4 (Clear Fork above confluence with West Fork)** **Sample Date:** July 16, 2003

| Family | Species | Number of individuals by seine | Number of individuals by electroshock | Total |
|---|---|---|---|---|
| Atherinidae | *Menidia beryllina* - Inland Silverside | 106 | 6 | 112 |
| Catostomidae | *Carpiodes carpio* - River Carpsucker | - | 1 | 1 |
| | *Ictiobus bubalus* - Smallmouth Buffalo | - | 1 | 1 |
| | *Minytrema melanops* - Spotted Sucker | - | 4 | 4 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | - | 13 | 13 |
| | *Lepomis gulosus* - Warmouth | - | 1 | 1 |
| | *Lepomis macrochirus* - Bluegill | 5 | 107 | 112 |
| | *Lepomis megalotis* - Longear Sunfish | 4 | 131 | 135 |
| | *Micropterus salmoides* - Largemouth Bass | 38 | 28 | 66 |
| | *Pomoxis annularis* - White Crappie | - | 1 | 1 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | - | 137 | 137 |
| | *Dorosoma petenense* - Threadfin Shad | - | 37 | 37 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | - | 30 | 30 |
| | *Cyprinus carpio* - Common Carp | - | 6 | 6 |
| | *Pimephales promelas* - Fathead Minnow | - | 2 | 2 |
| | *Pimephales vigilax* - Bullhead Minnow | 16 | 4 | 20 |
| Cyprinodontidae | *Fundulus notatus* - Blackstripe Topminnow | 33 | 2 | 35 |
| Ictaluridae | *Pylodictis olivaris* - Flathead Catfish | - | 1 | 1 |
| Lepisosteidae | *Lepisosteus oculatus* - Spotted Gar | - | 1 | 1 |
| | *Lepisosteus osseus* - Longnose Gar | - | 1 | 1 |
| Percidae | *Percina macrolepida* - Bigscale Logperch | - | 10 | 10 |
| | Total | 202 | 524 | 726 |

**Observations:** Seined 2 razorback musk turtles and 2 water scorpions; while shocking netted a Metter=s river cooter; each seine haul contained a lot of solid waste (i.e., cans, bottles, plastic jugs, etc.); 1 common carp, 1 largemouth bass, and 1 flathead catfish retained for chemical analysis; waste (examples - paper, bottles, cans, plastic, contraceptives, paper, hygiene products, oil filters) in every seine haul.

**Notes:** 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, G. Linam, C. Hoagland, B. Fillmore, B. Colbert, and C. Giggleman; Depth (in feet) 6.0 - 7.5 - 7.5 - 8.2 - 5.1; 0 = 6.9; Stream width 50 meters; stream habitat pool; substrate silt with trash; **21 species from 9 families**

**Central City - Trinity River Fishery Survey (IBI) Data Sheet:**

**Sample Site: 5 (West Fork above confluence with Clear Fork)** **Sample Date:** July 16, 2003

| Family | Species | Number of individuals by seine | Number of individuals by electroshock | Total |
|---|---|---|---|---|
| Atherinidae | *Menidia beryllina* - Inland Silverside | 201 | 13 | 214 |
| Catostomidae | *Minytrema melanops* - Spotted Sucker | - | 1 | 1 |
| Centrarchidae | *Lepomis cyanellus* - Green Sunfish | - | 13 | 13 |
| | *Lepomis gulosus* - Warmouth | - | 2 | 2 |
| | *Lepomis humilis* - Orangespotted Sunfish | 2 | - | 2 |
| | *Lepomis macrochirus* - Bluegill | 2 | 192 | 194 |
| | *Lepomis megalotis* - Longear Sunfish | 4 | 76 | 80 |
| | *Micropterus salmoides* - Largemouth Bass | 35 | 35 | 70 |
| Clupeidae | *Dorosoma cepedianum* - Gizzard Shad | - | 246 | 246 |
| | *Dorosoma petenense* - Threadfin Shad | 1 | 32 | 33 |
| Cyprinidae | *Cyprinella lutrensis* - Red Shiner | 8 | 8 | 16 |
| | *Cyprinus carpio* - Common Carp | - | 1 | 1 |
| | *Pimephales vigilax* - Bullhead Minnow | 11 | - | 11 |
| Cyprinodontidae | *Fundulus notatus* - Blackstripe Topminnow | 4 | - | 4 |
| Lepisosteidae | *Lepisosteus oculatus* - Spotted Gar | - | 1 | 1 |
| Percidae | *Etheostoma chlorosomum* - Bluntnose Darter | 2 | - | 2 |
| | *Percina macrolepida* - Bigscale Logperch | 1 | 1 | 2 |
| Poeciliidae | *Gambusia affinis* - Western Mosquitofish | 2 | - | 2 |
| | Total | 273 | 621 | 894 |

**Observations:** Seined 2 crawfish, caught 9 razorback musk turtles and saw 1 nutria, numerous geese, ducks, one kingfisher, and several cricket frogs; 1 largemouth bass and 1 common carp retained for chemical analysis; waste (examples - paper, bottles, cans, plastic, contraceptives, paper, hygiene products, oil filters) in every seine haul.

**Notes:** 8 seine hauls; 1 hour (4-15 minute runs) electroshocking; collectors - B. Bristow, G. Linam, C. Hoagland, B. Fillmore, B. Colbert, and C. Giggleman;
Depth (in feet) 6.8 - 12.2 - 11.9 - 11.5 - 7.5; 0 = 10;
Stream width 75 meters; stream habitat pool; substrate silt;
**18 species from 9 families**