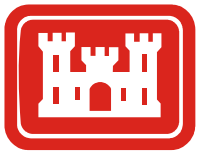
PLANNING DESIGN REPORT
AND
ENVIRONMENTAL ASSESSMENT

FOR

OLMOS CREEK SECTION 206 AQUATIC ECOSYSTEM RESTORATION PROJECT
BEXAR COUNTY, TEXAS



U.S. ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT
819 TAYLOR STREET
FORT WORTH, TEXAS 76102-0300

In Cooperation with

CITY OF SAN ANTONIO, TEXAS

NOVEMBER 2006

FINDING OF NO SIGNIFICANT IMPACT
PROPOSED IMPLEMENTATION OF THE OLMOS CREEK
SECTION 206 AQUATIC ECOSYSTEM RESTORATION PROJECT
SAN ANTONIO, BEXAR COUNTY, TEXAS

Description of Action. The United States Army Corps of Engineers (USACE) has developed a Planning Design Report (PDR) and integrated Environmental Assessment (EA) to assess the potential impacts to the environment that may result from the implementation of the Section 206 Aquatic Ecosystem Restoration Project on Olmos Creek, San Antonio, Bexar County, Texas. The recommended alternative would include the restoration of approximately 73 acres of riparian bottomland hardwood forest adjacent to Olmos Creek. Approximately six acres of aquatic habitat within Olmos Creek would be restored and improved by reducing erosion and increasing stream shade providing better habitat for a variety of freshwater species. Additionally, the recommended alternative would restore over 17 acres of riparian grassland by planting native grasses. Riparian grassland restoration would provide additional benefits to the study area by increasing habitat and species diversity and improving aquatic habitat conditions.

Anticipated Environmental Effects. Ecological factors guiding the development of restoration alternatives included the low species diversity and fragmentation of the existing riparian corridor, a lack of hard mast producing trees, a lack of trees greater than six inches diameter at breast height (dbh), an abundance of both non-native and invasive plant species, areas with low amounts of stream shade, areas experiencing high amounts of erosion, and a lack of native grass species. Fifteen economically feasible restoration alternatives, including the no action alternative, were identified through the planning process to address ecological needs within the project area. Under the no action alternative, proposed project measures would not be implemented and existing fish and wildlife habitat would continue to degrade due primarily to the large number of invasive plant species and associated urban encroachment. Other alternatives addressed various options for riparian corridor restoration and enhancement, vegetation plantings, erosion control, and old-field restoration. Thirteen of the fourteen remaining alternatives were eliminated from further consideration either because they did not meet habitat restoration objectives of the proposed project or had inferior benefit/cost ratios. The recommended alternative that was identified through the planning process would meet the long-term ecological and habitat restoration objectives of the project, provide an incrementally justified benefit/cost ratio, and have support from participating resource and sponsor agencies.

No significant adverse environmental impacts are anticipated with the recommended alternative for geologic, biological, or cultural resources. The recommended alternative is not likely to adversely affect any plant or animal species or habitat that is proposed or listed as threatened or endangered according to the Endangered Species Act. During construction, the recommended alternative would result in minor, short-term discharges to waters of the United States and is subject to provisions of Section 404 of the Clean Water Act. The recommended alternative would meet the conditions of Nationwide Permit (NWP) 13, Bank Stabilization, under Section 404. The recommended alternative, as proposed, would not induce or increase flood damages within the study area and is in compliance with executive order 11988, Floodplain Management.

Public Comments. Two comments were received from Natural Resource Agencies. The U.S. Fish and Wildlife Service provided a comment stating that they concurred with the project and provided recommendations for deer management during construction. The Texas Commission on Environmental Quality provided a comment asking USACE to coordinate with the local floodplain administrators. No comments were received from the general public or other resource agencies.

Facts and Conclusions. Based on a review of the information contained in this EA and the comments received, it is concluded that the implementation of the Olmos Creek Section 206 Aquatic Ecosystem Restoration Project is not a major Federal action, which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969, as amended.

DATE: _____

CHRISTOPHER W. MARTIN
Colonel, U.S. Army Corps of Engineers
District Engineer

SYLLABUS

This Planning Design Report / Environmental Assessment (PDR/EA) is submitted under the authority of Section 206 of the Water Resources Development Act of 1996, as amended. The purpose of this feasibility study is to identify areas of ecosystem degradation, evaluate measures to restore important ecological resources, and recommend a plan for implementation, if one can be found that is technically feasible, environmentally acceptable, and supported by the non-Federal partner. The goal of the recommended restoration alternative would be to restore aquatic habitat and the associated riparian community to benefit the variety of resident and migratory wildlife that utilize the study area.

Olmos Creek is located near the central portion of Bexar County, Texas, approximately 5 miles north of the City of San Antonio central business district. The study area is located on lands owned by the City of San Antonio and the City of Alamo Heights within the Olmos Basin Reservoir. The reservoir was created by the construction of Olmos Dam that had the sole purpose of flood control, protecting the City of San Antonio located just downstream. The reservoir basin, being limited to the types of development that could occur within the floodplain, has begun to attract a variety of recreational facilities including a city park, skeet range, golf course, baseball fields, and other recreational amenities. This has altered a substantial acreage of aquatic, grassland, and bottomland forest habitat located within the study area. The study area comprised of grassland, remnant bottomland forests, and in-stream aquatic habitat, lies within the Olmos Creek watershed and was found to be suitable for ecosystem restoration.

The recommended alternative consists of the restoration of approximately 73 acres of bottomland hardwood habitat, 17 acres of native riparian grasslands, and six acres of in-stream aquatic habitat. The total project cost is estimated at $1,102,559. The total project cost would be shared between the Federal government ($716,663) and the City of San Antonio ($385,896), who would represent the non-federal partner. USACE would refund approximately $103,297 to the City of San Antonio for additional lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) above the 35% non-Federal cost share guidance for ecosystem restoration. The City of San Antonio would be responsible for all operation, maintenance, replacement, and repair costs upon completion of construction.

This report includes an environmental assessment to evaluate the potential effects that could result from project implementation. Items marked with an (*) indicate information required to fulfill National Environmental Policy Act requirements. A Finding of No Significant Impact has been signed for the proposed action.

For more information, please contact U.S. Army Corps of Engineers, Fort Worth District, CESWF-PER-EE, ATTN: Rob Newman (817)-886-1762, 819 Taylor Street, Fort Worth, Texas 76102

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INTRODUCTION

Location*

Olmos Creek is located near the central portion of Bexar County, Texas, approximately 5 miles north of the City of San Antonio central business district. The study area is located on lands owned by the City of San Antonio and the City of Alamo Heights. **Figure 1** shows the project vicinity within the San Antonio Metropolitan Area. **Figure 2** shows the specific location of the study limits in greater detail.

Study Authority*

The study is authorized under the continuing authority provided to the Chief of Engineers by Section 206 of the Water Resources Development Act of 1996, as amended. The U. S. Army Corps of Engineers (USACE) is the lead agency for this study. This study was initiated at the request of the San Antonio River Authority (SARA) on behalf of the City of San Antonio (COSA) in a letter dated February 28, 2002 (**Appendix A**).

Study Purpose, Area, and Scope*

The purpose of this study was to identify areas of ecosystem degradation, evaluate measures to restore important ecological resources, and recommend a plan for implementation, if one can be found that is technically feasible, environmentally acceptable, and supported by the non-Federal sponsor. The goal of a recommended restoration alternative would be to restore the riparian corridor and aquatic communities to benefit a variety of resident and migratory wildlife that utilize the study area. San Pedro Avenue and Olmos Dam demark the upper and lower study limits, respectively (**Figure 2**).

Field investigations were conducted to characterize riparian and aquatic habitat within the study area and to evaluate their overall ability to support resident and migratory wildlife species. A multidisciplinary team approach was used to conduct the studies and included the USACE, U.S. Fish and Wildlife Service (USFWS), SARA, Texas Parks and Wildlife Department (TPWD), and the COSA.

Identification of Preliminary Goals

Stream channels and associated riparian corridors are natural resource types that are increasingly exposed to threat by removal or modification as urban areas continue to grow. The importance and need for protection of these types of habitats is supported by the evolution of the Federal regulations under Section 404 of the Clean Water Act, which not only places emphasis on avoiding and minimizing stream impacts, but also stresses the need for maintaining vegetative buffers or corridors when practicable.

Aquatic and riparian habitat within the Olmos Creek study area have experienced moderate degradation and disturbance due to various activities such as construction of recreational facilities and encroachment of residential developments. These activities have led to a fragmented riparian corridor containing a number of invasive / non-native plant species as well as increased erosion. The riparian area along Olmos Creek has the ability to improve water quality, provide habitat and refuge for native plants and animals, improve aesthetics, and restore connectivity with other landscapes (Verry et al., 2000). These attributes are especially important in urban areas like San Antonio, Texas, where riparian habitat is limited. Noss et al. (1995) designated riparian forests, especially those occurring in the South, as a nationally endangered ecosystem due to an 84% national decline in riparian forests since early settlement. The bottomland hardwood ecosystem in Texas prior to European settlement once extended over 6.5 million hectares (ha); it is estimated that less than 40% of this original extent still remains (Frye, 1986), with only a few small and isolated patches of old growth scattered amongst the floodplains of the eastern third of the state. Losses of intact bottomland hardwoods in the past 50 years have at times been greater than 120,000 ha per year (Barry and Knoll, 1999). The study team recognized opportunities for restoration and enhancement along and within Olmos Creek requiring only minimal modification of the existing landscape. The study team decided that the restoration efforts would focus on three primary

areas within the Olmos Creek system: 1) Restoration of the existing riparian forest corridor to address low species diversity, fragmentation, a lack of hard mast producing trees, a lack of stream shading, and an abundance of both invasive and non-native plant species; 2) Restoration of aquatic habitat by addressing excessive bank erosion and subsequent sedimentation of in-stream habitat; and 3) Restoration of native riparian grassland to increase habitat diversity within the riparian corridor and improve aquatic habitat conditions.

Figure 1. Olmos Creek General Study Area Location

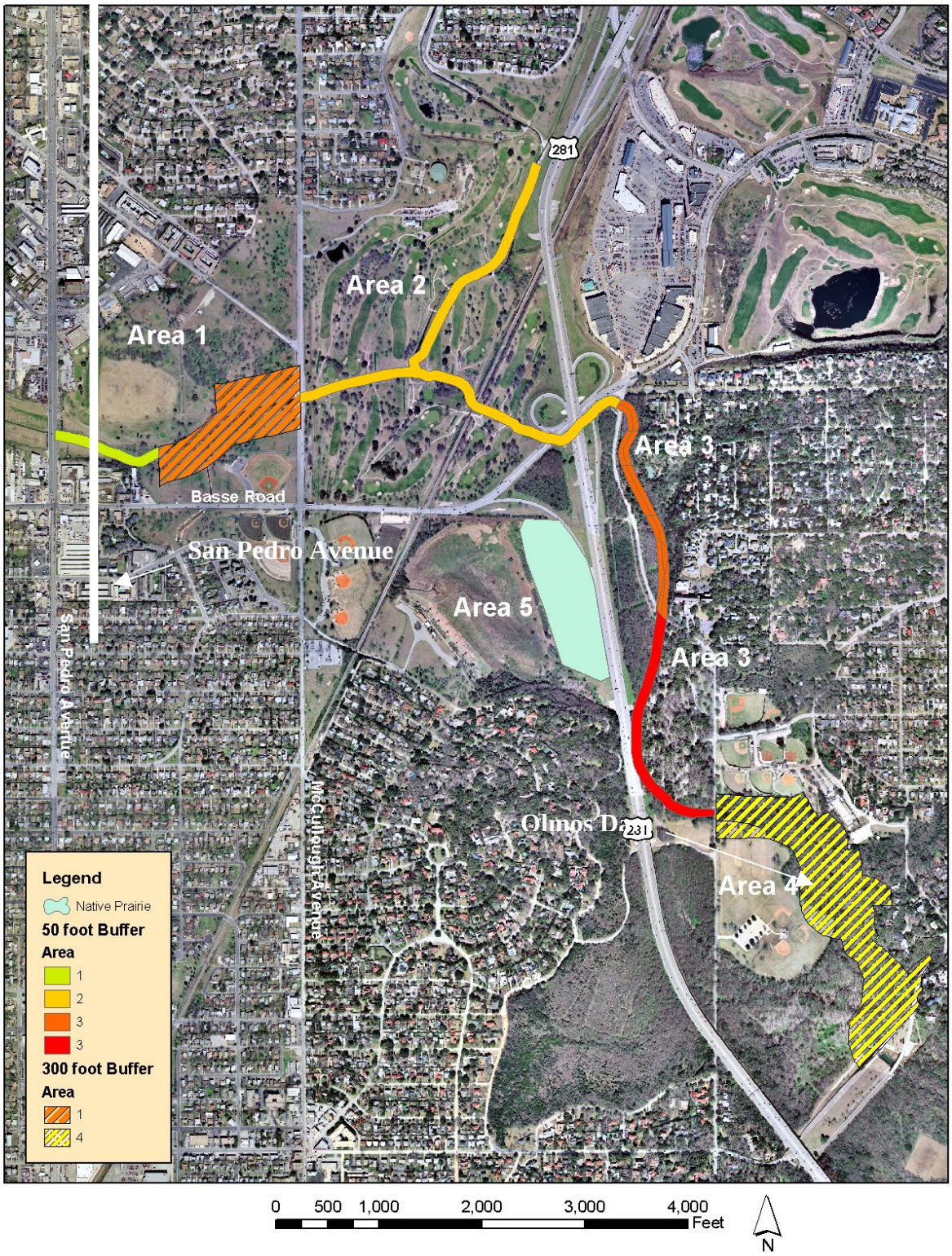


Figure 2. Olmos Creek Project Study Limits

EXISTING CONDITIONS*

Climate

San Antonio has a modified subtropical climate because of its location on the edge of the Gulf Coastal Plains. The average temperature (based on 100-year figures) is 69.9 degrees Fahrenheit (°F). The humidity varies from an average of 80% in the early morning to an afternoon level of 50%. San Antonio averages about 28 inches of rain per year, with the heaviest amounts in May and September. Winter temperatures dip below freezing only about 20 days per year on the average.

Natural Regions, Geology, and Soils

The proposed project area is located in central Bexar County. Bexar County lies within three of the eleven Texas Natural Regions: 1) South Texas Brush Country; 2) Edwards Plateau; and 3) Blackland Prairies. The southern two-thirds of the county is a relatively level or undulating plain sloping upward from the southeast to the northwest rising from about 500 to 1000 feet in elevation. The northern third is an old eroded plateau that has been dissected by numerous streams that generally flow in a northwest to southeast direction. According to the 1992 San Antonio East, Tex. 7.5 Minute Quadrangle, the surface topography of the proposed project area is approximately 700 feet above mean sea level (msl) with gentle sloping to the south.

The formations exposed at the surface in San Antonio are those of the Mesozoic and Cenozoic eras. The geology underlying the proposed project area is fluviatile terrace deposits. These deposits are streambed deposits typically consisting of clays, gravels, sands, and silts.

The soils in the proposed project area are part of the Austin-Tarrant association. This association is comprised of moderately deep and very shallow clayey soils over chalk and marl. The proposed project area is mainly comprised of the Trinity soil series. The Trinity series consists of alluvial soils that are deep, dark colored, and nearly level. Trinity and Frio soils, frequently flooded, occur as narrow, long, and irregularly shaped areas on the flood plains of small streams and larger field drainage ways. They are mostly in the northern and central parts of the county. Furthermore, these soils are capable of supporting a heavy cover of vegetation, are naturally high in fertility, and have a good capacity for holding water.

Hydrology

Basin Description - Olmos Creek is a headwater tributary to the San Antonio River, in San Antonio, Texas. It originates at Interstate Highway Loop 1604, about 7 tenths of a mile east of the intersection of Interstate Highway 10, and then proceeds in a southeasterly direction, paralleling the Southern Pacific Railroad to the Interstate Highway Loop 410 crossing. Olmos Creek then continues southeastward to the San Pedro Avenue crossing and then turns in a more eastward direction as it enters the flood pooling area of Olmos Reservoir. This reservoir, often referred to as a “dry detention” project, is formed by Olmos Dam (constructed in 1925-1926), which is situated adjacent to and on the east side of US Highway 281, about 6 tenths of a mile north of its intersection with Hildebrand Avenue. Approximately 8 tenths of a mile downstream from the dam, Olmos Creek reaches its confluence with the San Antonio River, at the San Antonio Springs, in the vicinity of the Hildebrand Avenue crossing.

The 32 square-mile watershed above Olmos Dam is generally oval in shape, with a length of about 10.5 miles and an average width of about 3.0 miles. Elevations within this relatively steep basin range from about 1,060 feet National Geodetic Vertical Datum (NGVD) to about 680 feet NGVD. The watershed is highly developed, primarily with residential use, but significant corridors having commercial use exist along each of the major thoroughfares bisecting the watershed.

Olmos Dam is operated exclusively as a detention basin for controlling excessive amounts of water during flood periods. Water is not impounded within the reservoir during dry periods. The dam is a concrete, gravity-type structure on rock foundation, 1,941 feet long and 60 feet high above the streambed.

The outlet structure consists of six rectangular conduits, each 6.5 feet wide and 8 feet high at their entrance, controlled by slide gates. These conduits are drawn down to dimensions of 5.75 feet wide by 7.83 feet high, at a point approximately 15 feet from the upstream face of the dam. The reservoir has a storage capacity of about 15,500 acre-feet at the crest of the dam, elevation 728.0. At this elevation, approximately 1,050 acres of land would be inundated.

Prior Studies - A few studies have been undertaken specifically regarding the hydrologic performance and/or general safety of the Olmos Dam. These include: "Stability Report – Olmos Dam" in July 1974 and "Definite Project Report" in December 1975, both by Hensley-Schmidt, Incorporated.

The original flood insurance study (FIS) was prepared by the USGS for the Federal Emergency Management Agency (FEMA) in July 1979. It became effective on 15 December 1983. Based on the flood profiles presented in the currently effective (4 January 2002) FIS report, the Olmos Reservoir pool elevations (in feet, NGVD) for selected flood recurrence intervals are as follows:

10-Year	50-Year	100-Year	500-Year
717.8	723.4	726.2	735.4

An ongoing FIS update, under the Limited Map Maintenance Program (LMMP) has recently been submitted to FEMA for review. The LMMP FIS relates primarily to the San Antonio River and San Pedro Creek (a major right bank tributary near downtown San Antonio), but happens to include updated hydrologic analyses related to the inflows and routing through the Olmos Reservoir, under present watershed development conditions. It should be noted that the currently effective FIS for Olmos Creek is not scheduled for any revision as part of the LMMP FIS activities.

Development of Discharge Versus Frequency Relationships - The U.S. Army Corps of Engineers (USACE) hydrologic analysis computer program "HEC-1" was used to compute the synthetic rainfall, runoff volumes, and unit/flood hydrographs, to route the flood hydrographs downstream, and to tabulate frequency peak discharges. The computed probability peak pool elevations in the Olmos Reservoir are outlined in **Table 1** below.

Table 1 -- Olmos Reservoir Peak Pool Elevations

Annual Exceedance Frequency (Percent)	Recurrence Interval (Years)	Peak Pool Elevation (Feet NGVD)
50	2	709.0
20	5	713.8
10	10	717.1
4	25	719.6
2	50	721.2

Surface Water and Other Aquatic Resources

The proposed project area includes a reach of Olmos Creek extending from San Pedro Avenue to Olmos Dam (**Figure 2**). Olmos Creek is an ephemeral stream that derives its flow from three sources – rainfall, stormwater runoff, and the backwater effects of Olmos Dam.

Existing water quality in Olmos Creek is affected by rainfall and associated stormwater flows originating from both industrial and non-industrial non-point sources. The State of Texas List of Impaired Water Bodies, also known as the Clean Water Act (CWA) Section 303(d) List, identifies: 1) water bodies that do not meet the standards set for their use, or are expected not to meet their use in the near future; 2)

which pollutants are responsible for the failure of a water body to meet standards; and 3) water bodies that are targeted for clean-up activities within the next two state fiscal years. The development of a Total Maximum Daily Load (TMDL) is required for those pollutants that exceed established water quality standards. A TMDL is an estimate of the maximum amount of pollution a body of water can receive and still meet water quality standards set for its use. The major parameters that are measured to determine whether a water body meets the standard for its use are metals, organics, fecal coliform bacteria, dissolved oxygen, and dissolved solids. Currently, no water quality data is available for Olmos Creek. However, based on the Draft Texas 2002 CWA Section 303(d) List, the Upper San Antonio River, Segment 1911, exceeds the water quality standard for fecal coliform bacteria. Segment 1911 extends from a point 1,968 feet downstream of FM 791 at Mays Crossing near Falls City in Karnes County to a point 328 feet upstream of Hildebrand Avenue at San Antonio in Bexar County. Although this segment does not include Olmos Creek, it is likely that similar water quality exists due to their proximity (i.e. – Olmos Creek contributes directly to the headwaters of the Upper San Antonio River). **Figure 3** below depicts the approximate location of Segment 1911 in relation to Olmos Park, which is located slightly to the north and west.

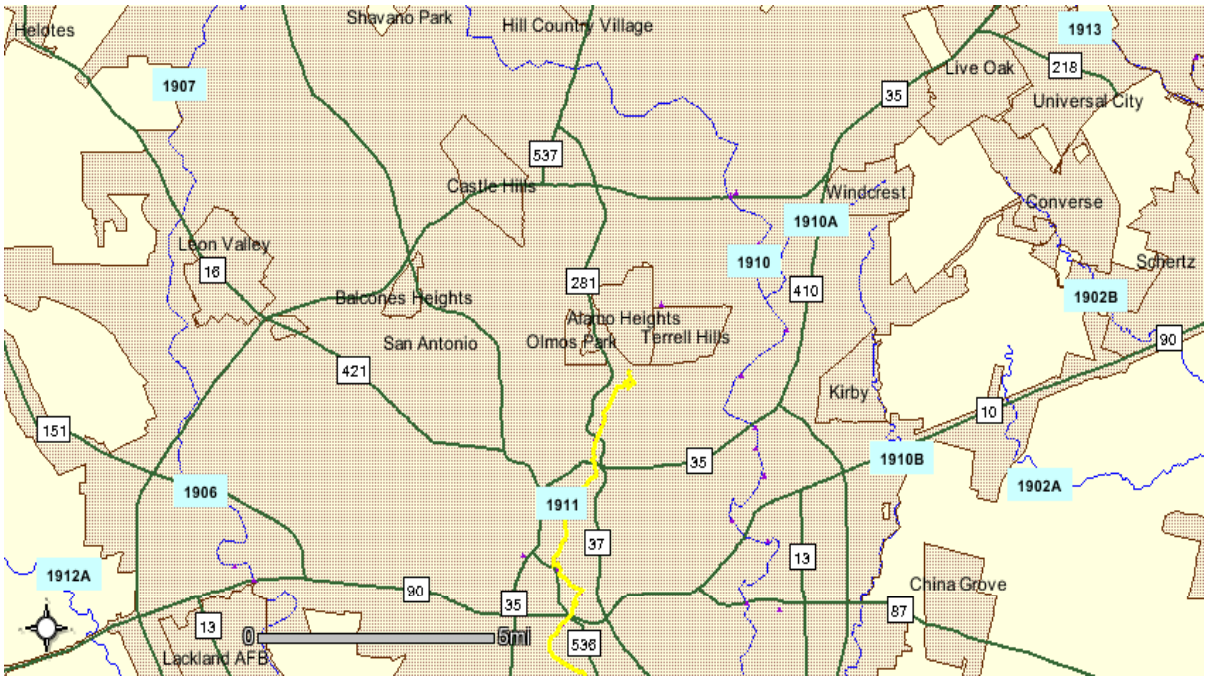


Figure 3. Location of Segment 1911 (Upper San Antonio River) in Relation to Olmos Creek.

The proposed project area lies over the Edwards Aquifer Artesian Zone. The Edwards Aquifer is the primary source of groundwater within the proposed project area. It is a Federally-designated 'sole source' aquifer, serving as the only source of drinking water for the COSA. The aquifer is a limestone formation associated with the Balcones Fault Zone.

According to the Environmental Protection Agency (EPA) and USACE, wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soils. According to the USFWS National Wetlands Inventory (NWI) map, San Antonio, TX East sheet, three types of wetlands are located within the proposed project area. There are three Riverine, Intermittent, Streambed, Temporarily Flooded, Excavated (R4SBAx) wetlands, two Palustrine,

Unconsolidated Bottom, Permanently Flooded, Diked/Impounded (PUBHh) wetlands, and one Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded (R2USC) wetland located between San Pedro Avenue and the Missouri Pacific Railroad. No wetlands are indicated on the NWI map between the Missouri Pacific Railroad and Olmos Dam.

Fish species that may occur in Olmos Creek include largemouth bass (*Micropterus salmoides*), Guadalupe bass (*Micropterus treculi*), channel catfish (*Ictalurus punctatus*), and blue gill (*Lepomis macrochirus*). Exotic species that may occur are common carp (*Cyprinus carpio*), introduced sunfish species (*Lepomis spp.*) and introduced shad species (*Dorosoma spp*.). Other tolerant species such as Mozambique Tilapia and Rio Grande Cichlids may also occur. A list of fish species known to occur in this area can be found in **Appendix G.**

Several parameters were measured to determine the relative value of existing in-stream aquatic habitat within the study area. The parameters were chosen based on field observations that noted two key problems: 1) lack of stream canopy cover (stream shading) in Areas One and Two (**Figure 2**), and 2) areas of erosion in Areas One and Two (**Figure 2**). To quantify the extent of the above problems, measurements of the existing stream shade and amount of embeddedness were taken within the study area. Embeddedness is measured as a percentage to which a rock on the streambed is buried, or embedded in finer materials. Because specific habitat suitability models do not exist for the parameters that were measured, best professional judgment was used to extrapolate the values of the measurements and normalize those values to obtain a habitat index value between 0.0 and 1.0. Within the evaluation, a habitat index value of 0.0 represents the lowest comparative value of habitat whereas 1.0 represents the optimum value of a particular habitat. Habitat units for each area where then calculated by multiplying the habitat index value by the acreage of available habitat. The aquatic habitat units based on stream shade are summarized in **Table 2**.

Table 2 – Existing Habitat Units Based on Stream Shade for Olmos Creek

Location	Habitat Index Value	Acres	Habitat Units
Area One	0.0	0.93	0.00
Area Two	0.0	2.11	0.00
Area Three	1.0	1.59	1.59
Area Four	1.0	1.17	1.17

*Note: Locations of specific study areas are identified in Figure 2.

Embeddedness measurements were made with grab samples along a 2,500 feet stretch of Olmos Creek in Area Three. Area Three was specifically targeted due to its location downstream of the areas exposed to high erosion forces in Areas One and Two. Although embeddedness measurements were not taken in Areas One, Two, and Four, habitat index values were determined using visual assessment and best professional judgment. The aquatic habitat units based on embeddedness are summarized in **Table 3**.

Table 3 – Existing Habitat Units Based on Embeddedness for Olmos Creek

Location	Habitat Index Value	Acres	Habitat Units
Area One	0.9	0.93	0.84
Area Two	0.9	2.11	1.89
Area Three	0.9	1.59	1.43
Area Four	0.9	1.17	1.05

Using the above data, an overall assessment of the aquatic environment was made by averaging the habitat units for both stream shade and embeddedness throughout the study area excluding Area Five. **Table 4** summarizes the total aquatic habitat units based on the above parameters.

Table 4 – Existing Aquatic Habitat Units Based on Embeddedness and Stream Shade for Olmos Creek

Location	Stream Shade Habitat Units	Embeddedness Habitat Units	Average Habitat Units
Area One	0.00	0.84	0.42
Area Two	0.00	1.89	0.95
Area Three	1.59	1.43	1.51
Area Four	1.17	1.05	1.11

Aquatic Environment. As indicated in the above tables, stream shade ranged from an index value of 0.0 in Areas One and Two to 1.0 in Areas Three and Four. At the same time, embeddedness measurements were consistently high in Areas One through Four, scoring 0.9 in all areas. Overall, the aquatic environment in Areas One and Two scored the lowest due to their low stream shade index values while Areas Three and Four scored much higher due to lowered amounts of embeddedness and higher percentages of stream shade.

Riparian Wildlife Habitats

Bexar County lies within the Texan, Tamaulipan and Balconian biotic provinces. The proposed project area lies entirely within the Olmos Basin, an urbanized portion of the City of San Antonio. The majority of the study area upstream of Basse Road may be characterized as severely degraded and fragmented bottomland forest that is now being used for recreational purposes such as golf, baseball, and softball. Only a very narrow strip of riparian corridor still exists in this region. The majority of the study area downstream of Basse Road can be classified as moderately degraded bottomland forest. This area is less fragmented but contains few hard mast producing trees and is quickly becoming overrun with invasive and non-native species, especially *Ligustrum spp*. Although lacking in species richness and overall species diversity, all structural layers are present (herbaceous, shrub, tree) which provide more opportunities for wildlife use.

Animals that would normally be found in this type of environment are: raccoon (*Procyon lotor*), Eastern cottontail (*Sylvilagus floridanus*), Eastern fox squirrel (*Sciurus niger*), Virginia opossum (*Didelphis virginiana*), Hispid cotton rat (*Sigmodon hispidus*), and striped skunk (*Mephitis mephitis*). There are

many species of birds, both migrant and resident, in Bexar County and the proposed project area. Some of the most common are: Carolina chickadee (*Poecile carolinensis*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), red-tailed hawk (*Buteo jamaicensis*), and turkey vulture (*Cathartes aura*). Common reptiles and amphibians likely to inhabit the proposed project area are: cricket (*Acris crepitans*) and leopard frogs (*Rana sphenocephala*), Gulf coast toad (*Bufo valliceps*), slider (*Trachemys scripta*), yellow mud turtle (*Kinosternon flavescens*), and diamondback water snake (*Nerodia rhombifer).*

An overall evaluation of the quality of existing riparian habitats within the proposed project area was conducted implementing the Habitat Evaluation Procedure (HEP) developed by the USFWS. The HEP utilizes a Habitat Suitability Index (HSI), which ranks the comparative value of habitat either for a single species, multiple species, or on an ecosystem basis. Within the evaluation, an HSI value of 0.0 represents the lowest comparative value of habitat whereas 1.0 represents the optimum value of a particular habitat. Two habitat types were selected that best represent the wildlife communities (habitats) surveyed in the project areas. The raccoon, barred owl (*Strix varia*), Eastern fox squirrel, and green heron (*Butorides virescens*) were used to represent species that utilize riparian woodland habitat. The red-tailed hawk, scissor-tailed flycatcher (*Tyrannus forficatus*), eastern meadowlark (*Sturnella magna*), and eastern cottontail were used to represent species that utilize riparian grassland habitat. These baseline values were used to determine the average annual habitat units gained over the life of the project for each restoration alternative. **Table 5** below summarizes the existing habitat conditions as determined by the use of HEP.

It should be noted that the original habitat type that once existed in Area Two was bottomland hardwood forest. This area has now been converted into a municipal golf course. As such, future without project conditions for Area Two were based on the value of this area as a bottomland hardwood forest.

Table 5 – Existing Riparian Habitat Conditions as Determined by Habitat Evaluation Procedures

Habitat Types	Acreage	HSI Value	Habitat Units
Riparian Woodland (Area 1)	18.53	0.38	7.04
Riparian Grassland (Area 2)	6.50	0.53	3.45
Riparian Woodland (Area 3)	12.46	0.82	10.22
Riparian Woodland (Area 4)	37.47	0.60	22.48
Riparian Grassland (Area 5)	17.62	0.55	9.69
Total:	**92.58**	**NA**	**52.88**

Riparian Grassland. It was determined that the HSI values for grassland communities within the study area ranged from 0.33 for the eastern cottontail in Area Two to 1.0 for the scissor-tailed flycatcher in Area Five. This provided for an overall average of 0.53 for the grassland habitat located in Area Two to 0.55 for the grassland habitat located in Area Five. Although the grasslands were considered optimum habitat for the scissor-tailed flycatcher, they were considered poor habitat for the eastern cottontail (lack of hiding cover) and meadowlark (lack of grass for food production and lack of perching sites).

Riparian Woodland. HSI values for riparian forest habitats ranged from 0.08 for the fox squirrel in Area One to 0.93 for the green heron in Area Three. Area One had the lowest HSI value (0.38) due to clearing

of trees for recreational purposes. Areas Three and Four were more characteristic of a riparian forest habitat and therefore had higher HSI values (0.60 – 0.82). However, intrusion of invasive and non-native species and a lack of hard mast trees lowered overall HSI values.

Endangered and Threatened Species

There are currently eleven Federally-listed endangered species and one Federally-proposed threatened species in Bexar County as shown in **Table 6** below. In addition, several species designated by the TPWD as threatened, endangered, or rare are located within Bexar County.

Table 6 – Federally Listed Threatened and Endangered Species for Bexar County

Common Name	Scientific Name	Listing Status
Blacked-capped vireo	*Vireo atricapillus*	Endangered
Braken Bat Cave Meshweaver	*Cicurina venii*	Endangered
Cokendolpher Cave Harvestmen	*Texella cokendolpheri*	Endangered
Golden-cheeked warbler	*Dendroica chrysoparia*	Endangered
Government Canyon Bat Cave Meshweaver	*Cicurina vespera*	Endangered
Government Canyon Bat Cave Spider	*Neoleptoneta microps*	Endangered
Ground beetle (no common name)	*Rhadine exilis*	Endangered
Ground beetle (no common name)	*Rhadine infernalis*	Endangered
Helotes mold beetle	*Batrisodes venyivi*	Endangered
Madla's Cave Meshweaver	*Cicurina madla*	Endangered
Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered
Mountain plover	*Charadrius montanus*	Threatened

Based on respective habitat requirements and field observations, no Federally-listed endangered species or Federally-proposed threatened species are expected to be encountered within the proposed project area. In addition, the probability of encountering TPWD-designated threatened, endangered, or rare species would be very low.

Recreational, Scenic, and Aesthetic Resources

When not being utilized for floodwater storage, much of the Olmos Basin provides recreational use for citizens through parks, playgrounds, ball fields, a skeet range, and a municipal golf course.

The proposed project area consists of two very different habitat types. Below Basse Road, adjacent to Olmos Creek, a dense riparian corridor containing lush vegetation and a mature tree canopy exists. In an urban setting, such as this portion of Olmos Creek, this type of area tends to increase the scenic and aesthetic value of the community. Upstream of Basse Road, adjacent to Olmos Creek, the environment consists mainly of constructed recreational amenities, i.e. - golf courses and ball fields, as well as city open space. Although these areas increase the recreational values of the study area, their scenic and aesthetic values can be improved upon. A stream channel, such as Olmos Creek, that flows through an urban setting is frequently ecologically impoverished and perceived as aesthetically displeasing because it lacks the local in-stream and riparian heterogeneity and complexity found in naturally functioning stream corridors.

Cultural Resources
An archaeological investigation was conducted to determine if significant cultural resources were present within the study area. Currently, there are seven archeological sites that have been recorded and are on file at the Texas Archaeological Research Laboratory for the Olmos Creek Study area. These sites are located along Olmos Creek and five of the seven are concentrated on the south side of the existing Olmos Dam. Four of the sites located on the south side of the dam consist of lithic scatters containing burned rock and lithic tools. Another site located at the base of the dam in vicinity to the four-recorded sites, contained similar burned features, but was not recorded. The fifth recorded site, located south of the dam, is a historic trash dump dating to at least the 19th century. The remaining two sites located north of the dam consist of discrete lithic scatters, one with associated midden debris and burned rock and the other with lithic tools.

The search was limited to within the five identified study areas on both sides of Olmos Creek. The recorded sites are limited by the amount of previous work conducted in these areas. Therefore, the full extent of cultural resources within the overall project area is unknown pending a full cultural resources survey, inventory, and assessment of particular proposed impact areas.

Hazardous Materials
A review of standard environmental record sources in accordance with the American Society for Testing and Materials *(*ASTM) Practice E 1527 was conducted by the Environmental Design Branch, Fort Worth District, Corps of Engineers as part of a Hazardous, Toxic, and Radioactive Waste (HTRW) Investigation for Olmos Creek, Section 206 Study in San Antonio, Texas. Environmental Data Resources, Inc. (EDR) was contracted to search Federal and state environmental databases that track activities associated with hazardous waste and incidents that have resulted in major environmental impairment. A summary of the EDR search results are located in **Appendix B**.

A total of twenty-eight federal databases, six State of Texas databases, two Brownfield databases, and twelve "other" state databases were searched for potential HTRW activities within the study area. The search resulted in the identification of three Resource Conservation and Recovery Information System (RCRIS) listings, fifteen Leaking Underground Storage Tank (LUST) listings, thirteen Underground Storage Tank (UST) listings, one Facility Index System (FINDS) listing, and one State of Texas Industrial Hazardous Waste (TX IHW) listing within a one-mile radius of the study area.

Floodplains
Executive Order 11988 has an objective to avoid, to the extent possible, long and short-term adverse impacts associated with occupancy and modification of the base floodplain. Further objectives are the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative and protection and restoration of natural floodplain functions. U.S. Army Corps of Engineers regulations for implementing EO 11988 (ER 1165-2-26) defines the base floodplain as the one percent chance, or 100-year floodplain. For the most part, lakes, wetland features, and flood damage reduction measures require being located within the floodplain to provide their intended function. Some recreational features do not need to be located within the floodplain to fulfill their basic purposes.

The proposed project area lies exclusively within the Olmos Basin and the 100-year floodplain according to the Flood Insurance Rate Map (FIRM), Bexar County, Texas, Panel 451, Map Number 48029C0451 E, February 16, 1996. As stated previously, the primary land use within Olmos Basin is floodwater storage for the protection of downtown San Antonio. When the area is not inundated with floodwaters, it is used primarily for recreation.

Air Quality

The EPA uses six "criteria pollutants" as indicators of air quality, and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS). Areas of the country where air pollution levels persistently exceed the NAAQS may be designated as nonattainment areas. Conversely, areas of the country that do not persistently exceed the NAAQS are designated as attainment areas. The proposed project area would be located entirely within the Metropolitan San Antonio Intrastate Air Quality Control Region (AQCR), AQCR #217. As seen in **Figure 4** below, this area is considered "Near nonattainment for ozone only" according to the Texas Commission on Environmental Quality (TCEQ).

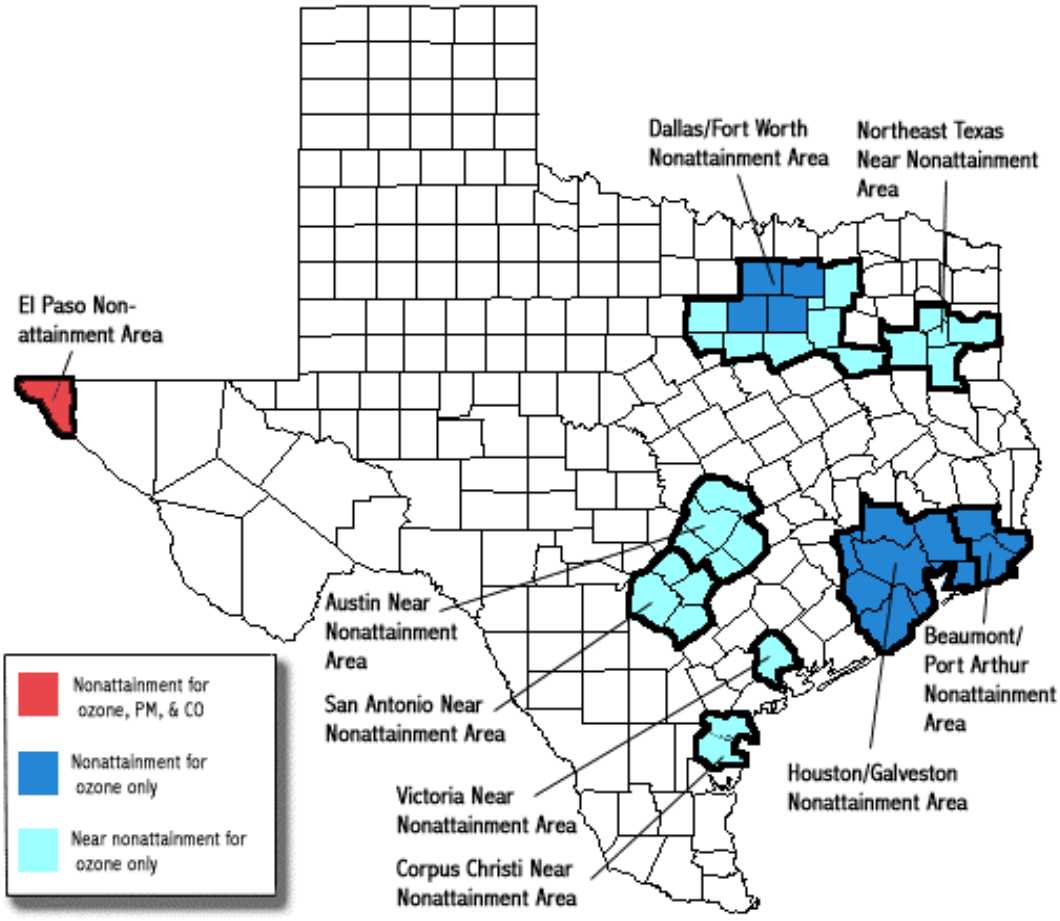


Figure 4. Counties Designated as Attainment, Near Nonattainment, or Nonattainment for Criteria Pollutants in Texas.

Ozone (O_3) is a photochemical oxidant and the major component of smog. Ozone is not emitted directly into the air but is formed through chemical reactions between precursor emissions of volatile organic compounds (VOC) and oxides of nitrogen in the presence of sunlight. High temperatures stimulate these reactions so that elevated concentrations of O_3 are typically detected during the warmer months. Precursors for O_3 are emitted by transportation, industrial, and biogenic sources. The NAAQS threshold value for ozone is 0.12 parts per million (ppm) or 125 parts per billion (ppb), measured as one-hour average concentration.

Noise
Pursuant to Article III, Chapter 21 of the City of San Antonio Municipal Code, maximum permissible noise levels depend on the land use of the property that contains the noise source (e.g., industrial, commercial, or residential) and the land use of the property receiving that noise. Maximum permissible noise levels range from 63 average weighted decibels (dBA) in residential zoning districts to 85 dBA in the Entertainment zoned districts. Baseline noise levels within the immediate vicinity of the proposed project area would not be expected to exceed the maximum permissible noise levels for a prolonged period of time.

Environmental Justice
Based on the U.S. Census Bureau, Census 2000 Redistricting Data, the COSA population is 58.7% Hispanic, 31.8% White, 6.5% Black, and 3.0% Other. In accordance with the provisions of Executive Order 12898, each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin.

PLAN FORMULATION*

The existing riparian and aquatic communities in the study area do not represent the maximum habitat quality that could be expected within the study area. Due to continued urban growth and development in the region, open spaces are either removed from the landscape or degraded due to secondary effects such as fragmentation or sedimentation of aquatic habitats. As urban encroachment continues, greenbelts along streams and rivers are becoming increasingly scarce and fragmented. Subsequent effects from removal or fragmentation of habitat include reduction of vegetative structural diversity and overall species richness.

Specific ecological factors guiding the development of restoration alternatives included the low species diversity and fragmentation of the existing riparian corridor, a lack of hard mast producing trees, a lack of trees greater than six inches (dbh), an abundance of both non-native and invasive plant species, areas with low amounts of stream shade, areas experiencing high amounts of erosion, and areas with poor vegetative cover that results in excessive runoff and subsequent stream bank instability and poor stream water quality. Currently, the riparian corridor along Olmos Creek is fragmented, very narrow in places, and lacking in species diversity. Given the lack of mast producing species in the area, natural regeneration is limited to invasion by light-seeded plants propagated by wind. Seedlings of heavy-seeded oak species are most prevalent in areas where floodwaters cause deposition of acorns and where duff is sufficient for regeneration. Currently, there is an inadequate supply of hard mast producers within the contributing watershed to provide natural establishment of a forest dominated by hard mast producers. The lack of species diversity and hard mast producing trees is most prevalent in the upper portion of the study area (Areas One and Two). Based on the existing environmental degradation within the study area, plan formulation was guided by a number of objectives, which included:

- Restoration and enhancement of the aquatic environment by increasing stream shade and reducing erosion;
- Restoration and enhancement of the riparian corridor through the reduction of both non-native and invasive species;
- Increasing species diversity of existing riparian corridors focusing on mast producing species;

- Reforestation with appropriate species of open areas thereby expanding existing riparian corridors and reducing fragmentation; and
- Diversification of both habitat and wildlife within the riparian corridor and improvement of aquatic habitat through restoration of riparian grassland habitat.

Measures Considered but Screened from Detailed Study

This section describes measures and alternatives that were initially considered but eliminated from detailed study. During the development of the Preliminary Restoration Plan (PRP) several measures were formulated to help restore or improve the aquatic and riparian habitat in the different areas of Olmos Creek. Several of these measures were removed from consideration after further review. An interdisciplinary project delivery team (PDT), which included members from the COSA, SARA, USACE, USFWS, and TPWD evaluated possible structural and non-structural measures that could be implemented to improve the habitat of Olmos Creek. Because each Area (or reach) within the study area had unique environmental characteristics and associated problems, each area was considered individually. As such, measures and alternatives were initially formulated for each area separately, and are discussed below. The following measures were screened from detailed study within each area:

Area One

a) *Restoration of riparian grassland:* This measure was removed early in the plan formulation process due to the fact that this area in its native condition was not grassland habitat. In addition, it was determined by USACE, USFWS, and TPWD that restoring the bottomland hardwood riparian buffer along this section of creek could create more habitat units by connecting upstream and downstream sections and creating a continuous wildlife movement corridor.

b) *Removal of concrete-lined storm channel to decrease erosion:* This measure was removed from further consideration due to the potential for increased flood damages. This channel is a "new build" by the City of San Antonio and drains flood waters from an upstream neighborhood.

c) *Riffle / pool modification:* This measure was removed from further consideration due to the fact that the existing upstream portion of Olmos Creek is used primarily for flood water conveyance into Olmos Basin. Placement of pool / riffle structures in this section of Olmos Creek was deemed not feasible due to the likelihood that the high flows would wash out these structures during heavy rainfall events.

Area Two

a) *Restoring width / meander ratios:* This measure was removed from further consideration due to the fact that this would not be compatible with current land use practices. The land in this reach is currently being used for recreational golfing. The golf course is owned and operated by the City of San Antonio, which has expressed a disinterest in making these types of modifications to the course.

b) *Construction / raising of new golf cart path bridges:* This measure was removed from further consideration due to the fact that this would require demolition and construction of approximately eleven concrete crossings across this section of Olmos Creek. It was deemed not feasible due to excessive costs.

c) *Complete removal of existing Texas Department of Transportation (TXDOT) channel:* This measure was removed early in the plan formulation process due to a lack of interest by TXDOT and the high costs that would be incurred if such a measure were implemented.

Area Three

a) *Restoring width / meander ratios:* This measure was removed from further consideration due to the fact that Olmos Creek, between Jones-Maltsberger and Devine Road, is bordered by a limestone cliff on the east bank and large native trees on the west bank. Restoring width / meander ratios would require cutting into the limestone cliff and/or taking out many large native trees adjacent to the stream bank, which would likely require mitigation if implemented.

Area Four

a) *Restoring width / meander ratio:* This reach of Olmos Creek is similar to Area Three in that the stream banks are bordered by large native trees. Restoring width / meander ratios would require cutting and/or removing many large native trees adjacent to the stream bank, which may require mitigation if implemented.

Area Five

a) *Creation of wetland cell:* This measure was removed from further consideration due to surrounding land use hazards. This area is located off of the main channel and is situated between the Olmos Basin Skeet Range and Highway 281. The existing skeet range and highway traffic represent unacceptable hazards to migratory waterfowl species that would utilize the constructed wetland.

Measures used for Formulation of Alternatives

Area One

a) *Restoration of riparian corridor:* Clearing of land within this reach has created large areas of open landscape where riparian woodlands once occurred. Reforestation with native trees and grasses could create a more natural riparian corridor to be utilized by local wildlife. Creation of riparian woodland habitat would require several actions. First, removal of invasive johnsongrass (*Sorghum halapense*) and giant ragweed (*Ambrosia trifida*) would need to occur. In addition, removal of existing debris would be required so that proper equipment could be used for plantings. The area would then need to be planted with ground cover (native grasses) and selected hard and soft mast producing trees. All scales would require the above actions for successful restoration. Scales for plantings are listed below:

Scale 1 – no action.
Scale 2 – 1" caliper plantings at 65 trees / acre of hard and soft mast producers; native grass seeding at 8 lbs. / acre.
Scale 3 – 100 seedlings / acre of hard and soft mast producers; native grass seeding at 8 lbs. / acre.
Scale 4 – 50 / 50 mix of 1" and seedlings at 83 trees / acre (41 – 1" caliper trees and 42 – seedlings / acre); native grass seeding at 8 lbs. / acre.

b) *Erosion control:* Area One is experiencing bank erosion at the location where the concrete-lined storm drain empties into Olmos Creek. A flow baffle could be placed at the mouth of this channel to reduce flow velocities into Olmos Creek and in turn reduce bank erosion. This area could also be planted with live black willow *(Salix nigra)* stakes at the mouth of the storm channel and in the area experiencing erosion on the north bank of Olmos Creek to help reduce bank erosion.

Scale 1 – no action.
Scale 2 – flow baffles.
Scale 3 – live staking at 3 stakes / 4 square feet.

Area Two

a) *Restoration of riparian corridor:* In general, Area Two is a well-manicured golf course with only small strips of native plant species occurring in-stream and within five feet from the banks of Olmos Creek. There are also remnant stands of trees that were not cleared when the golf course was built that lie between the fairways and in some of the out-of-bounds areas. Chinese tallow *(Triadica sebifera)* and chinaberry *(Melia azedarach)* were seen on the golf course but do not lie within the project study limits. We recommend that these species be removed from the golf course to remove potential seed sources. Because Area Two lies almost exclusively within the Olmos Basin Municipal Golf Course, creation of a continuous riparian corridor with large native trees was deemed not feasible due to interference with play on the course. To the extent possible, it was formulated that areas lying between fairways and those areas along the creek not in direct line of play could be planted with hard mast producing trees such as pecan and black walnut and soft mast producers such as bald cypress, cottonwood, and sycamore. Understory grasses could also be planted to increase the habitat diversity and availability within the golf course. These plantings are not to exceed a 50 feet (ft.) buffer limit set by the City of San Antonio Parks Department.

Scale 1 – no action.
Scale 2 – 1" caliper plantings at 65 trees / acre of hard and soft mast producers; native grass seeding at 8 lbs. / acre.
Scale 3 – 100 seedlings / acre of hard and soft mast producers; native grass seeding at 8 lbs. / acre.
Scale 4 – 50 / 50 mix of 1" and seedlings at 83 trees / acre (41 – 1" caliper trees and 42 – seedlings / acre); native grass seeding at 8 lbs. / acre.

b) *Erosion control:* Area Two was identified as experiencing high levels of erosion, especially near the golf cart paths that cross Olmos Creek. To reduce the amount of sediment entering the stream and control the erosion, identified stream banks located upstream and downstream of the cart paths would be armored with rip-rap alone or rip-rap and supplemental live willow stake plantings.

Scale 1 – no action.
Scale 2 - 12"-24" rip-rap.
Scale 3 – 12"-24" rip-rap with live willow stakes at 3 stakes / 4 square feet.

c) *Creation of pilot channel:* Downstream from the golf course is a large concrete-lined channel owned and operated by TXDOT. This channel was identified as having several degrading effects on the aquatic ecosystem of Olmos Creek. This channel was initially identified as being a barrier to up and downstream aquatic species movement, due to the fact that the

channel is extremely shallow under normal water flow conditions. In addition, the concrete-lined channel had little shading except for that provided by three bridges that cross the channel. This exposes the channel to high levels of solar radiation, causing an increase in stream water temperatures. By cutting a pilot channel into the existing concrete-lined channel, stream flow could be concentrated to create greater depths as water passes through the channel. This would allow aquatic species the ability to move up and downstream as well as reduce the stream temperatures during periods of bright sunshine and high temperatures.

Scale 1 – no action.
Scale 2 – 3' x 3' pilot channel.

Area Three

a) *Enhancement of riparian corridor:* Area Three was characterized as having several problems relating to the existing riparian corridor. First, the entire area contained invasive and non-native plant species throughout the understory. Species included privet *(Ligustrum spp.)*, chinaberry, and others. These plant species are considered detrimental to the health of the riparian corridor and should be removed. Second, the reach between Jones-Maltsberger Road and the first crossing of Devine Road was identified as having few hard mast producing trees, which limited food availability for species such as the fox squirrel. To correct this problem, open space would be created and planted with hard mast producing trees such as pecan and live oak. Open spaces would be created by: 1) removing the invasive and non-native plant species, and 2) thinning of the thick hackberry and cedar elm trees (approx. 0.5 acres) that dominate this section of Olmos Creek. In addition, existing debris would be removed so that proper equipment could be used for plantings. All scales would require the above steps for successful restoration. Scales for plantings are listed below:

Scale 1 – no action.
Scale 2 – 1" caliper plantings at 65 trees / acre of hard mast producers.
Scale 3 – 100 seedlings / acre of hard mast producers.
Scale 4 – 50 / 50 mix of 1" and seedlings at 83 trees / acre (41 – 1" caliper trees and 42 – seedlings / acre).

b) *Riffle / Pool Modification - Relocation / demolition of utility crossings:* It was determined by USACE and USFWS that the main problem in the park area of Olmos Creek was the multiple pipeline and bridge crossings. There are currently three active pipelines, one abandoned pipeline, and one COSA Parks Department Bridge that cross within the park (approx. 2,500 ft.). These crossings are causing two problems: 1) blockage of aquatic species movements up and downstream from the park, and 2) the pool/riffle ratio is nearly four times that recommended by the USFWS (i.e., one to one). Demolition of the abandoned pipeline, relocation of up to three pipelines that are in use, and the demolition of the COSA Parks Department Bridge would reduce the pool/riffle ratio to a level closer to that recommended by USFWS. It was determined by USACE and USFWS that demolition of the abandoned pipeline alone would not increase the in-stream habitat value. However, since it is no longer in use, it should be removed and is included in all scales.

Scale 1 – no action.
Scale 2 – conversion of two 24" pipelines to inverted siphons.
Scale 3 – conversion of one 24" and one 48" pipelines to inverted siphons.
Scale 4 – conversion of two 24" and one 48" pipelines to inverted siphons.

Scale 5 – conversion of one 24" and one 48" pipelines to inverted siphons; demolition of COSA Parks Department Bridge.
Scale 6 – conversion of two 24" and one 48" pipelines to inverted siphons; demolition of COSA Parks Department Bridge.

c) *Park Area Restoration:* Lastly, the area located between the first crossing and second crossing of Devine Road (within the park area) lacks a riparian buffer on the side of the creek where Olmos Basin Park is located. It was determined that the Bermuda grass that currently occupies this area could be removed using a herbicide treatment. This area could then be planted with understory shrubs and native grasses to create a riparian buffer on both sides of the creek. All scales would require the above measures for successful restoration. Scales for plantings are listed below:

Scale 1 – no action.
Scale 2 – 1-gallon shrubs at 20 shrubs / acre; native grass seeding at 8 lbs. acre.

Area Four

a) *Enhancement of riparian corridor:* The riparian corridor within Area Four was characterized as having similar problems as those in Area Three. First, the entire area contained invasive and non-native plant species throughout the understory. Species included privet, chinaberry, and others. These plant species are considered detrimental to the overall health of the riparian corridor and should be removed. Second, the entire reach was identified as having few hard mast producing trees, which limited food availability for species such as the fox squirrel. To correct this problem, open space should be created and planted with hard mast producing trees such as pecan and live oak. Open spaces would be created by: 1) removing invasive and non-native plant species, and 2) thinning of the thick hackberry and cedar elm trees (approx. 1.0 acres) that dominate this section of Olmos Creek. In addition, existing debris would be removed so that proper equipment could be used for plantings. All scales would require the above steps for successful restoration. Scales for plantings are listed below:

Scale 1 – no action.
Scale 2 – 1" caliper plantings at 65 trees / acre of hard mast producers.
Scale 3 – 100 seedlings / acre of hard mast producers.
Scale 4 – 50 / 50 mix of 1" and seedlings at 83 trees / acre (41 – 1" caliper trees and 42 – seedlings / acre).

Area Five

a) *Restoration of Riparian Grassland:* Clearing of lands within Area Five has left a large area of open space that has been colonized by native grasses and forbs as well as several species of invasive and non-native plant species such as johnsongrass and giant ragweed. In order to achieve restoration to a native grassland habitat, the area would first have to be wicked with a herbicide to remove the johnsongrass and giant ragweed. This would decrease the number of invasive and non-native plant species within the study area. Treatment would then be followed by planting (overseeding) a seed mix containing native grasses. This would serve to increase food and cover for many grassland bird species, mammals, and rodents. All scales would require the above steps for successful restoration. Scales for plantings are listed below:

Scale 1 – no action.
Scale 2 – overseeding with native grasses at 8 lbs. / acre.

INCREMENTAL COST ANALYSIS

Cost analysis techniques (Robinson et al., 1995) were used to determine the most cost effective restoration alternative in terms of incremental cost per habitat unit gained. All of the measures identified in the above section were evaluated using annualized habitat gains versus annualized cost estimates (including those for operation and maintenance). Annualized habitat unit gains for each solution, including the "no action" measure were computed for a 50-year period. This time period was established as the project life period, based on the period of time it would take for all aspects of the restoration to reach a level of maturity necessary to meet the goals of the project.

Typically, the cost analysis technique evaluates a particular restoration solution (e.g. reforestation) that may have a range of different size scenarios, which are referred to as scales. A solution is often evaluated with a range of other restoration solutions (e.g. erosion control) of various scales. Solutions in the cost analysis usually have relationships of dependency or exclusion with other solutions. An example of dependency would be a restoration alternative that specifies reforestation if, and only if, erosion control is implemented. Therefore, when the model is processed, if an erosion control solution other than the "no action" is deemed a cost effective alternative, the model will evaluate the various reforestation solutions. If the "no build" erosion control solution is deemed to be cost effective, the "no build" reforestation solution is automatically represented in the model. For purposes of this analysis, no relationships of dependency or exclusion were included.

The cost analysis model evaluates the multiple combinations of solutions to develop alternatives that are cost effective and incrementally justified (i.e., best buy alternatives). The alternatives analysis selected fifteen combinations of restoration measures that would be cost effective and incrementally justified. The following is a summary of the restoration measures identified in each of these alternatives. If a specific restoration measure is not listed, it means that the combination plan chose the "no action" or "no build" alternative for that measure.

Alternative 1. No action / future without project; land restrictions would not change, but due to the potential of creating a manicured landscape on City owned lands adjacent to Olmos Creek due to increased recreational needs and the high number of invasive and non-native plant species that are present, average annual habitat units (AAHU's) would decrease over time from 56.87 to 28.56.

Alternative 2. Alternative 1 with native riparian grassland restoration located in Area Five. grassland restoration would involve the purchase of approx. 17.62 acres, two applications of herbicide for invasive control, and overseeding with native grasses at 8 lbs. / acre. This alternative would provide an additional 9.83 AAHU's of grassland habitat over the project life period as compared to the "no action" alternative. However, AAHU's would still decrease over the project life from 56.87 to 38.39.

Alternative 3. Alternative 2 with the addition of flow baffles for erosion control in Area One. The flow baffles would be located at the terminus of the storm channel to reduce flow velocities and erosion. This alternative would provide an additional 2.58 AAHU's over the project life period as compared to Alternative 2. However, AAHU's would still decrease over the project life from 56.87 to 40.97.

Alternative 4. Alternative 3 with the replacement of flow baffles with live willow stakes for erosion control in Area One. Live staking would occur on approximately 3,000 square feet near the terminus of the concrete-lined storm drain located in Area One. Staking would occur at three stakes per four square feet. Live staking provides benefits to the terrestrial environment as well as the aquatic environment. This alternative would provide an additional 2.33 AAHU's over the project life period as compared to Alternative 3. However, AAHU's would still decrease over the project life from 56.87 to 43.30.

Alternative 5. Alternative 4 with the restoration of the riparian corridor in Area Two (Olmos Municipal Golf Course). Restoration of the riparian corridor in Area Two would require the purchase of approximately 11.44 acres, drilling / overseeding of 6.5 acres with native grasses at 8 lbs. / acre, and planting of 6.5 acres of seedling hard and soft mast tress at 100 seedlings / acre. Alternative 5 would provide approximately 3.91 AAHU's over the project life as compared to Alternative 4. However, AAHU's would still decrease over the project life from 56.87 to 47.21.

Alternative 6. Alternative 5 with the restoration of the riparian corridor in Area Four. Restoration of the riparian corridor in Area Four would require the purchase of approximately 37.47 acres, removal of invasive and non-native plant species, selective thinning of 1.0 acre of cedar elm and hackberry trees, and planting of approximately 4.91 acres of seedling hard and soft mast producing trees at 100 trees / acre. This alternative would also involve removal of debris and trash in the area so that proper planting equipment can be utilized. Alternative 6 would provide an additional 18.66 AAHU's of riparian corridor habitat over the project life as compared to Alternative 5 and increase AAHU's over the project life from 56.87 to 65.87.

Alternative 7. Alternative 6 with the restoration of the riparian corridor in Area One. Restoration of the riparian corridor in Area One would require the purchase of approximately 18.53 acres, two applications of herbicide for invasive control, drilling / overseeding of 18.53 acres with native grasses at 8 lbs. / acre, and planting of 18.53 acres of seedling hard and soft mast trees at 100 seedlings / acre. This alternative would also involve removal of debris and trash in the area so that proper planting equipment can be utilized. Alternative 7 would provide an additional 8.86 AAHU's of riparian corridor habitat over the project life as compared to Alternative 6.

Alternative 8. Alternative 7 with replacement of seedling hard and soft mast producing trees at 100 / acre with 1" caliper trees at 65 / acre in Area Four. Restoration of the riparian corridor in Area Four would require the purchase of approximately 37.47 acres, removal of invasive and non-native plant species, selective thinning of 1.0 acre of cedar elm and hackberry trees, and planting of approximately 4.91 acres with 1" caliper hard and soft mast producing trees at 65 trees / acre. This alternative would also involve removal of debris and trash in the area so that proper planting equipment can be utilized. Alternative 8 would provide an additional 3.75 AAHU's of riparian corridor habitat over the project life as compared to the Alternative 7. Alternative 8 would increase AAHU's over the project life from 56.87 to 78.48.

Alternative 9. Alternative 8 with the addition of rip-rap and live willow stakes within Area Two (Olmos Municipal Golf Course). The addition of this measure would reduce the amount of erosion along the banks of Olmos Creek and reduce sedimentation downstream. This measure would require the purchase of approximately 2.107 acres, placement of approximately 288 cubic yards of rip-rap adjacent to the golf cart bridges, and planting of

1,635 live willow stakes at three stakes per four square feet. Alternative 9 would provide an additional 3.67 AAHU's over the project life as compared to Alternative 8.

Alternative 10. Alternative 9 with the restoration of Olmos Park within Area Three. Restoration of the park area would require the purchase of approximately 2.73 acres, one application of glyphosate to remove the Bermuda grass, drilling / overseeding of 2.73 acres with native grasses at 8 lbs. / acre, and planting of 1 gallon shrubs at 20 shrubs / acre. The addition of Alternative 10 would provide approximately 82.95 AAHU's over the project life.

Alternative 11. Alternative 10 with the restoration of the riparian corridor in Area Three. Restoration of the riparian corridor in Area Three would require the purchase of approximately 7.86 acres, removal of invasive and non-native plant species, selective thinning of 0.5 acre of cedar elm and hackberry trees, and planting of approximately 1.0 acre of 1" caliper hard and soft mast producing trees at 65 trees / acre. This alternative would also involve removal of debris and trash in the area so that proper planting equipment can be utilized. Alternative 11 would provide an additional 3.77 AAHU's of riparian corridor habitat over the project life as compared to Alternative 10. Alternative 11 would provide an overall gain in AAHU's over the project life from 56.87 to 86.72.

Alternative 12. Alternative 11 with the addition of 1" caliper plantings in Area One. This alternative involves essentially the same measures as the alternative above with the only difference being the size and rate of hard and soft mast producing trees to be planted in Area One. The addition of this measure would increase AAHU's from 56.87 to 88.54 over the project life.

Alternative 13. Alternative 12 with the addition of in-stream restoration involving the conversion of two 24" pipeline crossings to inverted siphons within Area Three. In-stream restoration within Area Three would involve the purchase of approximately 0.86 acres, demolition of an abandoned concrete encased utility line, and conversion of two 24" pipeline crossings to inverted siphons. The addition of this measure would increase AAHU's from 56.87 to 89.65 over the project life.

Alternative 14. Alternative 13 with the addition of 1" caliper plantings in Area Two. This alternative involves essentially the same measures as Alternative 5 above with the only difference being the size and rate of hard and soft mast producing trees to be planted in Area Two. The addition of this measure would increase AAHU's from 56.87 to 90.00 over the project life.

Alternative 15. Alternative 14 with additional in-stream restoration involving the creation of a pilot channel in Area Two through the TXDOT concrete-lined channel. In-stream restoration within Area Two would involve the purchase of approximately 1.05 acres and the creation of a 3' x 3' pilot channel through a 912' section of concrete-lined channel owned and operated by TXDOT. The addition of this measure would increase AAHU's from 56.87 to 90.03 over the project life.

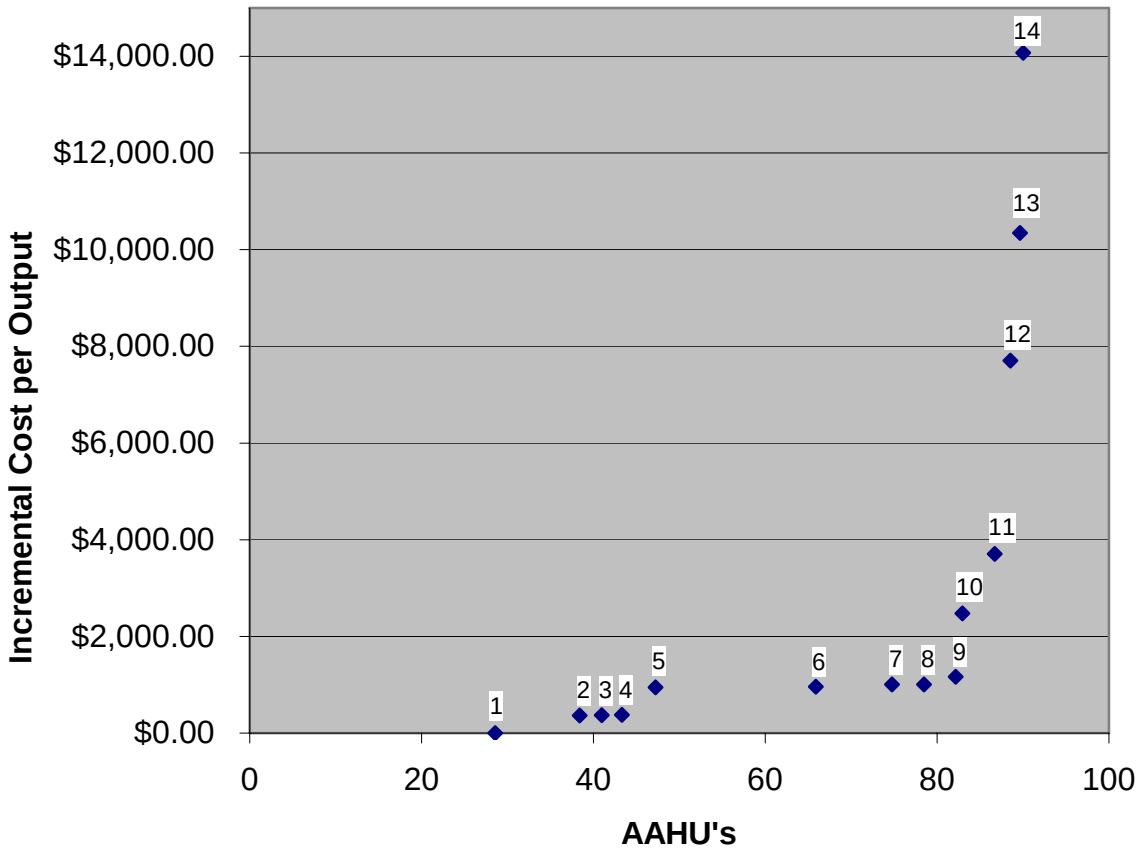
As shown above, fifteen different "best buy" alternatives were identified using the Cost Analysis Techniques for this study. **Table 7** identifies the AAHU's, incremental AAHU's annualized costs, incremental annualized costs, average cost per AAHU, and incremental cost per output for each of the fifteen incrementally justified or best buy alternatives. **Figure 5** is a graphic representation showing the AAHU's and incremental cost per output for all of the best buy alternatives. Alternative 15 is not identified in Figure 8 as a result of its high Incremental Cost per Unit Output ($1,012,167). Removing

this value from the graph allows for a more accurate graphical representation of the Incremental Costs per Output versus Annual Habitat Units.

Table 7 – Incremental Cost Analysis of Best Buy Alternatives

Best Buy Alternative	AAHU's	Incremental AAHU's	Annualized Costs	Incremental Annualized Costs	Average Cost per AAHU	Incremental Cost per Output
1	28.56	28.56	$ 0.00	$ 0.00	$ 0.00	$ 0.00
2	38.39	9.83	$ 3,600.00	$ 3,600.00	$ 93.80	$ 366.22
3	40.97	2.58	$ 4,550.00	$ 9,490.00	$ 111.00	$ 367.82
4	43.30	2.33	$ 5,440.00	$ 8,860.00	$ 125.50	$ 380.26
5	47.21	3.91	$ 9,140.00	$ 3,701.00	$ 193.50	$ 946.55
6	65.87	18.66	$ 27,010.00	$ 17,871.00	$ 410.00	$ 957.72
7	74.73	8.86	$ 35,920.00	$ 8,915.00	$ 480.70	$ 1,006.21
8	78.48	3.75	$ 39,710.00	$ 3,783.00	$ 505.90	$ 1,008.80
9	82.15	3.67	$ 43,980.00	$ 4,272.00	$ 535.30	$ 1,164.03
10	82.95	0.80	$ 45,960.00	$ 1,981.00	$ 554.00	$ 2,476.25
11	86.72	3.77	$ 59,940.00	$ 13,979.00	$ 691.20	$ 3,707.96
12	88.54	1.82	$ 73,970.00	$ 14,028.00	$ 835.40	$ 7,707.69
13	89.65	1.11	$ 85,450.00	$ 11,487.00	$ 953.20	$ 10,348.65
14	90.00	0.35	$ 90,380.00	$ 4,925.00	$ 1,004.20	$ 14,071.43
15	90.03	0.03	$ 120,740.00	$ 30,365.00	$ 1,341.10	$ 1,012,167.00

Figure 5 - Incremental Cost per Output versus AAHU



RECOMMENDED RESTORATION ALTERNATIVE*

The recommended restoration alternative was designed to enhance and restore existing wildlife habitat through a combination of measures directed at both aquatic and terrestrial habitat types. The study team determined that **Alternative 11**, as identified above, should be the National Ecosystem Restoration (NER), or recommended plan alternative based on the AAHU gained per annualized unit cost. In addition, Alternative 11 was the most cost effective plan that met all the study objectives as outlined in the Plan Formulation section above. Alternative 11 increases the AAHU's from 56.87 to 86.72, resulting in a gain of approximately 30 AAHU's. Of even greater importance is the fact that Alternative 11 would create a continuous riparian corridor extending the length of the study area. This continuous corridor would provide passage from San Pedro Avenue to below Olmos Dam for species such as migrating neo-tropical birds as well as other terrestrial species within the area. Birds, in particular neo-tropical migrants, utilize these areas as stop over points during long migrations to either nesting areas to the north or wintering areas in Central and South America. Riparian corridors connect other habitats and provide a food source and resting area for these species. Riparian forests provide havens for a multitude of insects that migratory songbirds rely on during migration. Since these habitats are diminishing and were not very common to start with in this part of the country, they are very significant to the survival of numerous birds (USFWS Letter, 2004). In addition, the corridor would provide much needed shade to Olmos Creek and the vegetation would help to prevent erosion. A detailed description of the recommended alternative is located below. Diagrams of specific measures are included in **Appendix D.**

Area One
The recommended alternative proposes the restoration of the riparian corridor between San Pedro and McCullough Avenues in Area One. Total riparian corridor restoration would be approximately 18.53 acres and in-stream restoration would be approximately 0.93 acres. The riparian corridor width would range between 50 and 300 ft. from the stream bank on both sides of Olmos Creek.

Riparian corridor restoration would involve the removal of invasive johnsongrass and giant ragweed. This would be accomplished through two glyphosate herbicide applications (wicking). In addition, debris and trash would be removed so that proper equipment could be used for plantings. The area would then be planted with a native grass mix at a rate of 8 lbs. / acre. Grass species such as little bluestem *(Schizachyrium scoparium)*, big bluestem *(Andropogon gerardii)*, Indiangrass *(Sorghastrum nutans)*, Canada wildrye *(Elymus canadensis)*, switchgrass *(Panicum virgatum)*, and blue grama *(Bouteloua gracilis)* are examples that could be included in the mix. Reforestation with hard and soft mast trees would follow at a rate of 100 seedlings / acre. Examples of tree species that could be planted in areas that are more frequently inundated by the creek (within 0 – 15 ft. of the stream bank) include black willow, bald cypress *(Taxodium distichum)*, pecan *(Carya illinoensis)*, American sycamore *(Platanus occidentalis)*, and eastern cottonwood *(Populus deltoides)*. In those areas that are less frequently flooded (within 15 – 300 ft. of the stream bank) species such as escarpment live oak *(Quercus fusiformis)*, bur oak *(Quercus macrocarpa)*, pecan, and Texas persimmon *(Diospyros texana)* could be planted.

In-stream restoration in Area One involves reduction in erosion at the point where the concrete-lined storm channel enters Olmos Creek. Erosion control would be accomplished with the use of live black willow stakes planted at a rate of three stakes per four square ft. Approximately 3,000 square ft. would need to be planted.

Area Two
The recommended alternative proposes the restoration of the riparian corridor and in-stream restoration within Area Two (Olmos Municipal Golf Course). Total riparian corridor restoration would be approximately 6.5 acres and in-stream restoration would be approximately 2.1 acres. The riparian corridor width would extend 50 ft. from the stream bank on both sides of Olmos Creek. The amount of riparian corridor restoration is limited in this area due to the constraints associated with being located within the golf course. Riparian corridor plantings would not be located in fairway areas.

Riparian corridor restoration would involve the planting of a native grass mix at a rate of 8 lbs. / acre. Grass species such as little bluestem, big bluestem, Indiangrass, Canada wildrye, switchgrass, and blue grama are examples that could be included in the mix. Reforestation with hard and soft mast trees would follow at a rate of 100 seedlings / acre. Examples of tree species that could be planted in this area include black willow, bald cypress, pecan, American sycamore, and eastern cottonwood.

In-stream restoration in Area would involve reduction in erosion at the multiple golf cart path bridges that cross the creek in this reach. Erosion control would be accomplished with the use of 12-24" rip-rap accompanied by live black willow stakes planted at a rate of three stakes per four square ft. Approximately 288 cubic yards of rip-rap along with 2,200 square ft. of live black willow stakes would be needed for bank stabilization near the cart path bridges.

Area Three
The recommended alternative proposes the restoration of the riparian corridor between Basse Road and the second crossing of Devine Road in Area Three. Total riparian corridor restoration would be approximately 6.91 acres. The corridor width would extend 50 ft. from the stream bank on both sides of Olmos Creek.

Riparian corridor restoration within Area Three can be divided into two separate sections. The first section extends 50 ft. in width from the bank on both sides of the creek between Basse Road and the first crossing of Devine Road and includes 50 ft. on the south side of Olmos Creek between the first and second crossings of Devine Road. Restoration in this section would include removal of invasive and non-native plant species such as *Ligustrum spp.,* Chinaberry, and Chinese tallow tree. This would be accomplished by utilizing a cut-stump method and applying an herbicide such as picloram. Approximately 0.5 acres of thick tree canopy (mainly hackberry *(Celtis laevigata)* and cedar elm *(Ulmus crassifolia)*) would also need to be selectively thinned within this reach so that plantings of hard mast producing trees could occur. Plantings with hard mast trees (approx. one acre) would follow at a rate of 65 – 1" caliper trees / acre. Examples of tree species that could be planted in this area include native pecan, black walnut *(Juglans nigra)*, escarpment live oak, and bur oak. In addition, existing debris and trash would be removed so that proper equipment could be used for plantings.

The second riparian corridor section extends 50 ft. in width from the stream bank on the north side of Olmos Creek between the first and second crossings of Devine Road and contains approximately 2.73 acres. This section is contained entirely within the Olmos Basin Park, where the riparian corridor can be described as parkland with large hard mast trees that are widely spaced and a groundcover consisting primarily of Bermuda grass. Restoration in this section would require an initial application of a glyphosate herbicide to control the Bermuda grass. Following the herbicide application, the area would be planted with a native grass mix containing species such as little bluestem, big bluestem, Indiangrass, Canada wildrye, switchgrass, and blue grama at a planting rate of 8 lbs. / acre. In addition, one-gallon size shrub species such as coralberry *(Symphoricarpos orbiculatus)*, possumhaw *(Ilex decidua)*, yaupon *(Ilex vomitoria)*, and American beautyberry *(Callicarpa americana)* would be planted at 20 shrubs / acre.

Area Four

The recommended alternative proposes the restoration of the riparian corridor between the second crossing of Devine Road and Olmos Dam in Area Four. Total riparian corridor restoration would be approximately 37.47 acres. The riparian corridor would range from 50 to 300 ft. in width from the stream bank according to adjacent land practices within this area.

Riparian corridor restoration in Area Four would include removal of invasive and non-native plant species such as *Ligustrum spp.,* Chinaberry, and Chinese tallow tree. This would be accomplished by utilizing a cut-stump method and application of an herbicide such as picloram. Selective thinning of approximately 1.0 acre (mainly hackberry and cedar elm trees) would also be needed to "open" the thick tree canopy so that plantings of hard mast producing trees could occur within this reach. Plantings with hard mast trees (approx. 4.91 acres) would follow at a rate of 65 – 1" caliper trees / acre. Examples of tree species that could be planted in this area include native pecan, black walnut, escarpment live oak, and bur oak. In addition, existing debris would be removed so that proper equipment could be used for plantings.

Area Five

The recommended alternative proposes that Area Five, located west of Hwy. 281 and south of Basse Road, be restored to a native riparian grassland habitat. The restoration of native riparian grassland would occur on approximately 17.62 acres.

Native riparian grassland restoration would involve the removal of invasive johnsongrass and giant ragweed. This would be accomplished through two glyphosate herbicide applications (wicking). The area would then be planted with a native grass mix at a rate of 8 lbs. / acre. Grass species such as little bluestem, big bluestem, Indiangrass, Canada wildrye, switchgrass, and blue grama are examples that could be included in the mix.

Importance of Project Outputs

The recommended alternative was designed with the specific intent of improving and restoring wildlife habitat. Approximately 58 average annual habitat units would be gained in comparison to the "no action" alternative, which considered natural succession, and future land uses (**Table 8**).

Table 8 – Future With and Future Without Project Average Annual Habitat Units

Habitat Types	Future W/O AAHU's	Future With AAHU's	Difference Between With and W/O
Riparian Woodland (Area 1)	4.46	13.32	8.86
Aquatics (Area 1)	0.31	5.22	4.91
Riparian Woodland (Area 2)	0.00	3.91	3.91
Aquatics (Area 2)	0.71	4.38	3.67
Riparian Woodland (Area 3)	4.88	9.45	4.57
Aquatics (Area 3)	0.82	0.82	0.00
Riparian Woodland (Area 4)	11.65	34.06	22.41
Riparian Grassland (Area 5)	5.73	15.56	9.83
Total:	**28.56**	**86.72**	**58.16**

The project as proposed would result in the restoration of approximately 73 acres of riparian / bottomland hardwood habitat with mast producing trees, shrubs, and grass species. The bottomland hardwood ecosystem in Texas prior to European settlement once extended over 6.5 million hectares; it is estimated that less than 40% of this original extent still remains (Frye, 1986), with only a few small and isolated patches of old growth scattered amongst the floodplains of the eastern third of the state. Losses of intact bottomland hardwoods in the past 50 years have at times been greater than 120,000 ha per year (Barry and Knoll, 1999). Bottomland hardwoods extend west of Bexar County Texas and are the most western extent of this habitat in the continental United States (Mitsch and Gosselink, 1993), making them a significant natural resource to restore. The decreased fragmentation of the riparian habitat would also provide better corridors for wildlife migration, primarily for fall and spring migrants such as neotropical songbirds. Neo-tropical migrants utilize these areas as stop over points during long migrations to either nesting areas to the north or wintering areas in Central and South America. Since these habitats are diminishing, and were not very common to start with in this part of the country, they are very significant to the survival of numerous birds (USFWS Letter, 2004).

The proposed restoration in Area 5 would result in the restoration of approximately 17 acres of riparian grassland habitat. Native grassland has probably been degraded more than any other habitat type in Texas. The U.S. Biological Service claims a 99% loss of native grassland habitat due to introduced grasses, over-grazing, urban development, and lack of fire (Noss et al., 1995), making this habitat a very significant natural resource to restore. The elimination of abundant lower quality vegetation such as johnsongrass and giant ragweed would allow for native grasses and forbs to become established, promoting optimum habitat conditions. In addition, the native grassland would also serve to diversify the habitat types located within Olmos Basin that in turn would increase wildlife diversity and improve aquatic habitat conditions.

The recommended alternative was also intended to improve the aquatic habitat of Olmos Creek. By implementing erosion control measures in Areas One and Two, erosion and subsequent deposition of

sediment downstream would be reduced. This would help to maintain and restore natural substrate conditions for approximately 5.8 acres within Olmos Creek. Turbidity and temperature are two water quality parameters that could be reduced following implementation of riparian corridor and in-stream habitat restoration measures. As the restored riparian corridor matures, several benefits to in-stream habitat would likely occur: 1) increased stream shading would help moderate high stream temperatures, 2) inputs of large woody debris would gradually increase and help capture sediments, increase stream bottom heterogeneity, and provide habitat for aquatic organisms, and 3) bank stabilization efforts would reduce erosion, water turbidity and subsequent sedimentation, which would improve water clarity in Olmos Creek. Aquatic organisms like macroinvertebrates and fish are known to be excellent indicators of water quality (Barbour et al., 1999, Curry and Hall, 2003, and Karr, 1981). Improvement in water quality should ultimately increase species diversity with Olmos Creek by providing more suitable habitat conditions for a wider variety of intolerant aquatic organisms.

Implementation of the ecosystem restoration project would also provide a variety of benefits to the participating stakeholder. In urban areas, opportunities to enjoy the aesthetic values of wooded riparian areas diminish as the urban areas grow. Restoration of Olmos Creek would provide unique opportunities to the non-federal sponsor and general public through environmental education, wildlife viewing and photography, and open space enjoyment. Property located adjacent to the restored property would also likely increase in value with the proposed restoration project.

Project Costs of the Recommended Alternative

Table 9 displays a summary of the construction costs for the recommended restoration alternative. **Table 10** displays the estimated total project costs, comprised of all expenditures related to the PDR / EA, land acquisition, and construction. The total project cost of the recommended alternative using August 2004 prices was estimated at $1,102,559.

Construction costs were updated using the Civil Works Construction Cost Index System (CWCCIS), revised 30 September 2006, EM1110-2-1304. A conversion factor of 1.0909 was calculated from the index values for Fish and Wildlife Facilities for 4th Qtr FY 2004 (Calendar Year July-September 2004) and 1st Qtr. FY 2007 (Calendar Year October-December 2006) as follows 639.89/586.56=1.0909. The total construction cost using updated November 2006 construction prices is $351,396. In addition, the real estate plan was updated to November 2006 prices and the new cost of the real estate is $519,431, which would bring the new project total to $1,162,077.

Table 9 - Summary of Estimated Construction Costs (August 2004 Prices)

Item	Construction Costs
Direct Costs:	
Area One	
- riparian corridor restoration	$28,595
- erosion control (live stakes)	$17,578
Area Two	
- riparian corridor restoration	$18,856
- erosion control (rip-rap / live stakes)	$23,183
Area Three	
- riparian corridor restoration	$20,779
- shrub plantings	$2,927
Area Four	
- riparian corridor restoration	$109,042
Area Five	
- native riparian grassland restoration	$5,246
Sub-total Direct Costs	**$226,206**
Indirect Costs:	
- Access, entry, etc. (7.4%)	$16,739
- Field and Home Office Overhead (24%)	$54,289
- Profit (10.3%)	$23,299
- Bond (0.7%)	$1,583
Total Construction Costs	**$322,116**
Total Construction Costs November 2006 Prices	**$351,396**

Table 10 - Summary of Estimated Project Costs (November 2006 Prices)

Item	Costs
Planning Design Report (includes plans and specs)	$ 289,000
Construction – Ecosystem Restoration	$ 351,396
Lands, Easements, Rights-of-Way, Relocations, Disposal Areas (LERRD)	$ 519,431
Post Project Monitoring and Habitat Assessment	$ 2,250
Total:	**$ 1,162,077**
Long-term Operation and Management (annual)	$ 22,677

ENVIRONMENTAL EFFECTS*

A discussion of the environmental effects of the "no action" and recommended alternative is covered below. The environmental effects, except for habitat improvements, were not utilized in selecting the recommended alternative. As such, a detailed analysis and discussion of the environmental effects for each alternative was not included. However, it was determined that the environmental effects of the other restoration alternatives would be very similar to those of the recommended alternative.

Natural Regions, Geology, and Soils

No Action Alternative

The "no action" alternative would have no significant impacts to natural regions, geology, or soils within the study area.

Recommended Alternative

The recommended alternative would utilize the qualities of existing soils to develop forested and grassland habitats in the Olmos Creek Study Area. The reforestation would be accomplished through commercial forestry techniques, which would minimize soil disturbance. The grassland restoration would result in minor soil disturbance. Disturbance is expected to be minimal since over-seeding would be the method of choice for planting native grasses. Approximately 2,000 square feet of soil would be disturbed within the Olmos Municipal Golf Course adjacent to the golf cart path bridges where slight earth work is expected to occur for placement of rip-rap and reinforcement with live willow stakes. Best management practices (BMP's) would be implemented to prevent the pollution of storm water into adjacent aquatic resources during project construction activities. A number of BMP's for erosion and sedimentation control could be implemented for the project including, but not limited to: 1) temporary seeding of disturbed areas, 2) seeding or hydromulching on erosion susceptible slopes, 3) establishing temporary sediment barriers consisting of a row of entrenched and anchored straw bales, and 4) construction of entrenched and staked filter fabric silt fences. It is anticipated that implementation of the proposed project would not have impacts to soils.

Hydrology

No Action Alternative

The "no action" alternative would have no significant impacts to the hydrology within the study area.

Recommended Alternative

Hydrologic Impacts of Proposed Project - The currently proposed Section 206 project would not significantly alter flooding conditions either upstream, downstream, or within the project reach. This is due to the fact that: 1) the proposal involves simply the enhancement of wildlife habitat via application of additional grass, shrub, and tree plantings; and 2) the project site is situated within the flood pooling area of the Olmos Reservoir. Impacts should be generally limited to low flow (i.e. non-flooding) conditions, where the enhanced vegetation would serve to buffer the existing channel bottom and banks from potential scour.

Waters of the United States

No Action Alternative

Under the "no action" alternative, it is anticipated that areas within Olmos Creek would continue to erode and sedimentation increase over time. However, the "no action" alternative would have no significant impacts to the hydrology within the study area.

Recommended Alternative

The recommended erosion control measures within the Olmos Municipal Golf Course could result in minor modifications to existing waters of the United States, including wetlands, as regulated by Section 404 of the Clean Water Act. Modifications include minimal fill in waters of the United States during landscape leveling and grading activities for placement of rip-rap reinforced with live stakes. Some of these areas are located at or below the normal high water mark. The proposed project appears to meet the criteria for Nationwide Permit (NWP) 13 - *Bank Stabilization*, which authorizes activities in waters of the United States associated with stabilization of stream banks. No channelization would be required during project construction. The TCEQ has issued a Section 401 water quality certificate for all NWP's and no further coordination is required if NWP 13 is used and certain BMP's are implemented.

Surface Water

No Action Alternative

The "no action" alternative would have no significant impacts to the surface water within the study area.

Recommended Alternative

The recommended expansion of the riparian corridor would help diffuse surface water runoff and filter pollutants from local stormwater runoff, thereby improving the aquatic system in terms of water quality in Olmos Creek over the life of the project. No negative effects to surface water are anticipated with the implementation of the recommended alternative.

Fish and Wildlife Habitat

No Action Alternative

Under the no action alternative, the fish and wildlife habitat within the study area is expected to continue to degrade over time. This expected degradation was attributed to continued urban growth and development in the region. However, the "no action" alternative would have no significant impacts to the fish and wildlife habitat within the study area.

Recommended Alternative
Although temporary impacts to vegetation would be expected during project construction, the contribution to the vegetative community in terms of increased species and structural diversity would be significant over the life of the project. Increased vegetative diversity correlates to increased spatial heterogeneity, which increases the ability of a habitat type to accommodate the life requirements (e.g. food and cover) of a wider range of wildlife species. Temporary disturbance and displacement of resident wildlife would be expected during project construction; however, it is anticipated that wildlife would move back into the area once construction is complete.

Endangered or Threatened Species
No Action Alternative
The "no action" alternative would have no significant impacts to endangered or threatened species within the study area.

Recommended Alternative
The recommended alternative has been reviewed by the USFWS and it has been determined that the recommended alternative would not adversely affect state or federally-listed threatened or endangered species. A copy of the USFWS correspondence is attached in **Appendix A**.

Recreational, Scenic, and Aesthetic Resources
No Action Alternative
The "no action" alternative would have no significant impacts to recreational, scenic, or aesthetic resources within the study area.

Recommended Alternative
The recommended alternative would have no adverse impacts on the recreational, scenic, and aesthetic resources in the area; rather, it is anticipated that over the life of the project, the proposed project features would have positive long-term effects. Impacts to scenic resources would be minimal during project construction and would be temporary in nature. Of the proposed restoration plantings, the grasses, trees, and shrubs would become relatively quickly established and attractive to view. Eventually, seedling plantings would mature enough to provide additional aesthetic value to the study area. It is anticipated that the proposed riparian grassland would become quickly established and functional, thereby providing additional scenic and aesthetic qualities to the area.

Cultural Resources
No Action Alternative
The "no action" alternative would have no significant impacts to cultural resources within the study area.

Recommended Alternative
The archaeological records investigation concluded that activities for the proposed riparian corridor and grassland restoration activities have the potential to affect previously recorded cultural resources, as well as resources not yet identified. The Texas Historical Commission (THC) has been notified of the proposed project and has agreed that a cultural resources survey is necessary before ground disturbing activities begin. A copy of the correspondence to the THC is attached in **Appendix A**. The survey and it's findings will be coordinated with the THC and determinations of effects to Historic Properties, if any, will be made in concurrence with the Commission. All National Register of Historic Places eligible properties will be mitigated in consultation with the THC prior to construction of the proposed project. If, after the cultural resources investigations are completed, construction unexpectedly uncovers cultural deposits, work would cease immediately in the area and the USACE, Fort Worth District and the THC would be notified of the discovery without delay.

Hazardous Materials

No Action Alternative

The "no action" alternative would have no significant impacts to hazardous materials within the study area.

Recommended Alternative

The results of the hazardous materials review indicate that it is unlikely that any of the recognized environmental conditions would pose an HTRW threat to the project. However, if excavation is considered at any of the sites of concern, environmental conditions may exist that could pose a problem. It would then be necessary to, at a minimum, conduct an HTRW site survey to determine if feasible pathways exist between the recognized environmental conditions and places of planned excavation. Additionally, soil and water sampling may be needed.

Floodplains

No Action Alternative

The "no action" alternative would have no significant impacts to floodplains within the study area.

Recommended Alternative

Executive Order 11988 has an objective to avoid, to the extent possible, long and short-term adverse impacts associated with occupancy and modification of the base floodplain. Further objectives are the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative and protection and restoration of natural floodplain functions. U.S. Army Corps of Engineers regulations for implementing EO 11988 (ER 1165-2-26) defines the base floodplain as the one percent chance, or 100-year floodplain.

The recommended alternative would have no long or short term adverse impacts associated with occupancy or modification of the base floodplain. Further, the recommended alternative does not support, directly or indirectly, development in the base floodplain. However, the recommended alternative does act to protect and restore the function of the natural floodplain.

Air Quality

No Action Alternative

The "no action" alternative would have no significant impacts to air quality within the study area.

Recommended Alternative

It is anticipated that the recommended alternative would have no significant impacts to air quality within the study area. Minor impacts, such as suspension of dust particles during construction may occur, but are expected to be minor and temporary in nature.

CUMULATIVE EFFECTS

In 1997, the Council on Environmental Quality (CEQ) developed a handbook that contained guidelines for addressing cumulative impacts in analyses prepared under the National Environmental Policy Act. The assessment of cumulative impacts is addressed in NEPA by its reference to interrelations of all components of the natural environment. The CEQ defined cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. The term "reasonably foreseeable" implies that the project may only have a general public knowledge or acceptance at a point in time and that details of design and project specific

impacts are yet to be developed or disclosed by the project proponent. This cumulative impacts analysis uses the level of information available at the time this PDR/EA report was prepared to describe these other projects and their respective potential impacts on the environment.

Numerous flood damage reduction, channelization, transportation, and recreation projects, along with general urbanization of the area has resulted in significant alterations to the historical condition of the San Antonio River Basin and within the Olmos Creek vicinity. Historical information related to the impacts of these past projects is unavailable and unattainable. Therefore, this cumulative impacts analysis considered the existing conditions to be a result of the past and present projects that have occurred in the study area and serves as a baseline to address impacts of the reasonably foreseeable projects.

Identification of Reasonably Foreseeable Projects

To assess the cumulative impacts on the resources within the Olmos Creek study area, the reasonably foreseeable projects of others that could, in concert with the Recommended Plan described above, contribute to cumulative impacts were identified. Several methods were used to identify these projects including informal verbal requests, literature reviews, and Internet searches from agencies and organizations that have information on proposed activities that could occur in the study area. Below is a list of those identified projects along with a brief description.

San Antonio Channel Improvement Project (SACIP) Mission Reach Ecosystem Restoration and Recreation, San Antonio River, San Antonio, Texas. In the late 1950s, construction of the SACIP began with the sole purpose of flood damage reduction. Section 335 of the Water Resources Development Act of 2000 provided authorization for the U.S. Army Corps of Engineers (USACE) to investigate opportunities to include ecosystem restoration and recreation as project purposes for the SACIP. In 2001, the San Antonio River Authority (SARA), serving as the local sponsor, partnered with the USACE to conduct a feasibility study. The investigations and recommended plan resulting from this study are documented in the *San Antonio River, San Antonio, Texas, Channel Improvement Project Ecosystem Restoration and Recreation General Reevaluation Report and Integrated Environmental Assessment*, dated February 2004.

The Mission Reach extends approximately from the Lone Star Boulevard Bridge (just downstream of the San Antonio River tunnel outlet) to approximately 3,800 feet downstream of Interstate Highway 410 in the southern part of Bexar County; a distance of approximately 8 miles.

A recommended plan was identified which provides aquatic and riparian restoration features to approximately 434 acres of the San Antonio River and associated riparian corridor while maintaining the existing level of flood protection provided by the SACIP. Restoration measures identified include a series of pools, riffles, and chutes, restored river remnants, embayments, tributary mouths, wetland and riparian vegetation. These restoration features are to be restored and sustained by: a pilot channel; a series of riffle structures; weirs; modification to the existing San Juan Dam; utility, storm water outfall, road sidewalk, and parking lot relocations; bridge modifications; channel invert erosion protection; channel slope and over-bank erosion projection; and planting native riparian vegetation. The project will includes recreation features such as a multi-use concrete trail, shade shelters, day use facilities, lighting and directional and interpretive signage.

The project is currently in the Pre-construction, engineering, and design (PED) phase. Construction of the first components is anticipated to begin in late 2007, and all construction is expected to be complete by the end of 2011.

Eagleland Habitat Restoration, San Antonio, Texas - Section 1135 of the Water Resources Development Act of 1986, as amended. The Eagleland Habitat Restoration Project is located within

San Antonio, Texas along the channelized portion of the San Antonio Channel Improvement Project from the Alamo Street Dam downstream to Lone Star Boulevard Bridge at the San Antonio River Tunnel Outlet. Clearing of the floodway and channel realignment destroyed the vast majority of the high quality riparian habitat. The project will restore a three-quarter mile section of the San Antonio River, and will relocate the existing base flow channel to meander primarily along the outside of existing bends. The inside slopes will be lowered and softened where adequate area is available within the larger flood control channel. Native species of grasses and trees will be planted along the channel side slopes, the top of bank, and within the flood control channel to the extent practicable. As flood capacity permits, trees will be brought down toward the river's edge along the outside meander bends to enhance riparian habitat development. A rock riffle structure will be constructed in the base flow channel to create a riffle-pool complex. In addition, tributary and stormwater outfall structures and weirs will be 'naturalized' through the use of native stone and wetland plantings. The project has an estimated total project cost of about $1.8 million. A construction contract was awarded in September 2003, and construction initiated in January 2004.

San Antonio Channel Improvement Project, PL 84-99 Project Information Report (February 2003). During late June and early July 2003, the watersheds of the headwater tributaries of the San Antonio River, including Olmos Creek and San Pedro Creek, were at the epicenter of severe thunderstorms. The San Antonio River Authority (SARA) requested assistance repairing four sites within the San Antonio Channel Improvement Project, and an additional 26 sites on behalf of the City of San Antonio, damaged by erosion and bank failure. Three of the four sites (SARA) and six of the 26 (city of San Antonio) fall within the Mission Reach for the ongoing GRR, and therefore were not included in the report and repair recommendation. The damaged areas are located along Alazan, Martinez, Apache, and San Pedro Creeks, and the San Antonio River. Rebuilding the channel slopes with compacted fill and reestablishing turf was selected as the recommended plan. The total annual benefits for the entire project are estimated at $7,100,000. The first cost to repair all the sites was estimated at $2,203,500, having a total annual cost of $190,200. The benefit-cost ratios of the tributaries and river range from 15.0 to 114.0, hence all are economically justified. The report recommended the repairs be approved for implementation. Construction began in March 2004 and is expected to be complete in February 2006.

San Antonio River, Federal Emergency Management Agency (FEMA), Limited Map Maintenance Program. The work involves hydrologic and hydraulic analysis of the San Antonio River, from approximately 4000 feet upstream of Hildebrand Avenue to downstream of IH 410, and San Pedro Creek from the upstream end at Myrtle Street downstream to it's confluence with the San Antonio River. The analysis incorporates the San Antonio River Tunnel and the San Pedro Creek Tunnel projects. Digital mapping for the 100-year and 500-year floodplain boundaries will be developed and incorporated as Flood Insurance Rate Maps. A Technical Notebook, documenting the technical aspects of the analysis will also be completed. The analyses began in February 2001, and are a joint effort between the Fort Worth District, the city of San Antonio, the San Antonio River Authority, and their contractors. Mapping for this program was completed in 2004 and is currently being reviewed by FEMA.

Guadalupe and San Antonio River Basins, Cibolo Creek Interim Feasibility Study. Alternating cycles of drought and flooding combined with population growth within the Guadalupe and San Antonio River basin have resulted in loss of life, extensive property damage, and severely degraded ecosystems. Recent flood events within the region accounted for at least 31 deaths, and caused damages estimated to be $300 million. Land use changes, drought and urbanization has impaired surface and ground water resulting in degraded ecosystems. Preliminary data show high potential for restoration of ecosystems dependent on the Edward's Aquifer and significant flood damage reduction

potential along the Cibolo Creek in the communities of Shertz and Selma. A feasibility study was initiated in 2002; the completion date is expected during 2008.

Guadalupe and San Antonio River Basins, Salado Creek Interim Feasibility Study, and Leon Creek Interim Feasibility Study. During a flooding event in 1998, an estimated 17 inches of rainfall was recorded within a 30-hour period. The devastation from that flood event resulted in 25 deaths, and 1,150 homes or businesses damaged or destroyed in the city of San Antonio, with significant damage occurring along the Leon Creek Watershed. Flood damages were estimated at $500 million in the city of San Antonio and the surrounding county area. During a July 2002 flood event, the San Antonio region received an estimated 16 inches of rainfall in six days resulting in 8 deaths, 280 homes damaged, and $8.9 million in estimated infrastructure damage. The study is part of a feasibility study of the Guadalupe and San Antonio River Basins. Urban growth within the watershed has resulted in environmental degradation and increased flooding frequency. The study will investigate the Leon Creek Watershed to address improvements in the interest of flood damage reduction, ecosystem restoration, water quality, water supply, recreation and other allied purposes. The Leon Creek study was initiated in 2004 and has an anticipated completion date in 2009. The Salado Creek study is expected to begin in October of 2005 and has an anticipated completion date of 2011.

Guadalupe and San Antonio River Basins, Lower San Antonio River Basin Interim Feasibility Study. Flooding within various portions of the Guadalupe and San Antonio River basins was severe in 1972 and in 1978, when portions of them were declared disaster areas. Flooding again plagued the area in 1997, with total damages estimated at $1.9 million. In October 1998 a large flood event accounted for at least 31 deaths, and caused damages estimated to be $300 million. Many communities experienced inundation to rooftop levels, with water velocities great enough to completely demolish brick homes. The most recent flood event, in June-July 2002, resulted in 9 deaths in the study area. The study consists of an investigation of the Guadalupe and San Antonio River Basins to address improvements in the interest of flood damage reduction, environmental restoration, water quality, water supply, recreation and other allied purposes. Both structural and nonstructural solutions will be investigated to reduce flood damages while addressing the environmental needs of the watershed. Initial studies have identified potential water resource opportunities in the *Cibolo*, *Leon*, and *Salado* watersheds and the region encompassed by the Goliad, Karnes, and Wilson Counties (Lower San Antonio River Basin). The overall feasibility study completion date is to be determined.

San Antonio Channel Improvement Project, Alamo Heights, Reconnaissance Study, and Woodlawn, Reconnaissance Study. During a July 2002 flood event, the San Antonio region received an estimated 16 inches of rainfall in six days resulting in 8 deaths, 280 homes damaged, and $8.9 million in estimated infrastructure damage. 905(b) Reconnaissance Reports to determine if there is a Federal interest have been completed and approved for both studies. Currently, Project Management Plans (PMP) and Feasibility Cost Sharing Agreements (FCSA) are being negotiated with the local sponsors.

Texas Department of Transportation Project, IH 410 and U. S. Highway 281 Intersection Roadway and Drainage Modifications. The Texas Department of Transportation (TxDOT) has proposed to upgrade and construct additional lanes along portions of IH 410 and US Highway 281 to upgrade the intersection to an interchange. As a result of the proposed road improvements, TxDOT proposes to construct modifications to 7,760 linear feet of existing concrete lined stream channel as described below (a general nationwide permit 14 was issued in December 2004):

- Expand 2,000 linear feet of 12-foot wide concrete pilot stream channel with herbaceous vegetated riparian corridor to a 90-foot wide concrete trapezoidal stream channel;

- Expand 3,650 linear feet of 12 to 60 foot wide concrete trapezoidal stream channel to a 70-foot wide concrete trapezoidal stream channel;

- Expand the existing box culverts under US Highway 281 by 40 feet;

- Replace the existing 240 foot long, 5.5 foot tall x 45 foot wide, concrete box culvert under IH 410 with one 240 foot long, 10 foot x 10 foot, concrete box culvert and two 240 foot long, 10 foot x 9 foot, concrete box culverts;

- Expand 1,630 linear feet of 25 foot wide concrete lined trapezoidal stream channel up to a maximum width of 40 feet wide and up to 8.3 feet deeper;

- Relocate an existing sanitary sewer pipeline and a potable water drinking pipeline;

- Expand three existing 240 foot long, 8 foot x 4 foot, concrete box culverts that convey drainage to the US Highway 281 drainage channel by adding two 240 foot long, 9 foot x 4 foot, concrete box culverts; and

- Expand five existing 390 foot long, 8 foot x 6 foot, concrete box culverts that convey drainage parallel to US Highway 281 by adding one 390 foot long, 6 foot x 6 foot, concrete box culvert and associate concrete riprap.

Olmos Basin Park Rehabilitation and Trail System Development. Specific details concerning exact locations, lengths, and quantities of recreational development within Olmos Basin Park have not been finalized at this time. However, based on information obtained from City of San Antonio personnel, this development could include, but is not limited to, new trails with trailheads, connections with existing park facilities, restroom renovations, and parking improvements.

Cumulative Assessment

To address cumulative impacts of the "no action" and recommended alternative in conjunction with multiple reasonably foreseeable projects of others, input from USACE environmental specialists and project managers was utilized. A matrix was developed to indicate the potential cumulative impacts for reasonably foreseeable projects on a series of environmental, social, and community resources. **Table 11** displays an assessment of the magnitude of the potential cumulative impacts in relation to the "no action" and recommended Olmos Creek restoration plan based upon information available at this time. It is important to keep in mind that by definition, a cumulative impact cannot occur unless there are direct or indirect impacts to a resource (discussed in Environmental Effects section) as a result of the proposed Federal project. As such, only those resources likely to experience cumulative impacts are addressed below. As can be seen in Table 11, the cumulative impacts resulting from this project would primarily result in slight to moderate beneficial impacts to Waters of the United States, surface water, fish and wildlife habitat, as well as recreational, scenic, and aesthetic resources. Again, because all alternatives identified above are similar in the fact that they are restoration oriented, it was determined that the cumulative impacts would be very similar to those of the recommended plan. As such, a detailed analysis and discussion of the cumulative impacts for each alternative was not included.

Table 11 - Cumulative Impact Analysis of Olmos Creek Aquatic Ecosystem Restoration Project with Reasonably Foreseeable Projects of Others for Environmental Resources within the Olmos Creek Study Area.

Environmental and Economic Resources Impacted	No Action Alternative	Olmos Creek Aquatic Ecosystem Restoration	Reasonably Foreseeable Projects of Others	Cumulative Impacts
Waters of the United States	□	□	□	□
Surface Water	○	□	□	□
Fish and Wildlife Habitat	□	□□	□	□□
Recreational, Scenic, and Aesthetic Resources	○	□	□□	□□

Legend: ○ No Effect □ Slight Adverse □□ Moderate Adverse □□□ Significant Adverse
□ Slight Beneficial □□ Moderate Beneficial □□□ Significant Beneficial

PROJECT IMPLEMENTATION

Project Management Plan

The Project Management Plan (PMP) describes the activities to be taken and followed during project implementation, including plans and specifications, project construction, and maintenance and monitoring. The plans and specifications shall include a planting design for the recommended planting plan to ensure that prescribed tree, shrub, and grass species are planted in appropriate locations with appropriate distribution to optimize survivability and future habitat values. In addition, the plans and specifications shall include a design for the erosion control measures (riprap and live willow staking) to ensure sustainability and effectiveness. The plans and specifications would enable preparation of a firm cost estimate for the project. **Table 12** displays the approximate costs for the plans and specifications phase. The cost of the plans and specifications phase is part of the overall study cost and would be shared jointly by the Federal and non-Federal sponsor.

Table 12 - Estimated Cost for Plans and Specifications
(November 2006 Costs)

Plans and Specifications Items	Cost in Dollars
Field Survey Erosion Control Locations	$15,000
Construction of Erosion Control Structures	$15,000
Field Surveys for Selective Thinning / Invasive Removal	$25,000
Removal of Trees	$12,500
Restoration Plantings	$20,000
Plan Layout/Cost Estimates	$5,000
Environmental Review, Coordination, and Compliance	$10,000
Real Estate Coordination	$5,000
Project Management	$12,500
Contingency (20%)	$24,000
Total:	**$144,000**

After award of a construction contract, the Federal government would oversee the construction of the restoration and recreation components of the recommended alternative. A warranty period for the actual construction items, including restoration plantings, would be determined before final acceptance of the project by the construction contractor. A monitoring and adaptive management plan would be included as part of the construction contract to monitor constructed areas and plantings and to determine any remedial actions such as vegetation replacement due to mortality. Remedial actions identified during the construction monitoring and adaptive management period would be funded as part of the total project cost, and cost shared 65% Federal and 35% non-Federal. **Table 13** outlines the estimated eight-year project implementation schedule from approval of the recommended plan to physical and financial closeout.

Table 13 - Project Implementation Schedule

Components	Date
Approval of PDR/EA	December 2006
Execute PCA	January 2007
Initiate Plans and Specifications	January 2007
95% Plans and Specifications	May 2007
Acquire Real Estate	June 2007
Advertise Construction Contract	July 2007
Initiate Construction	August 2007
Construction Complete	November 2009
Initiate Monitoring	November 2009 – November 2013
Physical and Financial Closeout	January 2014

Post Project Monitoring
Upon satisfying monitoring requirements and close-out of construction, a long-term monitoring plan would be provided to the non-Federal sponsor, which would outline procedures for documentation of restoration measures and the overall progress of the restoration areas. Restoration success is dependent on a number of variables and often is subject to unforeseen or unpredictable obstacles. Therefore, the monitoring plan would prove critical in maintaining the relationship between the management plan and ecosystem response as it would allow for modifications and adjustments to the restoration as necessary and feasible until restored areas become self-sustaining. Well-documented monitoring information would provide a basis for evaluation of the proposed mitigation measures as well as a reference for future restoration plans.

Various types of monitoring and habitat assessment techniques would be utilized to determine the post project success of the restoration effort. At a minimum, the USACE and non-Federal sponsor would monitor and evaluate the success of installed restoration measures such as erosion control structures and vegetation plantings throughout the project life. The USFWS would assist in post project habitat assessments through the use of HEP analysis. It is anticipated that the HEP analysis would occur approximately 5 to 10 years following construction completion. The post project HEP analysis would be compared with pre and post habitat conditions to assess the progress and success of the restoration project. Additional HEP assessments would be used throughout the project life to further evaluate project success and recommend adaptive management techniques to maintain optimal habitat conditions.

The non-Federal sponsor would be responsible for operation and maintenance of post project restoration measures, including vegetation replacements as well as erosion control structure repairs and management throughout the project life. The Operation, Management, Repair, Rehabilitation, and Replacement (OMRRR) Manual would be provided to the non-Federal sponsor and include consideration of periodic inspections, habitat assessments, and management recommendations for restoration measures.

Project Cooperation Agreement
The Project Cooperation Agreement (PCA) is a contract between the Federal Government and the non-Federal sponsor describing the rights and responsibilities of each party during project implementation, including cost sharing. The PCA would be executed after the receipt of Federal project approval and prior to advertisement of a construction contract. **Appendix F** provides a draft copy of the cooperation agreement.

Cost Apportionment
As described in the PCA, the total project cost would be shared between the Federal Government and the non-Federal sponsor on a 65% and 35% proportion, respectively. The non-Federal sponsor's 35% of the project total cost share is comprised of a credit for the value of all LERRD's, and credit for the value of any work-in-kind (WIK) services performed. In the event the value of the LERRD or WIK is less than 35%, the non-Federal partner would contribute the remaining value in cash. Credit for WIK can total 100% of the total non-Federal partner contribution but cannot result in a reimbursement. Further, with regard to WIK, the non-Federal partner would comply with applicable Federal and state laws and regulations, including the requirement to secure competitive bids for all work to be performed by contract. Contributions of cash, funds, materials, or services from other than the non-Federal partner or their contractor(s) may be accepted; however, such contributions would not be credited to the non-Federal partner share. These contributions would be applied to the entire total project cost and therefore reduce both the Federal and non-Federal share. **Table 14** displays the current estimated cost apportionment.

Table 14- Project Cost Apportionment

Item	Federal	Non-Federal	Total
Restoration Cost	$642,646	$0.0	$642,646
Real Estate		$519,431	$519,431
Adjustment for 65/35	$112,704	- $112,704	
Total Cost	$775,350	$406,727	$1,162,077
Cost Apportionment in Percent	65.0%	35.0%	100.0%

Real Estate Plan

The majority of the study area (approximately 96 acres) is currently owned in fee by the City of San Antonio. A small portion (approximately 2.5 acres) of the study area is in private ownership and would require a perpetual easement. This easement would be acquired by the City of Alamo Heights and assigned to the City of San Antonio by Memorandum of Agreement (MOA). Per the draft real estate plan, the total cost of real estate, including contingency is estimated to be $519,431. The total non-Federal Sponsor required contributions are estimated at $406,727 which would require the government to reimburse the City of San Antonio approximately $112,704 if the project were construction within the existing estimated budget. The Real Estate components of the project are fully disclosed in **Appendix E**.

Although it is normally Corps policy to purchase fee interest in lands for construction and operations and maintenance, the proposed easement would provide adequate interest for the proposed activities on the lands located within the City of Alamo Heights. These particular project lands consist of the immediate bank of a watercourse and would be used only for the installation of features that improve habitat for aquatic resources. In addition, these lands are limited to the acreage necessary to construct and operate the ecosystem restoration features. The total acreage needed by easement would be 2.5 out of a total of 98.5 acres. They also do not require public access and are isolated and limited from public access due to the watercourse. The proposed easement language would be approved by the Corps, local sponsor and City of Alamo Heights prior to signature of the Project Cost-sharing Agreement.

Operation and Maintenance

After completion of the monitoring and adaptive management period, the non-Federal sponsor would assume operation and maintenance responsibility for the entire project footprint, which includes sponsor-owned property and flowage easement property. The City of San Antonio is responsible for all long-term project operations, maintenance, repairs, replacements, and rehabilitations following completion of construction. Operations and maintenance costs were estimated at $22,677 per year based on required riparian corridor maintenance, debris removal activities, and repair of bank stabilization measures. The operation and maintenance schedule would vary by season and necessity and should include, but not be limited to the following activities: 1) periodic replanting and pruning of trees and shrubs in reforestation areas to improve stand health; 2) removal of debris from within the restoration areas; 3) annual removal or treatment of invasive and non-native plant species within the restoration area; and 4) monitoring for stability and repair of rip-rap / live willow stake structures located within Area Two when necessary.

The tree, shrub, and herbaceous species recommended for planting were specifically selected because they are native to the region and are expected to grow with minimal maintenance. However, it is anticipated that some maintenance would be required as described above, especially during the first few years after construction, to ensure successful establishment of vegetation plantings.

COORDINATION OF RECOMMENDED ALTERNATIVE

Views of Sponsor
The City of San Antonio has been identified as the non-Federal sponsor. The City of San Antonio has been involved during the development of restoration alternatives and concurs with the recommended restoration alternative. The City of San Antonio intends to participate in the implementation of the recommended alternative. A letter of intent stating the City of San Antonio's position is provided in **Appendix A**.

Results of Agency Coordination
The USFWS participated in the HEP analysis and served as a member of the project delivery team, whose recommendations helped serve as the basis for the restoration measures proposed in the recommended alternative. A final U.S. Fish and Wildlife Coordination Act Report was received on the proposed project. U.S. Fish and Wildlife Coordination Act Compliance letters are located in **Appendix G**.

As noted in the cultural resources section, the Texas State Historic Preservation Officer (SHPO) has reviewed the recommended restoration alternative and has concluded that additional studies would be required before construction could begin. Due to funding constraints a complete cultural resources survey has not been completed, but would be completed prior to any construction activities and would be coordinated with SHPO to gain Section 106 compliance.

Copies of the draft PDR/EA were sent to the following resource agencies as set forth by the National Environmental Policy Act (NEPA): TPWD; USFWS; EPA, Region 6; the THC; and the TCEQ. Only two comments were received. The USFWS supported the proposed project but suggested using white-tailed deer controls during restoration. Further communications with the USFWS indicated this was a suggestion if deer were a problem in the restoration area. All parties agreed that it would not be an issue and USACE would proceed without the control measures. TCEQ sent a standard comment notifying USACE that the local floodplain coordinators have approval authority over the project. The project has been coordinated with those individuals. Copies of all correspondence on the proposed restoration alternative are provided in **Appendix A.**

Regulatory Requirements
The proposed project has been reviewed in accordance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. In addition, Executive Order 11990, Protection of Wetlands and Executive Order 11988, Floodplain Management was considered during development of the proposed project. The Fort Worth District Regulatory Permits personnel have reviewed the proposed project and have determined that NWP 13, Bank Stabilization, would apply. The TCEQ has issued a water quality certification for NWP 13 and no further coordination for Section 401 water quality certification is required.

Due to the nature and intent of the proposed restoration activities, there are no practicable alternatives for conducting the project outside of the Olmos Creek floodplain. However, the proposed project would not impact or significantly alter the existing boundary of the 100-year floodplain in any way. The proposed project is in compliance with Executive Order 11988, Floodplain Management. The proposed project would neither adversely impact nor result in any loss of wetlands, which complies with Executive Order 11990. Based on the findings in the EA, a Finding of No Significant Impact (FONSI) has been prepared for signature by the Fort Worth District Engineer.

CONCLUSIONS

The PDR/EA documents the results of a study conducted under the authority of Section 206 of the Water Resources Development Act of 1996, as amended. The purpose of the study was to develop a recommended alternative for improving the aquatic and terrestrial wildlife habitat within the Olmos Creek Basin, thereby restoring in-stream, bottomland hardwood, and grassland habitat components for resident and migratory wildlife.

The recommended alternative would increase the habitat value of the study area over the life of the project by restoring approximately 73 acres of riparian corridor habitat with native tree, shrub, and grass species. In addition, the recommended alternative would also restore approximately 17 acres of riparian grassland habitat and implement erosion control techniques to reduce deposition of sediment in approximately 6 acres of Olmos Creek. Habitats not subject to direct management techniques would eventually become more valuable to wildlife species due to increased species and structural diversity (e.g. more food and cover). State and federal agencies across the country have made great efforts to protect and restore riparian and aquatic habitats. This project would play a major role in accomplishing these goals and would provide an example and impetus for future restoration projects in Texas and across the nation.

The City of San Antonio has been identified as the non-federal sponsor, and has been presented with the findings of this report. The City of San Antonio has offered their support for the recommended alternative, including the cost-sharing plan, and has agreed to assume responsibilities for all operation, maintenance, replacement, and repair costs.

An EA was integrated into the PDR to assess the potential environmental impacts of implementing the recommended alternative. To meet requirements of the National Environmental Policy Act, a public notice was released to the public on November 18, 2005, initiating a 30-day public review period, of the integrated project report and EA. No public comments were received from the general public and only minor comments were received from state and Federal resource agencies; therefore, a final FONSI was prepared for the proposed action.

RECOMMENDATIONS

I propose that the recommended alternative described in this Planning Design Report be authorized for implementation under the authority of Section 206 of the Water Resources Development Act of 1996, as amended, as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. The initial cost of this project is estimated to be $1,162,077.

Prior to the commencement of construction, local interests must agree to meet the requirements for non-Federal responsibilities as outlined in this report and future legal documents. The City of San Antonio has demonstrated that they have the authority and the financial capability to provide all non-Federal requirements for the implementation, operation, and maintenance of the project. The recommendations contained herein reflect the information available at this time and current Department of the Army policies governing formulation of individual projects. They do not reflect the program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch.

CHRISTOPHER W. MARTIN
Colonel, U.S. Army Corps of Engineers
District Engineer

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