

San Felipe Creek Master Plan

VOLUME I



Prepared for:

**The San Felipe Creek Commissioners
& The City of Del Rio**



and the



Prepared by:



TBPE Registered Firm No.: F-1741



TBPE Registered Firm No.: F-355

September 2012

NEI Project No. 8267/TWDB Contract No. 1004831077

Final Report

TRACT ADMINISTRATION
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EXECUTIVE SUMMARY

INTRODUCTION & BACKGROUND

San Felipe Creek originates approximately six miles northwest of Farm Road 2523 in southeastern Val Verde County and flows towards the southwest for eighteen miles to its mouth on the Rio Grande. The creek flows through the center of the City of Del Rio in Val Verde County, Texas. San Felipe Creek is primarily supplied by water flowing from the San Felipe Springs at a flow rate that typically ranges from 50 – 90 million gallons per day. The creek is the sole source of drinking water for the City of Del Rio and Laughlin Air Force Base. The stream has always been a primary recreation attraction for the citizens of Del Rio.

The drainage basin for San Felipe Creek consists of rural lands as well as highly urbanized areas. The urbanized areas help to exert an influence on the character and quality of water that flows in the creek. A significant presence of invasive species now exists in San Felipe Creek including *Arundo donax* (giant reed) and armored catfish (*Hypostomus plecostomus*).

San Felipe Creek is also home to many unique animal species. Among them are the Devils River Minnow that has been listed as a threatened species by the United States Fish & Wildlife Service (USFWS) since 1999. The San Felipe Gambusia is a recently identified species that is known to reside only in San Felipe Creek and is currently listed as a threatened species by the Texas Park & Wildlife Department (TPWD).

Due to the importance of water quality in San Felipe Creek, both as the sole source of drinking water for the citizens of the area and as the primary habitat of animals in the area, it became apparent to the participants that there was a need for a regional water quality planning study to identify opportunities for protecting water quality throughout the drainage basin.

The boundaries of the project are confined to the drainage basin of San Felipe Creek which is located in Val Verde County. The primary focus of the master plan includes the area of the drainage basin within the City Limits including the area of the San Felipe Country Club golf course and that portion of San Felipe Creek from U.S. Highway 90 downstream to Round Mountain. The boundaries of the Project Area are shown in **Figure 1**. The “Planning Area”

generally covers the portion of the San Felipe Creek drainage basin upstream of Round Mountain. This creates a planning area footprint of over 40 square miles which is shown on **Figure 2**.

PLANNING PROCESS

The project organization is divided amongst two primary sponsors, the City of Del Rio and the Texas Water Development Board (TWDB). The City of Del Rio designated its San Felipe Creek Commission as its primary contact during the planning process. Meetings were held during the course of the project in an effort to inform the Commissioners and the general public on the project findings, to update them on the progress of the planning effort, and to receive feedback from the Commissioners and the general public. A total of five public meetings were held for the project including meetings in October 2010, July 2011, November 2011, February 2012, and June 2012.

PROJECT GOALS & OBJECTIVES

Project Goals

For the San Felipe Creek Master Plan the following goals were identified during the planning process:

- As the sole source of drinking water for the City of Del Rio and Laughlin Air Force Base and the headwaters of San Felipe Creek, protecting the San Felipe Springs from water quality and quantity degradation is of paramount importance;
- Protection of both water quality and quantity is important for the maintenance of habitat for endangered species including the Devils River minnow that inhabit San Felipe Creek;
- Eradication of invasive species that have degraded both the water quality and quantity in San Felipe Creek. Specifically the eradication of the river cane and armored catfish and improving the habitat around Blue Hole;
- Continue to have San Felipe Creek as the centerpiece of Del Rio life; and,
- Provide amenities at or near San Felipe Creek which enhance public use of the Creek while providing water quality protection.

Project Objectives

For the San Felipe Creek Master Plan the following objectives have been identified:

- Adopt design standards that include requirements for Best Management Practices (BMPs) for water quality protection;
- Provide public facilities that encourage users of the creek to protect water quality in the creek;
- Maintain and repair existing facilities and provide recreational amenities that encourage responsible public use of the creek;
- Encourage the use of native vegetation so that riparian habitat is re-established along the creek which will provide significant ecological benefits by filtering pollutants, controlling soil erosion and supplying habitat for vegetation and wildlife;
- Working with the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and the Texas Parks and Wildlife Department to develop a plan for eradication of invasive species in and around the creek and for the cleaning of Blue Hole;
- Assure that open space is for public use and as habitat for plants and wildlife while being maintained to protect adjacent neighborhoods; and,
- Work toward a balance of public access and habitat protection for San Felipe Creek through ordinance enforcement, enhanced maintenance, and public education.

WATER QUALITY ISSUES & BEST MANAGEMENT PRACTICES

Water Quality Issues:

San Felipe Creek is confronted with a number of water quality issues that have the ability to negatively impact the creek and the creek area. The main water quality issues identified during the planning process included:

- **Invasive, Non-Native Species** - San Felipe Creek is currently being impacted by non-native species including *Arundo donax* (a.k.a., Giant Reed or River Cane) and armored catfish (*Hypostomus* sp.);

- **Urbanization** - Urbanization refers to the overall shift or trend of an area from a more rural community to a more developed, or urbanized area; Urbanization results in increased construction activities which remove natural vegetation and can potentially increase erosion and sedimentation;
- **Lack of Riparian Buffer** - Streams and rivers are typically protected by a vegetated bank area containing native grasses, flowers, shrubs and trees, known as the “riparian buffer”; urbanization often results in degradation or reduction in this riparian buffer area; San Felipe Creek, particularly the stream reach between US Highway 90 and Round Mountain, is an example of the impact that urbanization can have on a riparian buffer;
- **Bank Erosion** - Bank erosion is a direct contributor to a decrease in water quality within a stream or river; the erosion of stream banks will add sediment to the water which directly impacts the habitat of a clear, flowing stream by adding suspended solids to the water;
- **Vegetation Management** - While undeveloped land left in its natural state can be an effective measure for maintaining water quality, other activities occurring on undeveloped land can have adverse impacts on water quality; the primary threats from undeveloped land subjected to human activity are excessive erosion/sedimentation from disruption of natural vegetation and excessive nutrients and biological constituents;
- **Stormwater / Non-point Source Pollution** - Stormwater non-point source (NPS) pollution occurs as a result of rainfall events; NPS pollution poses a direct threat to San Felipe Creek as stormwater from the surrounding areas discharge directly into the creek; and,
- **Lack of Water Quality Protection on Existing Development** - Over the years urbanized development within the San Felipe Creek drainage basin has occurred without the benefit of water quality protection measures which can allow the water quality of the creek to be negatively impacted.

Water Quality Best Management Practices (BMPs)

Watershed management and water quality protection measures typically include both “structural” and “non-structural” measures, with these measures typically referred to as “Best

Management Practices” (BMPs). The EPA has adopted the following definitions for structural and non-structural BMPs:

Structural BMPs include engineered and constructed systems that are designed to provide for water quantity and/or water quality control of storm water runoff.

Non-structural BMPs include institutional and pollution-prevention type practices designed to prevent pollutants from entering storm water runoff or reduce the volume of storm water requiring management.

For the San Felipe Creek Master Plan the following BMPs were selected as most appropriate for the project area:

Structural BMPs:

- Vegetation Enhancement
- Bank Stabilization
- Riparian Area Restoration
- Vegetative Filter Strips
- Pervious Pavement
- Biofiltration/Bioretenion
- Hydrodynamic Separators

Non-Structural BMPs:

- Public Education
- Community Involvement
- Land Management/Ordinances
- Litter/Trash Pick Up
- Pet/Animal Waste
- Human Waste Control

PROJECT ALTERNATIVES

As outlined in the Project Goals and Objectives, the ultimate goal of the water quality protection measures presented in the Master Plan is to maintain or enhance the existing water quality and water quantity in San Felipe Creek. To accomplish this objective, the strategy has been to select measures that facilitate a decrease in anticipated pollutant loadings, minimize the potential for discharges into San Felipe Creek, or enhance the habitat in or near the creek. The measure selected include the following:

Control of Invasive Species:

Arundo donax Eradication

Recommendations for the eradication of *Arundo donax* include cutting the cane after flowering, which typically occurs in mid- to late summer, then removing the cut stalks and shredding them into pieces less than one inch in length; after waiting for new growth to occur in the next month, the cane should be sprayed with a combination of Rodeo (3% - 5% solution) and a surfactant; during the winter the dead biomass should be removed; this procedure should continue for several years until the cane is eradicated; the process is labor intensive and will require the commitment of significant financial resources.

Armored Catfish Eradication

The Armored catfish present in San Felipe Creek out compete native species for both food and habitat. Their activities also significantly contribute to the damage of the creek banks which has a negative impact on water quality by increasing the suspended solids in the water. There is currently no known effective eradication method, however, it is recommended that the City actively encourage on-going research and investigations into the control and elimination of this damaging pest.

Projects and Improvements:

The following proposed projects and/or improvements were recommended for the San Felipe Creek Area:

- **Bank Improvements:** includes the demolition, removal, reconstruction of some of the existing bank wall; in other areas it is recommended that the existing walls be removed and a more natural, riparian area established;
- **Creek Side Improvements:** includes new pervious parking surfaces, conversion of existing parking areas to pervious parking surfaces, public restrooms, community gardens, trash cans; pet waste stations;
- **Public Education:** includes the installation of public information kiosks along the creek area;

- **Hike & Bike Trail Improvements:** includes new hike and bike trails along the creek and also the conversion of existing trails from impervious surfaces to pervious surfaces; and,
- **Vegetation Management Areas:** includes the establishment of vegetation management areas along the creek to provide an organized structure for effectively managing the vegetated creek banks and upland areas located near the creek.

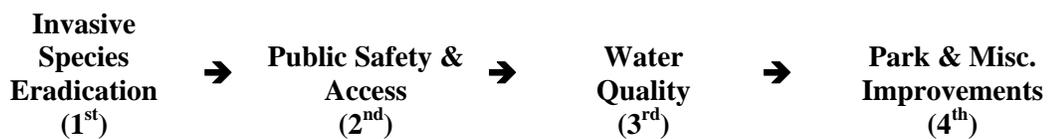
The San Felipe Creek project area was divided into six separate Project Areas A, B, C, D, E, and F as shown on **Figure 19** and the individual project are numbered according to their project area (i.e., A-1, C-12, etc..). Individual project descriptions and cost estimates are included in **Appendix G**.

PROJECT PRIORITIZATION

For prioritization purposes all of the individual projects have been placed in one of these four categories. It is recommended that the overall progression of project development proceed in the general order of: (1) Invasive Species Eradication; (2) Public Safety and Access and Citizen Well-being; (3) Water Quality; and, (4) Park and Miscellaneous Improvements.

PROJECT CATEGORIES

[Order of Preference →]



While it is acknowledged that due to funding levels, budget cycles, available resources, and other considerations, some projects may be moved ahead of other lower-ranked projects, the overall direction of project development should generally follow the project rankings included in this master plan. Priority rankings of the individual projects under the above project categories are included in **Appendix F**.

Project Timelines

The establishment of exact timelines for construction of the individual projects along San Felipe Creek is difficult without also establishing a detailed annual construction budget. The annual construction budget will be dependent on City budgeting priorities and available revenue, federal and State funding opportunities including grant monies, and other opportunities for cost sharing including donations and local volunteer participation. The following Immediate, Short-Term, and Long-Term project categories have been established:

- **Immediate Projects** - includes those projects that are recommended for action as soon as funding can be made available; due to the high importance placed on Invasive Species Eradication by the residents of Del Rio the highest priority projects are limited to the eradication of *Arundo donax* along San Felipe Creek from the Highway 90 bridge to Tardy Dam;
- **Short-Term Projects** - includes those projects that have the potential to positively impact public safety and access along the creek, or will provide a significant impact to water quality within San Felipe Creek; a short-term project is considered to be a project that will be started within five years; based on public surveys, public comments, and on-site inspections of the creek area the projects of most importance from a water quality perspective are cane eradication, bank repair and stabilization projects, and vegetation enhancement projects; and,
- **Long-Term Projects** - includes those projects not previously included as an Immediate project or a Short-Term project; long-term projects will tend to have a marginal benefit to water quality, have a high construction cost, or are projects that replace a currently functional system or improvement (e.g., an existing asphalt parking lot).

PLAN IMPLEMENTATION

Financing Options

It is important to remember that due to the timing of applications and program requirements, it may not be possible to implement the different projects in order of their priority. For example if funding is obtained for trail rehabilitation and trail extensions prior to securing funding for

invasive species eradication it would be advantageous to do the trail work first even though it may have a lower priority. Complete execution of the projects outlined and adopted as part of the Plan will hinge heavily on the understanding of the importance of flexibility in the implementation strategies.

Below are a list of different funding sources and options:

Local Funding: Annual Budgeting Process; Public-Private Partnerships; Foundation Funding.

State and Federal Sources: Texas Water Development Board; Texas Commission on Environmental Quality; Texas Parks and Wildlife Department; Texas Department of Transportation; Texas Department of Agriculture; U.S. Fish and Wildlife Service; U.S. Department of Agriculture; U.S. Department of Commerce; North American Development Bank/Border Environment Cooperation Commission; and the U.S. Environmental Protection Agency.

It is anticipated that there will be a limit to the availability of local resources to fund the proposed projects. The success and completion of the projects outlined in the final Master Plan will ultimately depend on the ability to secure combinations of financing from grants, low interest loans and donation from foundation funds.

Another important factor in the success of the Plan will be the continued fostering of strategic partnerships. The continued cooperation and success of these working relationships will be one of the driving forces behind securing funding for the individual projects.

CONCLUSIONS & RECOMMENDATIONS

Conclusions

San Felipe Creek has been the focal point of residents and visitors to the Del Rio area for thousands of years. The creek itself and the endangered species that live in the creek are particularly vulnerable to activities that occur in and around the creek area. To keep the creek and its surrounding areas healthy and vibrant for use by the creek's animal inhabitants, as well as local residents and visitors an organized effort of creek improvements and site development should be undertaken. By following an organized plan, including the recommendation in this

Master Plan, San Felipe Creek can be protected from harm and this area improved to allow the creek to once again become the focal point of this region of Texas.

Recommendations

The following is a summary of the major recommendations and includes a reference to the appropriate section of the Master Plan that discusses in detail the particular recommendation:

- **Coordinate** any planned improvement projects or other activities with local, State, and federal agencies (3,5,6, 5.3);
- **Elimination of invasive species** including *Arundo donax* (6.1, 9.3.1) and Armored catfish (6.2, 9.3.2);
- **Water quality best management practices (BMPs)** including structural BMPs (4.7.1, 9.4.1) and non-structural BMPs (4.7.2, 9.4.2);
- The following **Improvement Projects** should be pursued including Bank Improvements (9.5), Creek Side Improvements (9.6), Hike & Bike Trail Improvements (9.7), Infrastructure improvements (9.10), public education opportunities (9.9), and Land Management Strategies (9.10);
- **Project prioritization** which in general should follow the general order of: (1) Invasive Species Eradication; (2) Public Safety and Public Access improvements; (3) Water Quality improvements; and, (4) Park and Miscellaneous improvements; the developed individual project priority rankings should be used as a guide to determine the projects of highest-priority (10.2, 10.3);
- **Project time-frames** have been outlined as Immediate, Short-Term, and Long-Term; the timing of projects will most likely be determined by project funding, however, the projects should be completed in the most aggressive time-frame possible (10.4); and,
- **Project funding** should actively be pursued from all possible sources including local, State, and federal sources, the development of public/private partnerships, as well as individual and institutional donations (11.0).

1. BACKGROUND INFORMATION

1.1 Introduction & History of San Felipe Creek

Area Description, History & Reason for Planning Effort

San Felipe Creek originates approximately six miles northwest of Farm Road 2523 in southeastern Val Verde County and flows towards the southwest for eighteen miles to its mouth on the Rio Grande. The creek flows through the center of the City of Del Rio in Val Verde County, Texas. San Felipe Creek is primarily supplied by water flowing from the San Felipe Springs at a flow rate that typically ranges from 50 – 90 million gallons per day. The creek is the sole source of drinking water for the City of Del Rio and Laughlin Air Force Base. The stream has always been a primary recreation attraction for the citizens of Del Rio.

The drainage basin for San Felipe Creek upstream of the project area is approximately 25,800 acres (40.3 square miles) and consists of rural lands as well as highly urbanized areas. The urbanized areas help to exert an influence on the character and quality of water that flows in the creek. The stream has cut across limestone, shale, siltstone, and clay to form its valley. The native vegetation consists primarily of water-tolerant hardwoods and conifers, pecans, oaks, junipers, grasses, and mesquites. A significant presence of invasive species now exists in San Felipe Creek including *Arundo donax* (giant reed) and armored catfish (*Hypostomus plecostomus*), which are now located in many areas within or along the banks of the creek.

Archeological evidence indicates that the creek has been a source of water for thousands of years. The creek was named by Spanish missionaries who arrived in 1635. The founding of the San Felipe Agricultural, Manufacturing and Irrigation Company in 1868 lead to the use of the creek as a source of irrigation water via a canal system and allowed the cultivation of several thousand acres of land. The canal system established is still in use today.

San Felipe Creek is home to many unique animal species. Among them are the Devils River Minnow that has been listed as a threatened species by the United States Fish & Wildlife Service (USFWS) since 1999. The San Felipe Gambusia is a recently identified species that is known to reside only in San Felipe Creek and is currently listed as a threatened species by the Texas Park & Wildlife Department (TPWD).

Due to the importance of water quality in San Felipe Creek, both as the sole source of drinking water for the citizens of the area and as the primary habitat of animals in the area, it became apparent to the participants that there was a need for a regional water quality planning study to identify opportunities for protecting water quality throughout the drainage basin. In December 2009 the City of Del Rio submitted an application to the TWDB to secure funding for this planning effort. In January 2011 the City of Del Rio contracted with Naismith Engineering, Inc., and its subconsultant CP&Y and the Rio Grande River Institute to prepare a master plan for the San Felipe Creek area. The City of Del Rio agreed to provide the matching funds necessary to apply for matching funds via a Research and Planning Grant from the TWDB.

1.2 Project Sponsors and Funding Sources

1.2.1 Project Sponsors

The Project Sponsors include the City of Del Rio and the TWDB.

1.2.2 Project Funding Sources

The total planning cost for the project was \$140,000.00 of which \$70,000.00 would be funded through the TWDB's Research and Planning Grant Program and the remaining \$70,000.000 to be provide by the City of Del Rio.

1.3 Project Team

The project team consists of Naismith Engineering, Inc., CP&Y, Sul Ross State University - Rio Grande College, and the Rio Grande River Institute for Sul Ross State University - Rio Grande Research Center.

1.4 Definition of Planning Area

1.4.1 Project Boundaries

The boundaries of the project are confined to the drainage basin of San Felipe Creek which is located in Val Verde County. The primary focus of the master plan includes the area of the drainage basin within the City Limits including the area of the San Felipe Country Club golf

course and that portion of San Felipe Creek from U.S. Highway 90 downstream to Round Mountain. The boundaries of the Project Area are shown in **Figure 1**.

1.4.2 Planning Area Definition, Description, and Characterization

The “Planning Area” generally covers the portion of the San Felipe Creek drainage basin upstream of Round Mountain. This creates a planning area footprint of over 40 square miles which is shown on **Figure 2**.

1.5 Description of Planning Process

1.5.1 Organization

The project organization is divided amongst two primary sponsors, the City of Del Rio and the TWDB. The City of Del Rio has designated its San Felipe Creek Commission as its primary contact during the planning process.

1.5.2 Meetings

Meetings were held during the course of the project in an effort to inform the Commissioners and the general public on the project findings, to update them on the progress of the planning effort, and to receive feedback from the Commissioners and the general public. A total of five public meetings were held for the project including meetings in October 2010, July 2011, October 2011, November 2011, and January 2012. Below is a complete list of the meetings that were held over the course of the planning period with the time and location of each meeting noted in parentheses. All meetings, including the San Felipe Creek Commissioners Meetings were open to the general public.

MEETING DATES, TIMES and LOCATIONS:

San Felipe Creek Commission Meetings -

- Kick-off First Public Meeting, **October 20, 2010** (Noon, City of Del Rio City Hall, Del Rio, Texas)
- Progress Meeting No. 1, **July 25, 2011** (Noon, City of Del Rio City Hall, Del Rio, Texas)
- Progress Meeting No. 2, **October 26, 2011** (10:00 a.m., City of Del Rio City Hall, Del Rio, Texas).

- Draft Master Plan Presentation, **February 16, 2012** (11:30 a.m., City of Del Rio City Hall, Del Rio, Texas).
- Final Master Plan Presentation, **June 28, 2012** (City of Del Rio City Hall, Del Rio, Texas).

Public Meetings -

- Kick-off First Public Meeting, **October 20, 2010** (5:30 p.m., City of Del Rio Convention Center, Del Rio, Texas)
- Public Meeting - Progress Meeting No. 1, **July 25, 2011** (5:30 p.m., City of Del Rio Convention Center, Del Rio, Texas)
- Public Meeting - Progress Meeting No. 2, **October 26, 2011** (5:30 p.m., City of Del Rio Convention Center, Del Rio, Texas).
- Public Meeting - Draft Master Plan Presentation, **February 16, 2012** (5:30 p.m., City of Del Rio Convention Center, Del Rio, Texas).
- Public Meeting - Final Master Plan Presentation, **June 28, 2012** (City of Del Rio Convention Center, Del Rio, Texas).

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2. SAN FELIPE CREEK WATERSHED

2.1 Introduction & History

San Felipe Creek flows through the heart of the City of Del Rio and has been a focal point for this area of Texas for thousands of years. The Creek and its drainage basin are located in Val Verde County, with the majority of the drainage basin lying within the City's City Limits or its Extraterritorial Jurisdiction (ETJ), and the majority of the Creek lying within the City Limits. Creek flow is supplied mainly by a series of springs known collectively as San Felipe Springs and collectively these springs discharge an average of 50 to 90 million gallons of water a day making San Felipe Springs the fourth largest natural spring in Texas. This water serves as a source of drinking water, irrigation water, and provides a recreational opportunity that has been enjoyed by community residents for as long as anyone can remember. San Felipe Creek is home to the San Felipe gambusia, a fish that only occurs in San Felipe Creek and has been listed by the TPWD as a threatened species, as well as the Devils River Minnow, a fish listed by both the TPWD and the USFWS as a threatened species.

Archeological findings demonstrate that the Val Verde County area has been home to humans for thousands of years. As early as 1590, European explorers are known to have visited San Felipe Springs. In 1862 the Taylor family established the first permanent settlement along San Felipe Creek which is considered by many to be the founding of Del Rio. In the ensuing years the springs and the Creek have served as a source of water for travelers, missionaries, military, and settlers. The Creek was dammed by the San Felipe Agricultural & Mining Company (SFAMC) in the 1870's and through a series of canals provided irrigation to approximately 5,000 acres of land located south of the downtown area. Since that time the Creek has provided water for drinking and irrigation purposes, and as a source of power for the operation of gristmills, electric power plants, an ice plant, and other businesses and industries that located to the area.

The Balcones Escarpment runs along the southern and eastern edges of the Edwards Plateau, generally from north of Austin, southward to San Antonio, then westward toward Del Rio. This line of cracked and fractured limestone provides an ideal release point for water stored deep underground in a reservoir known as the Edwards Aquifer. The waters from San Felipe

Springs have dissected limestone, shale, siltstone and clay to form a valley and has created a creek that is characterized by a mostly rocky, gravelly bottom area lined by water-tolerant pecans, oaks, junipers, grasses, and mesquites.

San Felipe Springs is actually a series of ten or more springs that originate approximately three miles northeast of downtown Del Rio and extend for more than a mile along San Felipe Creek. Two major springs, known as the East (aka, Spring #3) and the West Spring (a.k.a., Spring #4) account for approximately 75 percent of the creek flow, and together provide the sole source of drinking water for the City of Del Rio and Laughlin Air Force Base. The Creek flows for an approximately 9 miles in a mostly southern direction, ultimately discharging into the Rio Grande downstream of the International Amistad Reservoir.

With portions of the creek's drainage basin lying within an urbanized area, the creek and its ecosystem are vulnerable to activities typical of such an area. Such activities can have a significant impact on the water supply and water quality of both San Felipe Creek and the Rio Grande downstream of Del Rio. San Felipe Creek is part of the Rio Grande Basin and is identified by the Texas Commission on Environmental Quality (TCEQ) as Segment 2313. In the past, the San Felipe Creek river segment has been identified by the TCEQ, or its predecessor agencies, as being water quality impaired.

Additional details on the history and characteristics of San Felipe Creek and the surrounding area is included in the Environmental Documentation (**Appendix A**) and the previously approved San Felipe Creek Vision Plan (**Appendix C**).

2.2 Geology, Geography, Climate & Demographics

2.2.1 Geology, Geography & Climate

The City of Del Rio is located in the southeast corner of Val Verde County at the crossroads of US Highways 277 and 90. The City lies along the southwestern edge of the Edwards Plateau, the northwestern edges of the south Texas brush country known as the Tamaulipan mezquital, and the eastern edge of the Chihuahuan Desert. The convergence of these three distinct ecosystems results in an area is characterized by a diverse mixture of desert shrub vegetation, grasses, and trees.

The Del Rio area is underlain by the Edwards Aquifer which is comprised of Edwards Limestone, which is a several hundred foot thick layer of porous, fractured rock that has the ability to store and convey significant quantities of water. The area terrain is generally level with some areas dissected by canyons and drainage channels. The downtown area is located approximately 3 miles from the Rio Grande and the international border with Mexico.

The climate is semi-arid with drought conditions present during parts of most years. The average annual rainfall is approximately 18 inches, with most of the rainfall occurring in the form of thunderstorms between the months of April through October. Even though it is located over 300 miles from the Gulf of Mexico the area is subject to airmasses that move in general northwesterly direction off the Gulf. Of particular concern are tropical weather systems that move in land and have the ability to produce large amounts of precipitation in a short period of time. The hottest time of year usually occurs in the month of August which has an average high temperature of 96.2 degrees and an average low temperature of 74.3 degrees. The coolest time of year usually occurs in the month of January which has an average high temperature of 62.8 degrees and an average low temperature of 39.7 degrees.

2.2.2 Demographics

Val Verde County has a total population of approximately 49,000 (US Census 2010). The City of Del Rio is the County Seat and currently has a population of approximately 35,591 (US Census 2010) with an estimated 11,298 households. The racial makeup is of the City was 84.6% White, 1.5% Black, 0.5% Native American, 0.5% Asian, 0.1% Pacific Islander, and 2.0% from two or more races. Persons of Hispanic or Latino origin comprised approximately 84.1% of the population. The median household income was \$31,990, with approximately 23.9% of all person below the poverty line. Persons under 18 years of age comprised 29.4% of the population, which exceeded the 27.3% average for all of Texas. Persons 65 years of age or older comprised 13.2% of the population, which exceeded the 10.3% average for all of Texas.

2.3 Existing Development

The San Felipe Creek area has been under development for hundreds of years. However, the first permanent settlement of Del Rio has been credited to James Taylor and his wife Paula Losoya Taylor who established permanent residence near San Felipe Creek in 1862, known as San Felipe Del Rio. The community applied for a city charter in 1875; however the City was not officially incorporated until 1905. The boundaries for this new city included the areas of modern day downtown, as well as the area along San Felipe Creek.

The San Felipe Creek drainage basin has distinct areas of development. The area of the creek south of US Highway 90 is primarily single-family residential, with some municipal buildings, parkland property, light industrial uses, and agricultural operations. Much of the immediate bank areas in this portion of the creek include property owned or controlled by the City of Del Rio. Residential single-family development in this portion of the drainage area includes large sections with a developed density of 5 to 6 homes per acre. The neighborhoods bordering San Felipe Creek are mostly developed for the area of the creek up to 3 miles downstream of the US Highway 90 Bridge.

North of US Highway 90 the area of the drainage basin within the City Limits is a mixture of commercial properties, large-lot (estate lot) single-family residential (per zoning), and single-family residential. The northern portion of the drainage basin outside the City Limits primarily includes a large amount of undeveloped properties which are used for agricultural operations and some oil and gas development. Immediately north of the US Highway 90 Bridge across San Felipe Creek is the San Felipe Country Club which is located on approximately 88 acres of land and includes a nine hole golf course, club house, and swimming pool. The Country Club was organized in 1921 and the golf course property currently surrounds San Felipe Springs #1, #2, #3, and #4.

2.4 Floodplain

San Felipe Creek and its adjacent areas are directly impacted by floodwaters. Weather frontal systems may stall over the area or tropical weather systems from the Gulf of Mexico may occasionally drift inland, with each system having the capability of creating large rainfall rates that can significantly impact short-term stream flows.

One such event occurred in August of 1998 when the remnants of Tropical Storm Charley drifted inland from the Gulf of Mexico and stalled over the Del Rio area generating as much as 15 inches of rainfall in a 12-hour period. The rainfall resulted in a massive increase in the flow of San Felipe Creek sending a 5 foot wave of water down the creek. The floodwaters devastated the neighborhoods that adjoin San Felipe Creek, killing 9 people, destroying 200 homes, and damaging over 1,000 properties. The City is still recovering from this tragic event and evidence of flood damage can be seen along parts of the Creek.

The 100-year floodplain straddles San Felipe Creek and affects neighboring properties on either side of the creek. In addition to the 100-year floodplain, the floodway accounts for a large portion of the creek-side property of San Felipe Creek, particularly for that portion of the Creek downstream of US Highway 90. The approximate boundary of the existing 100-year floodplain is shown on the Existing Land Use Map (**Figure 3**).

2.5 FEMA Buyout Properties

As a result of the 1998 Flood created by Tropical Storm Charley, the City of Del Rio has worked with the Federal Emergency Management Agency to buy flood-prone or vulnerable properties along San Felipe Creek. The FEMA Buyout Program has included over several hundred individual properties and has resulted in the purchase of over 275 acres of land. As part of the participation agreement any building on the property is moved or demolished, and the vacant land is then restricted from further or future development in an effort to minimize possible damage from subsequent storm events. The approximate locations and boundaries of the FEMA Buyout Properties are shown on the Existing Land Use Map (**Figure 3**).

2.6 Zoning

Zoning is the process by which the City may designate or control a particular land use for properties within the City Limits. The zoning process provides the City the ability to control and encourage the type of development that will occur on a particular property, or within a certain boundary or area. Zoning also allows the City to group compatible land uses and to prohibit development or activities on properties that may be considered incompatible by adjoining property owners or area residents. The City's ability to zone property for a

designated use only applies to those areas within the City Limits and is not applicable to areas outside the City, including those areas within the City's ETJ.

The portion of the San Felipe Creek drainage basin upstream of Round Mountain lies both inside and outside the City Limits and has a combined area of approximately 25,800 acres. At the present time approximately 3,162 acres (or 12%) of the drainage basin lies within the City Limits and approximately 22,638 acres (or 88%) lies outside the City Limits.

Current zoning in the San Felipe Creek drainage basin consists mainly of single-family residential areas including both small-lot and large-lot development. Also, present within the drainage basin are commercial and industrial properties. A copy of the City's current Zoning Map is included as **Appendix H**. Of particular importance is the significant amount of City-controlled property adjacent to San Felipe Creek. This City property includes parks, municipal buildings, open space, and recently acquired FEMA Buyout properties.

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3. PROJECT GOALS, OBJECTIVES, STRATEGIES & PRIORITIES

The development of a Water Quality Master Plan includes many elements both technical such as engineering and biology as well as policy issues. Working with the San Felipe Creek Commission (“Commission”) and from public input at meetings during the planning process it is evident that there is a strong community desire to address both short and long term needs to protect water quality, continue public access and protect endangered species in San Felipe Creek. Establishing goals, objectives, strategies and priorities are a critical part of the plan. They form the basis of communicating with the public and provide a basis for decision makers to allocate resources to implement the plan. To assist in this process the following definitions are used as a guide in establishing goals, objectives, strategies and priorities.

3.1 Project Goals

Goals are an expression of what the Del Rio City Council, Commission and general public wishes to achieve in the protection of San Felipe Creek. Goals should be general in nature, reflect community values, and not detail specific actions necessary to achieve the goal. For the San Felipe Creek Master Plan the following goals have been identified:

- As the sole source of drinking water for the City of Del Rio and Laughlin Air Force Base and the headwaters of San Felipe Creek, protecting the San Felipe Springs from water quality and quantity degradation is of paramount importance.
- Protection of both water quality and quantity is important for the maintenance of habitat for endangered species including the Devils River minnow that inhabit San Felipe Creek.
- Eradication of invasive species that have degraded both the water quality and quantity in San Felipe Creek. Specifically the eradication of the river cane and armored catfish and improving the habitat around Blue Hole.
- Continue to have San Felipe Creek as the centerpiece of Del Rio life.

- Provide amenities at or near San Felipe Creek which enhance public use of the Creek while providing water quality protection.

3.2 Project Objectives

The objectives can be described as the milestones that need to be met in order to accomplish the goal. Objectives should be measurable and realistic. For the San Felipe Creek Master Plan the following objectives have been identified:

- Adopt design standards that include requirements for Best Management Practices (BMP's) for water quality protection for new development and where practicable retrofit existing improvements to implement BMP's.
- Provide public facilities that encourage users of the creek to protect water quality in the creek.
- Maintain and repair existing facilities and provide recreational amenities that encourage responsible public use of the creek.
- Encourage the use of native vegetation so that riparian habitat is re-established along the creek which will provide significant ecological benefits by filtering pollutants, controlling soil erosion and supplying habitat for vegetation and wildlife.
- Working with the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and the Texas Parks and Wildlife Department to develop a plan for eradication of invasive species in and around the creek and for the cleaning of Blue Hole.
- Assure that open space is for public use and as habitat for plants and wildlife while being maintained to protect adjacent neighborhoods.
- Work toward a balance of public access and habitat protection for San Felipe Creek through ordinance enforcement, enhanced maintenance, and public education.

3.3 Project Strategies

Strategies are the details on how to implement the objectives.

3.4 Project Priorities

Projects identified in the plan need to be prioritized in order to allocate resources from the identified strategies.

3.5 Project Constraints

In order to develop project priorities and strategies for their implementation, the constraints that are facing the project must be identified. A project constraint is something that has the potential to influence or impact the potential strategies to be employed to meet the project goals. Project constraints include the existing floodplain, the FEMA Buyout Properties, existing zoning and land use, current City ordinances, land ownership and control, endangered and threatened species, invasive species, and financial considerations. Each identified constraint should be considered for its potential to impact any proposed project implementation strategies, projects, or other project related activities.

3.5.1 - Floodplain

The existing 100-year floodplain straddles San Felipe Creek throughout the project area (**Figure 3**). Such an occurrence is typical of a creek or river, however, the boundaries of the 100-year floodplain will significantly impact how a property is developed. Development of property within the 100-year floodplain must follow FEMA guidelines and must comply with applicable City ordinances and regulations. FEMA requirements stipulate that no residential structures may be constructed within the boundaries of the 100-year floodplain unless the building's lowest floor (including basements) is elevated to or above the elevation of the 100-year flood event (a.k.a., the "base flood event"). City of Del Rio Floodplain Protection ordinances require residential structures to have a finished floor elevation at least two (2) feet above the base flood elevation. Also, non-residential structures must be flood-proofed in accordance with FEMA requirements, while City Floodplain Protection ordinances prohibits the operation of any nonresidential use with the delineated FEMA floodplain.

To address the constraints presented by the 100-year floodplain it is recommended that any non-residential development proposed by this master plan be located outside the boundaries of the 100-year floodplain or flood-proofing of the proposed improvements should be required. As an alternative to flood-proofing, limiting construction of proposed improvements within the 100-year floodplain to ground-level improvements would satisfy typical FEMA requirements.

3.5.2 - FEMA Buyout Properties

As previously detailed in Section 2.5, the FEMA Buyout Program has included the purchase of several hundred individual properties for a total of over 275 acres of land (**Figure 3**). The program allows for the purchase of property, with the funding assistance from FEMA, that is vulnerable to damage by floodwaters or that may contribute to or exacerbate flooding conditions. Any property purchased as part of this program is owned by the City of Del Rio and the program requires that any building on the property must be moved or demolished. The vacant land is then restricted from further or future development with no permanent structures allowed on the property. The land must forever remain as open space.

The significant area of land along San Felipe Creek provides the City with numerous options with respect to its future use. FEMA regulations will allow the land to be used as open space, parks, trails, a wildlife or nature refuge, community gardens, greenways, or permeable parking areas. Gazebos would also be allowed on the property provided they were open-sided. As projects are planned these types of uses should be considered for the FEMA Buyout properties.

3.5.3 - Existing Zoning / Land Use

As summarized in Section 2.6, zoning is the process by which the City may designate or control a particular land use for properties within the City Limits. A property's zoning designation will allow certain development to occur on the property. The portion of the San Felipe Creek drainage basin that lies within the City Limits consists mainly of properties zoned for single-family residential development, including both small-lot and large-lot development. Also, present within the drainage basin are commercial, industrial properties,

and multi-family residential properties. The current Zoning Map for the City of Del Rio has been included in **Appendix H**.

As project area planned for development within the zoned portions of the San Felipe Creek drainage basin, the project must be adapted to conform to the current zoning requirements for the property, or a request in the zoning designation will be required. For individual projects, the zoning of surrounding properties should be considered to ensure that the proposed development is consistent with the existing and proposed land uses in the area.

3.5.4 - Ordinances

The City has several existing ordinances that have the potential to impact any future projects or improvements planned within the San Felipe Creek drainage basin. Ordinances of significant importance have been identified and are summarized in Table 3.1 on the following page.

3.5.5 - Land Ownership/Control

Land ownership in the San Felipe Creek drainage basin is a mixture of public-owned and privately-owned properties. Depending on the owner, access to a particular property may be restricted. Land ownership should be considered when planning projects and control of the property should be obtained, either through ownership or an access easement, to ensure that the planned activities are allowed. This issue of land ownership will be particularly important during the process of invasive species eradication. Currently, there are large areas of invasive river cane along the banks of San Felipe Creek that are on private property. Prior to any eradication efforts, the City must work with the private property owners to ensure that access agreements are in place for any planned entrance by City crews or City-procured contractors. Where possible, the use of a public-private partnership is encouraged to allow access to property with respect to invasive species eradication.

Table 3.1. Applicable City Ordinances.

<u>Ordinance No.</u>	<u>Ordinance Details</u>
Chapter 7 - Art. IX.	San Felipe Creek Master Plan Commission. Establishes the Commission and details its structure, duties, and authority. Indicates that projects along San Felipe Creek within the Scope of the Master Plan shall be reviewed by the Commission prior to city council action.
Chapter 11.	Flood Damage Prevention. Restricts or prohibits construction within the designated floodplain/floodway in an effort to prevent or minimize flooding or flood damage/losses. New construction shall be designed and constructed to minimize flood damage.
Chapter 12.	Food and Food Establishments. Regulates eating and drinking establishments, food and drink vendors, caterers, and kitchens preparing food for sale, and mobile food units. Outlines requirements for review of construction plans & pre-operational/ regular inspections.
Chapter 16.	Licenses and Business Regulations. Outlines requirements for licenses and permits required by businesses or establishments within the City Limits.
Chapter 19.5.	Parks, Recreation and Public Gathering Places. Outlines regulations and standards for behavior, use, and activities within City parks, recreation and public gathering places. Establishes & details the duties of the San Felipe Creek Walk and Brown Plaza Associations.
Chapter 19.5 - Art. IV	San Felipe Creek Walk Association. Establishes the San Felipe Creek Walk Association to plan, manage, and coordinate activities conducted along the San Felipe Creek Walk area. Allows fees to be charged to individual, organizations, and concessionaires.
Chapter 20.	Peddlers, Solicitors and Vendors. Regulates vendors and solicitors including street vendors who sell merchandise within the City Limits.
Chapter 23.	Sewers. Regulates the discharge of wastes into public waters, as well as the City's sewer system, including fats, oils and greases. Establishes the requirements for a discharge permit. Regulates private sewage facilities.
Chapter 24.	Solid Waste. Regulates the collection and disposal of solid waste within the City Limits. Prohibits the collection or storage of solid waste materials on private property in an effort to keep waste materials out of public waters, and from creating a nuisance condition.
Chapter 29.	Water. Establishes rules and regulations for the City's water system, including the regulation of water wells, the operation of the City's distribution system, and for water conservation and drought contingency plans.
Chapter 30.	Zoning. Guides land development within the City Limits. Helps protect existing land owners, while retaining the City's rich historical heritage and protecting the environment. Ensures growth follows the City's Comprehensive Master Plan (the Del•RioPlan).

3.5.6 - Endangered/Threatened Species

San Felipe Creek plays host to threatened and endangered species. The Devils River Minnow has been listed as a threatened species by the United States Fish & Wildlife Service (USFWS) since 1999. The San Felipe Gambusia is a recently identified species that is known to reside only in San Felipe Creek and is currently listed as a threatened species by the Texas Park & Wildlife Department (TPWD). Additional information on these species and other threatened or endangered species known to be present in and around the project are discussed in more detail in the Environmental Documentation portion of this Master Plan included in **Appendix A**. The presence of these threatened species in the planning area will likely require that the type and extent of any planned improvements in and around the area of the creek must avoid having a negative impact on the habitat of the species in the creek.

During the development of this master plan a line of communication has been maintained with the USFWS staff members. As project development continues it will be important to continue these communication efforts. It will also be necessary to demonstrate to both federal and State agencies that planned improvements will result in positive impact on San Felipe Creek and the critical habitat the creek provides. The use of design and construction techniques that will help to minimize construction impacts and maintain or improve the creek habitat will be a key ingredient in the successful implementation of this Master Plan.

3.5.7 - Invasive Species

A significant presence of invasive species now exists in San Felipe Creek. Two of the most noticeable invasive species include *Arundo donax* (a.k.a., Giant Reed or River Cane), which is now located in many areas along the banks of the creek, and armored catfish (*Hypostomus* sp.) which appear to be present in almost all portions of the creek, especially in the section downstream of US Highway 90. These species are important due to their negative impact on the habitat of native species that live in and around the creek area. The *Arundo donax* is a significant water user and also out-competes other native vegetation in the riparian area of the creek, destroying the native habitat along the banks of the creek. The armored catfish may out compete the native species for food, and may also contribute to the destruction or damage of creek habitat due to their habit of burrowing into and under the bank area which can

ultimately result in bank failure, which can contribute to an increase in suspended sediment in the creek and a loss of established riparian area.

The elimination of invasive species in the San Felipe Creek drainage basin could be an important part of improving the water quality of San Felipe Creek. The eradication of the *Arundo donax* would improve creek habitat by allowing native vegetation to grow in and around the creek area, and would also help in maintaining or increasing the creek flow by eliminating a significant source of water demand. As the *Arundo donax* is eliminated it will be important to encourage the establishment of native vegetation in these areas. **Appendix B** provides a more complete outline of the *Arundo donax* problem and offers recommendation on how to eradicate this species from the San Felipe Creek drainage basin.

Control of the armored catfish would help to eliminate a possible source of competition for food, and would significantly reduce the bank erosion and destruction currently occurring within the project area. At the present time this species is being studied to determine if a suitable population control method is possible.

3.5.8 - Financial Considerations

As with any master planning project, the identification of, and planning for, needed and desired projects is only part of the mission. For the San Felipe Creek area many of the proposed projects or programs identified during the planning process will have a significant cost associated with their implementation. As the master plan moves from the planning stage to the implementation stage, the focus will be on obtaining the financial resources necessary to allow the plan to become a reality. The construction of individual projects or the initiation of new programs will have to be planned and scheduled to accommodate the financial constraints facing the City and local community.

4. WATER QUALITY

4.1 Definition of Water Quality

The definition of water quality can development of the Master Plan. For planning purposes water quality can be defined as the condition of water, as affected by chemical, physical, biological and habitat factors, and its hydrological regime, for use as a drinking water supply, for protection and propagation of wildlife, and for aesthetic and recreational use within the area of concern.

Water quality is often times a subjective term that has no universal definition among scientist, engineers, and land planners. However, the use of certain water quality parameters allows for the assessment, monitoring, and control of water quality. Some of the more common water quality parameters are solids, dissolved oxygen, nutrients, pathogens, petroleum hydrocarbons, metals, synthetic organic compounds, and physical parameters (i.e., temperature, pH, conductivity, etc...).

San Felipe Creek provides and supports critical habitat for the plants and animals living in and around the creek area. This habitat is most notably found to have the following characteristics: fast-flowing, spring-fed aquifers; high quality, pollutant-free waters; gravel stream bottom; and, diverse plant & animal biomass.

4.2 Existing Water Quality Regulatory Programs

There are many existing regulatory programs in place that deal with water quality and water quality issues. Although there are numerous specific water quality regulatory programs at both the federal and state level, the major programs pertaining to this planning effort are summarized below. More information on the specific requirements of each program can be obtained from the implementing agency.

4.2.1 TCEQ TPDES Regulations

The Texas Pollutant Discharge Elimination System (TPDES) regulations are state requirements instituted based on the federal Clean Water Act (CWA) and the Texas Water Code (TWC). The TCEQ has been officially delegated federal permitting authority for the

TPDES program under the National Pollutant Discharge Elimination System (NPDES). This means that the TCEQ administers the permitting and enforcement program for all NPDES discharges (all point source wastewater discharges and certain storm non-point source discharges) in the state.

The regulations require that a combination of “structural” and “non-structural” controls be utilized under the terms of an individual permit or other regulatory approvals, including permits by rule and general permits. These regulations include requirements for public notice and public involvement in the regulatory approval process. These regulations govern numerous types of discharges, including point source wastewater discharges and storm water non-point source discharges.

4.2.1.a - Point Source Wastewater Discharges

TCEQ TPDES regulations govern all point source wastewater discharges in the state, including domestic and industrial wastewater. These discharges are required to meet the treatment standards and effluent quality identified in the regulations.

The TCEQ has established Critical Water Quality Parameters listed in Chapter 7: Texas Surface Water Quality Standards, Chapter 307, §§307.1-307.10, required to allow human use and maintain aquatic life. These standards also include maximum threshold criteria for specific toxic materials for aquatic life protection. Parameters included in the TCEQ Water Quality Standards for specific stream segments in each river basin include: 1) chlorides; 2) sulfates; 3) total dissolved solids; 4) dissolved oxygen; 5) pH; 6) indicator bacteria; 7) temperature; and 8) flow criteria below which some of these previous standards (1-7) will not apply. The standards also list acute and chronic criteria for 39 different toxic materials.

4.2.1.b - Municipal Storm Water Discharges

In the early 1990’s, EPA adopted the Phase I Storm Water Regulations. Among other things, these regulations governed storm water non-point source (NPS) pollution from large (greater than 100,000 population) municipal separate storm sewer systems (MS4s). Under Phase I, MS4s were defined as publicly owned separate storm sewers that are located in an incorporated municipality or county with a population of 100,000 or more. The owners

and/or operators of these MS4s were required to obtain individual permits, characterize their storm water, institute certain monitoring and control measures, and conduct public education.

In 1999, the EPA adopted the Phase II Storm Water Regulations, which extended storm water NPS regulation to smaller MS4s in defined urbanized areas. Under Phase II, the definition of an MS4 was expanded to include any storm water conveyance or system of conveyances that is operated by a public entity within these defined areas. While the Phase II storm water regulations do not require cities to obtain individual permits, they must characterize their storm water and develop, implement, and enforce a Storm Water Management Plan (SWMP), designed to reduce the discharge of pollutants from their MS4 to the “maximum extent practicable.” The TCEQ issued a general permit (TXR0400000) to be used by all small MS4s on August 12, 2007 wishing to obtain coverage through a general permit.

At the present time, the City of Del Rio is not subject to either the Phase I or Phase II general permits. However, the EPA and TCEQ continue to promulgate regulations that could potentially affect the City with regards to the operation of a storm water collection system. The City should continue to monitor these regulatory agencies in order to stay abreast of the latest rule making activities.

4.2.1.c - Industrial Site Storm Water Discharges

In addition to regulating municipal NPS storm water discharges, Phase I of the EPA’s storm water regulations also governed a wide range of industrial site discharges. The list of regulated industrial activities was expanded in the Phase II storm water regulations. These industrial discharges are subject to numerous technical standards. The TCEQ has currently issued a general permit that can be used to cover discharges from industrial facilities meeting certain conditions. Industrial storm water dischargers can also obtain an individual TPDES permit, in lieu of utilizing a general permit. Both the individual and general permits require permittees to characterize their storm water and institute certain control measures. Industrial discharges obtaining coverage through a general permit are required to notify any applicable MS4s that may receive their storm water discharges.

4.2.1.d - Construction Site Storm Water Discharges

The TCEQ issued the Construction General Permit (CGP) on March 5, 2008 that regulates discharges from many construction activities. (TCEQ CGP No. TXR150000). Based on this permit, construction activities that generate runoff that goes into or adjacent to any surface water in the state are regulated according to the area of land disturbed. In general, all construction activities which disturb at least 1 acre of land are regulated under this permit. This 1 acre threshold applies to all parts of sites with a “common plan of development”, even if they are not constructed at the same time. The requirements of this provision apply regardless of the type or sequencing of construction. The application of this provision to commercial and multi-family residential construction is straightforward. However, this provision also governs all construction (including individual residences) within a typical residential subdivision, even if the residences are constructed well after the construction of the common development components (e.g. streets, drainage facilities, etc) is completed.

Current federal and state regulations require controls to be implemented to prevent storm water discharges from construction sites from adversely impacting water quality. TCEQ rules and regulations prohibit discharges from construction sites that “would cause or contribute to a violation of water quality standards or that would fail to protect and maintain existing designated uses.” These regulations also require all control measures to be “adequately maintained to effectively reduce or prohibit erosion”. Owners and operators are required to “describe and ensure the implementation of practices that will be used to reduce the pollutants in storm water discharges associated with construction activity at the construction site and assure compliance with the terms and conditions” of the regulations. Erosion and sediment controls must be designed to retain sediment on-site to the extent practicable with consideration for local topography, soil type and rainfall.

4.2.1.e - TCEQ OSSF Program

The Texas On-Site Sewage Facility (OSSF) Program is based on the Texas Health and Safety Code and is administered by the TCEQ. These regulations govern the installation, operation and maintenance of OSSF’s including septic tanks, irrigation systems, proprietary treatment systems and others. The program utilizes primarily “structural” controls, is implemented through a permit program, and can be delegated to qualified local governments. In the

planning area Val Verde County is the authorized agent that implements the TCEQ OSSF program.

4.2.1.f - Federal Endangered Species Program

The federal endangered species programs are administered by the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and are based primarily on the federal Endangered Species Act (ESA). The programs have several different elements. The first element is a “Listing Program” which includes procedures to evaluate and list “threatened” and “endangered” species, as mandated by the ESA. In instances where the implementing agency identifies a species as endangered, a Species Recovery Plan (SRP) is to be developed. Another element of the programs is a review of “Federal Actions” to avert or minimize their impact on endangered species. This requires all federal agencies to aid conservation efforts for endangered species and to consult with USFWS on direct federal actions, actions using federal funds, and the issuance of permits under federal programs, including delegated states. A third element of the programs is to prohibit the taking of endangered species. The implementing agency is allowed to adopt provisions to prohibit the taking, possession, sale, or transfer of certain endangered species, to allow the issuance of incidental take permits, and to coordinate Habitat Conservation Plans (HCPs).

In compliance with the ESA the USFWS prepared and published the Devils River Minnow Recovery Plan in 2005. This plan was developed to provide guidance and offer recommendations on efforts that may ultimately lead to the de-listing of the Devils River Minnow. A copy of this plan has been included in this report as **Appendix D**.

4.2.1.g - Other State Water Quality Programs

In addition to the programs presented above, there are several other state programs with a partial focus on water quality. These are listed below with a basic description of the regulated activities:

- Texas Oil and Gas Environmental Program – administered by the Railroad Commission of Texas (RRC), regulates the exploration and production of oil, gas and geothermal resources and the disposal and clean-up of associated wastes.
- Texas Municipal Solid Waste Program – administered by the TCEQ, regulates the transportation, storage, processing and disposal of municipal solid waste (garbage)
- Texas Petroleum Storage Tank Program - administered by the TCEQ, regulates the installation, operation and pollution from petroleum storage tanks
- Texas Industrial and Hazardous Waste Program – administered by the TCEQ, regulates the handling, transportation, storage, processing and disposal of hazardous and non-hazardous industrial solid waste
- Texas Agricultural and Silvicultural Water Quality Management Program – administered by the Texas State Soil and Water Conservation Board (TSSWCB), is a voluntary program to control pollution from certain agricultural operations.

4.2.1.h - Other Federal Water Quality or Related Programs

In addition to the programs presented above, there are several other federal programs with a partial focus on water quality, that have not already been covered under another federal or state program. These include:

- Federal Spill Prevention, Control and Countermeasure (SPCC) Program - administered by the U.S. EPA, regulates the storage and handling of petroleum products and hazardous materials.
- Federal Superfund Program – administered by the EPA, requires the compilation and management of the National Priorities List (NPL) for contaminated sites, governs the clean-up of those sites and outlines the Emergency Planning and Community Right-to-Know program.

- Federal Toxic Substances Control Program – administered by the EPA, regulates the creation, use, transportation, storage, processing and disposal of toxic substances.
- National Wetlands Program – administered by the U.S. Army Corps of Engineers, regulates construction activities, dredging and placement of fill in jurisdictional wetlands and navigable waterways.
- National Floodplain Program – administered by the Federal Emergency Management Agency (FEMA), regulates construction activities and development in floodplains.

4.3 Identification of Water Quality Issues Associated with San Felipe Creek

Based on the goals and objectives established for the Plan, there are many potential water quality threats and many different types of pollutants that may affect water quality. Many of these threats or pollutants result in some way from human activity. The major threats identified by the consultant team are presented below.

4.3.1. *Invasive, Non-Native Species*

Invasive, non-native species have the potential to negatively impact water quality. As outlined in **Appendix A** and Section 3.5.7, San Felipe Creek is currently being impacted by non-native species including *Arundo donax* (a.k.a., Giant Reed or River Cane) and armored catfish (*Hypostomus* sp.) which appear to be present in almost all portions of the creek, especially in the section downstream of US Highway 90. The *Arundo donax* uses a significant amount of water and drives out other native vegetation in the riparian area of the creek. The armored catfish appear to damage the bank areas contributing to erosion and bank stability issues. Each of these species contributes to negatively impacting water quality by increasing the amount of suspended solids introduced into the creek and by reducing the ability of the riparian area to act as a buffer or filter.

4.3.2. *Urbanization*

Urbanization can threaten water quality in several ways. As used in this plan, the term urbanization refers to the overall shift or trend of an area from a more rural community to a more developed, or urbanized area. Urbanization often results in more impervious cover, which increases storm water runoff rates and volumes, decreases recharge, and decreases base flow in streams. Urbanization also increases the resident population, introducing more human

activity into an area. This increase in human activity often results in additional pollutant loadings from storm water runoff, the generation of more wastes (solid and liquid), and an increased use of potentially harmful materials in the newly urbanized area. Urbanization results in increased construction activities which remove natural vegetation and can potentially increase erosion and sedimentation.

As areas change from undeveloped to developed, increases in pollutant loadings to surface water and groundwater and reductions in recharge and infiltration correspond directly to increases in development intensity. In general terms, as development intensity increases, water quality impacts also increase. In the current practice of water quality planning, the intensity of development is most often described by using the percentage of impervious cover resulting from the development. Impervious cover consists of buildings, streets, driveways, parking lots, and other types of impervious surfaces that generally increase the amount of rainfall which turns to runoff and correspondingly decreases the amount of infiltration (recharge).

While there is some disagreement among the scientific community on whether impervious cover is actually the source of additional pollutant loading or whether it is an indicator parameter tied to additional human activity, the threat to water quality posed by urbanization has consensus agreement among the scientific community. This threat in general is acknowledged by the existence of a number of federal and state regulatory programs intended to control the effects of urbanization on water quality through restrictions on land development.

For the planning area, urbanization of the San Felipe Creek drainage basin can be traced back to the Taylor Family's establishment of a settlement along San Felipe Creek in 1862. Since that time the area has seen the construction of homes, shopping centers, schools, roadways, parks, restaurants, convenience stores, and other developments typical of a growing community. At the present time, approximately 12 percent of the San Felipe Creek drainage basin upstream of Round Mountain lies within the City Limits, while 88 percent of the basin lies outside the City Limits. Of the area outside the City Limits, much of it is currently undeveloped.

4.3.3. Lack of Riparian Buffer

In undeveloped areas streams and rivers are typically protected by a vegetated bank area containing native grasses, flowers, shrubs and trees. This area has been termed the “riparian buffer” since the vegetation serves to reduce or mitigate, in a sense “buffer”, the potentially harmful effects of sediment, phosphorous, nitrogen, pesticides and other pollutants from reaching the water. A healthy riparian area also provides habitat for animals, helps to reduce water temperatures, reduces flood water velocities thereby aiding in stream bank stabilization and minimizing damage to surrounding properties, and increases dissolved oxygen levels in the water.

As urbanization begins to occur in and around a stream, the riparian area is often degraded or reduced, either through direct construction activities (e.g., bank improvements, channelization, land clearing) or through the secondary impacts attributed to urbanization (e.g., increased stormwater flow rates or volumes). San Felipe Creek, particularly the stream reach between US Highway 90 and Round Mountain, is an example of the impact that urbanization can have on a riparian buffer. Eroded areas, little to no vegetation, invasive non-native species, concrete or stone bank improvements, typify a good portion of the creek bank in this area. This lack of a healthy, native riparian area makes the creek more vulnerable to impacts on San Felipe Creek’s water quality by the sediment and pollutant loads constructed by stormwater runoff.

4.3.4 Bank Erosion

Bank erosion is a direct contributor to a decrease in water quality within a stream or river. The erosion of stream banks will add sediment to the water which directly impacts the habitat of a clear, flowing stream by adding suspended solids to the water. Bank erosion also leads to a loss of riparian vegetation which will reduce the stream’s ability to buffer the impacts of sediments and pollutants, and can also be a contributor to additional bank erosion.

4.3.5. Vegetative Management

While undeveloped land left in its natural state can be an effective measure for maintaining water quality, other activities occurring on undeveloped land can have adverse impacts on water quality. The majority of undeveloped land that is subjected to human activity is utilized for either agriculture or recreation. The primary threats from undeveloped land subjected to human activity are excessive erosion/sedimentation from disruption of natural vegetation and excessive nutrients and biological constituents.

4.3.6. Stormwater /Non-Point Source Pollution

Stormwater non-point source (NPS) pollution occurs as a result of rainfall events. When human activities or natural processes result in pollutants being present at or near the land surface, these pollutants can be taken up by storm water runoff and can result in NPS pollution. The impacts of NPS pollutants vary widely and depend on the following general factors:

- Topography
- Land surface characteristics
- Human activities or natural processes taking place
- Types of pollutants present

In the United States, NPS pollution has been documented to occur from urbanized areas, industrial/commercial areas, developing areas, agricultural areas, and areas affected by natural disasters (e.g. forest fires, volcanic eruptions, etc.)

Until relatively recently, storm water NPS discharges in the U.S. have been largely unregulated. In the early 1990's, EPA adopted the Phase I Storm Water Regulations, which attempted to address NPS pollution from industrial activity, construction sites greater than five (5) acres in size and from large (greater than 100,000 population) cities. In 1999, the EPA adopted the Phase II Storm Water Regulations, which extended storm water NPS regulation to additional industrial/commercial activities, smaller construction sites (greater than one [1] acre in size) and smaller cities in defined urbanized areas. Many states, including Texas, have been delegated the authority to implement these federal regulatory programs.

Further discussion of storm water NPS pollution is subdivided by the general types of activities that contribute to storm water NPS pollution.

4.3.6.a - Construction Storm Water Discharges

As discussed previously (Section 4.2.1.d), existing regulations govern storm water discharges from construction sites as small as one (1) acre. These regulations require that operators control the discharge of pollutants from the site using a variety of measures. In actual practice, many of the control measures specified in the current regulations are improperly used or improperly operated. In many instances, even when otherwise properly used, certain technologies are inappropriate in certain circumstances. In general, the failure to use the appropriate measures and the failure to properly install, inspect, maintain, and repair the measures used to control storm water discharges from construction sites poses a significant threat to water quality in the planning area, and specifically to San Felipe Creek.

While many different types of pollutants may be discharged from construction sites, the primary pollutant discharged is sediment in the form of suspended solids. The Natural Resource Conservation Service (NRCS) has identified sediment from eroded soil as having the ability to adversely impacting water quality, mainly due to significant changes in the appearance (aesthetics) and chemical characteristics of rainfall runoff. Sediment with the potential to adversely affect water quality can be transported from construction sites in several different ways, including the direct discharge of sediment in storm water, the transport soil, mud, or dirt from construction sites on vehicle tires, through spillage onto roadways and areas outside of control measures, and through accumulated dust which blows off the site. Sediment which leaves the site through one of these mechanisms is then exposed to the elements and can be transported in storm water runoff during the next rain event.

4.3.6.b - Other Storm Water NPS Discharges

Other types of storm water NPS discharges can also pose a threat to water quality in the planning area. Discharges from industrial activities and from urbanized areas are currently governed by TCEQ's storm water programs. The potential pollutants typically found in NPS discharges from industrial activities are similar to those described above for point source discharges. Potential NPS pollutants resulting from urban areas have also been described

previously under the discussion on Urbanization. In addition to these two regulated areas, other types of storm water NPS discharges can pose water quality threats. Discharges from agricultural activities can also generate significant amounts of pollutants. Failing to utilize proper tilling and erosion control practices can result in significant sediment generation from areas under cultivation. The sale of agricultural chemicals (primarily pesticides and nutrients) is stringently regulated and their use is controlled through educational processes (e.g. labeling, training, advertising, etc.) However, in areas where these controls are not diligently enforced, significant pollutants can be generated from the improper use of these chemicals. These other storm water NPS discharges also pose a threat to water quality in the planning area.

4.3.7. Lack of Water Quality Protection on Existing Development

While current science indicates to us the threat posed by urbanization, this threat has not always been identified and understood. Based on this lack of understanding, development has been allowed to occur in many areas of the Planning Region without the benefit of water quality protection measures. As presented in the discussion on Urbanization, this development has resulted in additional impervious cover which increases storm water runoff rates and volumes, and has introduced more human activity, resulting in additional pollutant loadings. While more recent developments may incorporate some limited water quality protection measures, the vast majority of the existing development in the Planning Region incorporates little or no water quality protection measures. The existence of this previous development, with no water quality protection measures, poses a threat to water quality in the Planning Region. The same potential pollutants and general types of threats identified in the section on Urbanization, including reduction of recharge and base flow replenishment, apply to existing development with no water quality protection measures.

4.3.8. Point Source Discharges

Point source discharges result from a limited number of activities, but in most areas account for a majority of the non-storm water flows into hydrologic systems. Almost all point source discharges result from the treatment of either domestic wastewater or from industrial/commercial process wastewater. While many different types of pollutants exist in domestic wastewater, the major threat to water quality stems from the excessive discharge of biological constituents (e.g. bacteria, viruses, etc.) and nutrients (e.g. phosphorous, nitrates,

etc.) The make-up and character of industrial/commercial process wastewater varies greatly and can include a wide range of chemical, biological, and nutrient constituents.

Point source discharges of wastewater were among the first environmental concerns to be regulated on a national level. Beginning in the early 1970's, the United State Congress established the Environmental Protection Agency (EPA) and initially charged the agency with evaluating and regulating point source discharges. In the intervening time, the EPA and various state-level agencies have identified and regulated most point source discharges.

For the planning area few, if any, permitted point source discharges are known to occur, however, there may be some non-permitted point source discharges in the area. Due to the historic regulation at the federal and state levels, very little local-level regulation of point source discharges has occurred in the planning area. In addition, there is currently little or no legal authority for local entities to regulate point source discharges.

4.4 Identification of Impact of Water Quality on Habitat Restoration & Protection

Typically, rivers, streams and creeks found in natural conditions serve as a complex ecosystem providing a diverse habitat for a large number of plants and animals. A properly functioning stream riparian area can help reduce pollutant load to the creek, can assimilate a variety of pollutant loads to the creek, can provide temporary storage of floodwaters, can lessen damage caused by floodwaters by reducing water velocities, can contribute to the recharge of groundwater resources, and can provide a diverse habitat for plant and animal species.

As stated previously, for centuries San Felipe Creek has provided and supported critical habitat for the plants and animals living in its drainage basin. The creek habitat is characterized by fast-flowing, spring-fed aquifers; high quality, pollutant-free waters; gravel stream bottom; and, diverse plant & animal biomass. Improving the water quality in San Felipe Creek will provide for an improved habitat for San Felipe Creek and its associated bank areas.

4.5 Water Quality Goals

For the San Felipe Creek Master Plan general water quality goals that can be established for the creek and its drainage basin include:

- Reduce Pollution to the Creek;
- Reduce Erosion - to both bank and upland areas;
- Reduce Trash and Litter accumulation in the creek area; and,
- Keep San Felipe Creek from being listed on the TCEQ's 303(d) List (for identified water quality impaired stream segments in the State).

Based on its 2005 Devils River Minnow Recovery Plan the USFWS has established the following goals for improving or maintaining the habit in San Felipe Creek:

- Protect adequate stream & spring flows
- Reduce pollutants (point/non-point)
- Manage Non-Native Species
- Improve riparian area

4.6 Identification of Water Quality Best Management Practices Appropriate for San Felipe Creek

4.6.1 *What is a Best Management Practice?*

A Best Management Practice (BMP) is a practice determined to be the most efficient, practical, and cost-effective measures identified to control a particular activity or to address a particular problem. Non-point source pollution BMPs are specific practices or activities that are used to reduce or control impacts to a water body from nonpoint sources, most commonly by reducing the loading of pollutants into the drainage basin or waterway. BMPs are separated into two distinct groups, structural and non-structural.

4.6.2 *Structural Best Management Practices*

Structural BMPs include engineered and constructed systems that are designed to provide for water quantity and/or water quality control of storm water runoff. Structural BMPs typically

require extensive construction or installation of the proposed BMP and regular, routine maintenance is often required.

4.6.2.a – Vegetation Enhancement & Management

Healthy, abundant vegetative ground cover slows and filters surface sediment from storm runoff, prevents erosion, and improves infiltration of water into the soil. More sediment is deposited on the land rather than carried into streams or water impoundments, and more water is retained in the riparian zone for slow release to the streams as base flow. Conversely, a lack of, or poor quality, vegetative cover can result in an increase in the sediment and pollutant load discharged to a local water body, increasing the turbidity and adversely impacting the quality of the water in the river, stream or lake.

Practices such as removing invasive species and propagating/re-establishing native plant communities will provide storm water runoff quality similar to undeveloped land in its natural state. Proper vegetative management may include the improvement or enhancement of the soil profile including the introduction of additional soil and/or organic material (e.g., topsoil and compost material), the improvement of the soil structure (e.g., soil retention blankets, plastic geogrid materials, etc...), the planting of native grasses and plants, and routine maintenance and care of these vegetative areas. A schematic of a typical vegetation enhancement soil structure, along with recommendations on preferred grasses to use in the San Felipe Creek area, is shown on **Figure 4**.

4.6.2.b – Stream Bank Stabilization / Riparian Area Restoration / Erosion Control

Similar to the lack of high quality vegetative cover, eroded bank areas of a stream or pond have a direct impact water quality. The eroded sediment will increase the turbidity of the water and will settle on the bottom areas which may contribute to a loss in habitat. The erosion of the bank area also reduces the riparian area along the banks of the water body. A healthy riparian area, with a variety of grasses, plants and trees, is very effective at reducing the sediment and pollutant load to the creek. The loss of riparian area will negatively impact a water body's ability to reduce or eliminate pollutants from stormwater.

Stream bank stabilization can include a variety of including sediment retention blankets, geogrid plastic soil retention systems, structural gabions or wall systems. However, the use of the most natural and environmentally sensitive stabilization system should be encouraged. A typical geogrid/geomat soil reinforcement system schematic is shown in **Figure 5**. A typical rock gabion structural system is shown in **Figure 6**.

The restoration of the riparian area should include a variety of native vegetation including grasses, shrubs and trees. The goal of any type of riparian restoration efforts should be a diverse area of native vegetation that closely mimics those areas found in natural, undeveloped areas. The use of native grasses and shrubs should be included along the entire length of the creek. The use of trees should be encouraged and maximized to the greatest extent possible. In an urban areas, the use of trees may need to be managed in an effort to avoid reduced sight-lines which may create possible security concerns, or where their use may lead to a reduction in the stormwater conveyance capability of the stream or river and therefore cause a concern of potential increase flooding issues.

4.6.2.c – Pervious Pavement

Pervious pavement systems include the use of pervious concrete, pervious asphalt, gravel pavement systems, or other similar systems. These systems are typically described by a structural, load-bearing surface, coupled with an underlying layer capable of temporarily storing stormwater prior to its release by infiltration or through a controlled drainage structure. The use of these systems can reduce both the rate and the amount of stormwater flowing to the creek, reducing the pollutant load to the creek and increasing recharge to groundwater. A typical pervious concrete pavement system for a parking area is shown in **Figure 7**. A similar-type pervious gravel pavement system for a parking area is also shown in **Figure 7**. In general, a pervious gravel pavement system is less expensive to construct than a similar-sized pervious concrete pavement system. A pervious concrete pavement system for a hike and bike trail is shown in **Figure 8**.

4.6.2.d – Vegetative Filter Strips

As their name implies, vegetative filter strips are areas of land where storm water is discharged for the purpose of utilizing the vegetation to trap sediment and other pollutants.

As standalone BMPs, vegetative filter strips are limited in that they can only accommodate sheet flow and not concentrated flow. If there is a need to discharge concentrated flow to a vegetated filter strip, adequate provisions should be incorporated to dissipate the energy and properly distribute the flow. The removal efficiency of these strips varies depending on the pollutant loading and the size of the strip, but they generally provide partial removal of suspended constituents and limited removal of dissolved constituents. Even though the recharge potential is lower with vegetative filter strips, when constructed in the recharge zone, their design should include recharge limitation features. In most instances, vegetative filter strips are intended to work in series with other structural BMPs. Typical layouts for vegetative filter strips adjacent to a roadway or a parking lot are shown in **Figure 9**, while a schematic for a vegetative filter strip is shown in **Figure 10**. A vegetative filter strip can be an important tool in mitigating the water quality impacts caused by paved parking areas, sidewalks, or hike and bike trails. If properly designed and constructed, it is possible to utilize a vegetative filter strip BMP for treatment of storm water runoff from impervious surfaces as an alternative to the pervious pavement systems described in Section 4.6.2.c.

4.6.2.e – Biofiltration / Bioretention Systems

Bio-retention systems are similar to retention/irrigation systems in that they capture storm water for subsequent reuse. However, this reuse takes place inside the retention system through the support of vegetation and benthic and aquatic organisms. Capture is accomplished using structures such as wet ponds or basins with adequate capacity to prevent discharge. These systems are also very effective at controlling a wide variety of pollutants, including both suspended and dissolved constituents.

Biofiltration/bioretention facilities are ideal for treating stormwater runoff from developed areas including parking lots, streets and roof areas. The systems can be sized for small or large flow volumes; however, their use is typically targeted for smaller sized drainage areas. Typical biofiltration/bioretention system layouts are shown in **Figures 11** and **12**. Typical cross sections for a biofiltration/bioretention system are shown in **Figure 13**.

4.6.2.f – Hydrodynamic Separators

Hydrodynamic separators are gravity, flow-through proprietary structures that include a settling unit that can effectively remove sediments and other pollutants that are often found in stormwater runoff. The units typically treat a point-source discharge of stormwater which make them an effective method of treatment for stormwater from bridges, curb cuts, and inlets. The units require no power and are relatively compact, so they provide a viable option for retrofitting existing developments with an effective stormwater BMP.

Hydrodynamic separators are most effective at settling or separating heavier particulate matter, solids, floatables, or trash, and are less effective at capturing dissolved pollutants or small particulates. A typical schematic for a hydrodynamic separator is shown in **Figure 14**; however each manufacturer has a different configuration and design for their particular unit. An important component in the success of such an installation is the proper sizing of the unit, which is typically based on peak stormwater flows. Manufacturer's sizing recommendations and guidelines should be followed for each individual installation.

Hydrodynamic separators come in a variety of configurations that are manufactured by a number of different companies. The units are relatively expensive to purchase and also require regular maintenance. Maintenance is generally in the form a vacuum truck pumping out the collected contents from the settling unit often on a monthly or quarterly basis, depending on the nature and amount of solids collected by the unit.

4.6.2.g – Water Quality Ponds

Water quality ponds are a form of stormwater BMP that uses a constructed pond or basin to collect and treat stormwater generated by a defined drainage area. Water quality ponds include a variety of different treatment options including sedimentation/filtration, extended detention, constructed wetlands, retention/irrigation systems, and number of others. These types of facilities are known to provide a high level of treatment.

However, water quality ponds often take up a considerable amount of land space and require adequate fall from the pond surface to the discharge point to allow for gravity flow, and

require a higher level of maintenance than many other stormwater BMPs. A typical configuration for a water quality pond is shown in **Figure 15**.

4.6.3 Non-Structural Best Management Practices

Non-structural BMPs include institutional and pollution-prevention type practices designed to prevent pollutants from entering storm water runoff or reduce the volume of storm water requiring management. Non-structural BMPs typically do not require extensive construction of proposed improvements, however, they do often times require extensive coordination, administration, and oversight.

4.6.3.a – Public Education

One of the most effective and economical of the non-structural BMPs is public education. Programs and activities that help to educate the general public on ways to reduce or eliminate sources of pollution are one of the simplest and cost-effective methods to positively influence the quality of water in neighboring streams, rivers, and lakes. The goal of a public education campaign or project is for people to gain an understanding of how their actions can affect water quality and to encourage them to take responsibility for those actions.

Public education activities can include the following:

- **Lawn and Garden Activities** - Programs that encourage composting, decreased fertilizer and pesticide use, water use efficiency, practical turf and lawn management strategies, appropriate plant selection, and soil analysis/improvement;
- **Proper Disposal of Household Hazardous Wastes** - Programs that educate citizens on impacts of hazardous household materials and alternatives to toxic chemicals; initiatives to provide disposal opportunities for paints, paint thinners, solvents, motor oil, antifreeze, and other chemicals;
- **Pet Waste Management** - Education to encourage pet owners who live in concentrated residential areas or areas where the waste could not be properly assimilated to collect and properly dispose of their pet's waste;

- **Trash Management** – Programs that educate citizens on impacts of garbage and control measures, including source reduction (alternative packaging, waste reduction, alternative chemicals, recycling etc,) and community clean-up programs;
- **School Programs** - Programs that educate school age children on non-point source pollution, water supply, and the importance of healthy streams, rivers, and lakes; programs could encourage field visits and activities to provide a hands-on, up close experience for the participants.

Educational information can be produced in the form of door hangers, mailers for inclusion with monthly water bills, informational signs and kiosks, and brochures and handouts. Although in some instances producing original educational materials may be necessary or desired, it is recommended that the community rely on materials prepared from other agencies or organizations in an effort to minimize the expense and the effort necessary to produce these types of materials.

4.6.3.b – Community Involvement

Community involvement is a key ingredient in the success of the water quality initiatives. Community involvement is often coupled with public education activities. Ideas to encourage community and citizen participation can include the “adoption” of certain, defined park areas by organizations or groups, a community-wide trash pickup day, a household hazardous waste collection day, park cleanup day, or other similar activities. These initiatives provide an opportunity to involve and educate citizens in the activities and actions that directly impact the areas they see every day. Citizen participation also encourages a sense of ownership that can affect people’s attitudes and actions throughout the year.

4.6.3.c – Land Management / Ordinances

Land use strategies, land management requirements, and ordinances can all be effective tools in controlling and mitigating certain activities that have the ability to adversely impact water quality. Within drainage basins an effective land management strategy can ensure that the land is developed in a manner that protects both the quantity and quality of water in the local streams and rivers.

4.6.3.c.i - Clustering/Low Impact Development

Clustering is the concept of concentrating the impervious cover within a tract of land to maximize separation from the impervious areas to potentially sensitive receptors, such as streams and critical environmental features. Clustering allows development of properties while helping to reduce the overall impact of the development on the local water bodies. Clustering creates buffer zones and areas that, when effectively managed, will directly impact the pollutant load generated by a developed area.

The concept of Low Impact Development (LID) has many elements common to clustering, however the underlying premise of LID is to take a holistic approach to design that minimizes the overall impact of development on a site. Instead of removing pollutants, LID concepts reduce runoff volumes, thereby reducing the impacts from the associated runoff, and further reducing the need for conventional structural BMPs. LID includes the following essential elements:

- Minimizing Impervious Areas
- Directed Growth (through land use ordinances and zoning)
- Sensitive Area Protection
- Open Space Preservation

While these concepts can be applied on a broad scale, the general concepts can also be applied to design on an individual site. For instance, minimizing contiguous impervious areas allows the surrounding pervious areas to more effectively offset the effects of increased runoff from the pervious areas. This process, in turn reduces the need for structural BMPs. Since they rely less on structural BMPs and more on the interaction of several different water quality protection measures working together, the use of LID procedures reduces the water quality risk from the catastrophic failure of a single BMP. For this reason, water quality plans often encourage the use of a LID approach over the more high impact designs which rely heavily on the use of structural BMPs.

4.6.3.c.ii - Impervious Cover Limits

Impervious cover consists of buildings, streets, driveways, parking lots, and other types of impervious surfaces. Typically, an increase amount of impervious cover leads to an increase in the amount of rainfall which turns to surface runoff and correspondingly decreases the amount of infiltration (recharge) to groundwater. In general, as the amount of impervious cover increases there is a measurable decrease in water quality of stormwater flows.

The concept of limiting impervious cover within a drainage basin can be one tool to help achieve improved water quality within the basin. However, localized impacts may occur from localized areas of higher intensity development within a particular site. For this reason, impervious cover limits should typically be used in conjunction with other stormwater BMPs to control the effects from the developed areas, and are not intended to be utilized as the sole water quality protection measure for site development.

4.6.3.c.iii - Land-use restrictions

Land use restrictions can be an effective tool in managing the development of land throughout a drainage basin. Typically, land use restrictions prohibit or limit a property or area from hosting certain activities that have been found to be detrimental to water quality, the environment, or neighboring properties. Land use restrictions can include the prohibition of waste disposal wells (disposal of liquid wastes by underground injection), feedlots or concentrated animal feeding operations, land disposal of Class I industrial wastes (landfills or land application sites), the use of sewage holding tanks as part of an organized sewage collection system, municipal solid waste landfill facilities, new municipal and industrial wastewater discharges.

Local jurisdictions, where and when appropriate, can develop land-use restrictions to prohibit some or all of these types of activities. In addition to these prohibitions, a local jurisdiction should also consider the development of restrictions on industrial facilities. Industrial facilities often concentrate operations and chemicals which can pose a serious threat to water quality. New industrial facilities would typically be restricted through their need to obtain a wastewater discharge permit; however, local jurisdictions should consider the explicit prohibition on industrial land-uses in vulnerable drainage basins.

4.6.3.c.iv - Zoning/Use limitations

In addition to certain land-use prohibitions, a City has the power to restrict the location of certain activities through zoning and/or use-limitations. These zoning powers may only be applied to the land inside the City Limits. The restriction of development throughout a drainage basin is an effective tool in managing and improving surface water quality.

4.6.3.d – Litter/Trash Pick Up Programs

Organized litter/trash pickup programs are an easy way to provide effective control of solid waste that may be illicitly deposited in and around the creek area. Volunteers may be targeted from specific organizations (schools, service organizations, clubs, etc...) or solicited from the general population. The concentrated efforts of a large number of persons can provide a source of labor that would be difficult for the City to match. Additional trash bins along streams and rivers, and throughout park areas can help encourage the proper disposal of trash and solid waste. Often times, an organized litter/trash pick up program ties its activities to a public education program that helps citizens and visitors better understand the negative impacts litter can have on the environment and water quality, and also encourages individuals to actively manage their own trash during picnics, outings, and public gatherings.

4.6.3.e – Pet/Animal Waste Control

Pet/animal waste control can include a combination of public education activities and installation of pet waste stations. Pet waste stations can include both a trash can and waste bags that facilitate and encourage the pickup of pet waste. The pet waste stations must be spaced so the distance between stations is not so great that it discourages waste collection. These stations must also be serviced on a regular basis to ensure that the waste is collected and the waste bags are resupplied.

4.6.3.f – Human Waste Control

Human waste control can be effectively managed by a combination of public education and the installation of adequate public restroom facilities and trash receptacles. For park areas public restrooms should be located in known high traffic areas and should be adequately spaced to ensure easy access for park visitors. The installation of an adequate number of trash

cans will help to provide a convenient, proper method for solid waste disposal. A targeted, public service campaign can be an effective tool in educating the public on the proper method of disposal of trash, diapers, and other such materials.

4.6.3.g – City Operation & Maintenance Practices

Impacts to water quality can be influenced by routine operation and maintenance practices followed by City crews and staff. Fertilizing type, frequency of application, rate of application, and location of application can all influence the amount of residue and nutrients that ultimately impact water resources. Pesticide usage can also impact water bodies with the timing and rate of application of prime importance. Other practices that can result in an impact to water quality are mowing heights, vehicle maintenance, trash collection schedules, street sweeping programs, and other often routine activities.

4.6.3.h – Agricultural Practices

Improper agricultural practices also have the ability to adversely impact water quality. The primary threats from agricultural operations include excessive erosion/sedimentation from over-grazing and improper tillage, excessive nutrients from improper fertilizer application and excess nutrients and biological constituents from improper animal waste management.

The following measures are recommended agricultural practices that help in minimizing the impacts of agricultural operations within a drainage basin:

Controlled Grazing – utilizing structural fencing and administrative rotation practices to evenly distribute grazing activity across the property, to avoid concentrating animal byproducts and vegetative disruption in the same areas over the long-term. This practice is also intended to balance forage consumption by grazing animals with plant biomass production in a manner that provides a portion of the plant resources for conservation purposes and maintenance of a healthy plant community;

Distributed Watering – similar to controlled grazing, the objective is to distribute watering activities around the property to avoid concentrating animal activity and byproducts in the same areas over the long-term;

Topsoil/Nutrient Maintenance and Enrichment – ensuring that the topsoil and grasses have adequate nutrients to support grazing and prevent the adverse impacts of over-grazing;

Weed/Invasive Plant Control – managing and controlling the propagation of weeds/invasive plants to ensure that soil nutrients are available for grasses and minimizing the need for supplemental nutrient application;

Select appropriate crops - choose crops which can be sustained from natural precipitation, and avoid the need for irrigation or additional water application;

Minimize the use of pesticides and nutrients - use the correct chemicals for the job and follow proper application procedures for each chemical used; and,

Use conservation practices (e.g. contour farming, hedgerow planting, crop rotation, etc...) - use appropriate conservation practices to minimize erosion/sedimentation as much as possible.

4.7 Recommendations for Water Quality Protection Measures for San Felipe Creek

Selection of appropriate BMPs depend on a combination of effectiveness, reliability, construction costs, maintenance costs, and aesthetics.

4.7.1 Structural BMPs

For the San Felipe Creek planning area the use of the following structural BMPs are recommended:

- **Vegetation Enhancement/Management**

The bank areas of San Felipe Creek have many locations that have little to no vegetative cover. Proper or improved vegetative practices will help to improve the water quality of San Felipe Creek by reducing the amount of sediment that is deposited in the creek. The improvement of vegetation throughout the drainage basin should be encouraged. Concentration of efforts in and around the areas near the creek will have the most positive impact on water quality. It is recommended that the City

improve the vegetative cover on City controlled property near San Felipe Creek by improving the soil structure and by the use of appropriate grasses and native plants.

- **Bank Stabilization**

The elimination of eroded bank areas along San Felipe Creek will improve water quality by reducing the sediment load to the creek, increasing the amount of healthy riparian area along the creek bank, and by improving the ability of the riparian area to more effectively remove sediment and pollutant loads before they reach the creek.

Stream bank stabilization can include a variety of treatments including sediment retention blankets, geogrid plastic matting, structural gabions or wall systems. As previously stated, the use of the most natural and environmentally sensitive stabilization system should be encouraged. Each proposed project will require evaluation by qualified professionals to ensure that the proposed improvements will withstand the effects of floodwaters and will not suffer from potential damage by the invasive species known to inhabit the area including armored catfish and nutria.

The goal of for the establishment of the riparian area along San Felipe Creek should be for a diverse, esthetically pleasing environment that blends in with the surrounding areas and is compatible with the intended land use by the public.

Figures 5 and **6** show examples of stream bank stabilization techniques that should be encouraged along the banks of San Felipe Creek. While no specific distance has been established for the riparian area, its distance from the edge of the creek should be maximized to the greatest extent practical. A goal of a 50 foot riparian area from the edge of the creek should help serve as a guide to future revisions and improvements to the bank areas. Within this 50 foot buffer area the use of impervious surfaces should be minimized and the use of a diverse, native plant species should be encouraged.

- **Riparian Area Restoration**

The restoration of the riparian area should include a variety of native vegetation including grasses, shrubs and trees. The use of native grasses and shrubs should be included along the entire length of the creek. The use of trees may be minimized in select areas where their use may reduce sight-lines and thereby create possible security concerns, or in areas where the reduction in stormwater conveyance caused by additional trees may be a concern. The use of trees should be encouraged and maximized to the greatest extent possible. To the maximum extent possible, riparian area restoration should be undertaken at the same time as bank stabilization efforts. An example of a typical riparian area is shown in **Figure 16**.

- **Vegetative Filter Strips**

As previously discussed, vegetative filter strips are areas of land where storm water is discharged for the purpose of utilizing the vegetation to trap sediment and other pollutants. The use of vegetative strips and buffers should be maximized throughout the San Felipe Creek area. Vegetative filter strips are typically limited due to the need for sheet flow onto the BMP area; however, their use around paved parking areas and other impervious cover areas should be encouraged. **Figures 9 and 10** show typical layouts and cross sections for vegetative filter strips. A minimum vegetative filter strip width of 15 feet should be provided, however the width of the vegetated area should be maximized to the greatest extent practical.

- **Pervious Pavement**

Possible short-term projects along San Felipe Creek that may utilize a pervious pavement system include new parking areas, new hike and bike trails, new sidewalks, and other future paved areas. Long-term projects along San Felipe Creek that can potentially use pervious pavements include the replacement of most impervious surfaces including existing parking lots, existing sidewalks, and existing hike and bike trails. Examples of pervious pavement systems are shown in **Figures 7 and 8**.

- **Biofiltration/Bioretenion**

For the San Felipe Creek area these types of facilities should be located away from the creek area and preferably up gradient from the creek since the filtration system should be located above the seasonal high groundwater table. Typical biofiltration/bioretenion systems are shown in **Figures 11, 12 and 13**.

- **Water Quality Ponds**

Water quality ponds include a variety of different treatment options, however for the San Felipe Creek area the use of constructed wetlands systems and/or sedimentation/filtration systems would appear to be the best options.

This type of BMP may be impractical for much of the San Felipe Creek drainage basin; however its use should be evaluated and considered for the undeveloped land that dominates the upstream portion of the drainage basin and for the FEMA Buyout Properties along the lower end of the project area. A typical schematic of a water quality pond is shown in **Figure 15**.

4.7.2 Non-Structural BMPs

For the San Felipe Creek planning area the use of the following structural BMPs are recommended:

- **Public Education**

Programs and activities that help to educate the citizens of Del Rio, park users, and visitors on ways to reduce or eliminate sources of pollution are one of the simplest and cost-effective methods to positively influence the quality of water in the San Felipe Creek.

- **Community Involvement**

Ideas to encourage community and citizen participation include a “Friends” of San Felipe Creek campaign, a community-wide trash pickup day, a household hazardous waste collection day, park cleanup day, or other similar activities.

- **Land Management/Ordinances**

Land use strategies, land management requirements, and ordinances can all be effective tools in controlling and mitigating certain activities that have the ability to adversely impact water quality in San Felipe Creek. In the San Felipe Creek drainage basin a large amount of the land upstream of the San Felipe Country Club property is either undeveloped or minimally developed. This area should be the focus of local efforts to ensure that the land is developed in a manner that protects both the quantity and quality of the flow from the San Felipe Springs.

Clustering/Low Impact Development

Clustering is the concept of concentrating the impervious cover within a tract of land to maximize separation from the impervious areas to potentially sensitive receptors, such as streams and critical environmental features. The concept of Low Impact Development (LID) has many elements common to clustering; the underlying premise is to take a holistic approach to design that minimizes the overall impact of development on the site.

It is recommended that the City consider the adoption of an ordinance that specifically encourages the use of clustering or LID within the City and surrounding areas.

Impervious Cover Limits

As stated previously, as the amount of impervious cover is increased over a drainage basin the surface water runoff typically increases, the amount of water infiltrating into the ground decreases, and there is a measurable decrease in water quality of the stormwater runoff. The City may consider limiting the percent of impervious cover on undeveloped properties. However, any impervious cover limits should not be imposed without requiring stormwater BMPs, implementation of land use restrictions, and additional land management strategies.

Land-use restrictions

The City should consider the development of a land use restriction ordinance that specifically prohibits activities detrimental to water quality. Such activities would include waste disposal wells (disposal of liquid wastes by underground injection), feedlots or concentrated animal feeding operations, land disposal of Class I industrial wastes (landfills or land application sites), the use of sewage holding tanks as part of an organized sewage collection system, municipal solid waste landfill facilities, new municipal and industrial wastewater discharges. Also restriction on the establishment of industrial facilities within the San Felipe Creek drainage basin should also be considered.

Zoning/Use limitations

The City has the power to restrict the location of certain activities through zoning and/or use-limitations within the City Limits. Much of the San Felipe Creek drainage basin within the City Limits is zoned for single-family residential use. The City has and should continue to monitor land use within its jurisdiction and make efforts to appropriately control land use to positively affect the quantity and quality of the water generated by San Felipe Springs.

- **Litter/Trash Pick Up**

It is recommended that an organized litter/trash pickup program run by community volunteers be established to provide additional man-power for trash and debris collection along the creek area. This volunteer effort would supplement the City's existing collection efforts by City Parks and Recreation staff. The effort could organize regularly scheduled clean up days (i.e., monthly, quarterly, semi-annual), target specific areas of the creek.

- **Pet/Animal Waste Control**

The City should actively implement a pet/animal waste control program that includes a combination of public education activities and installation of pet waste stations. Pet waste stations should be located at reasonable intervals along the creek to allow and encourage the proper disposal of animal waste. An organized public education

program should be implemented that details the reasons for pet waste disposal, both at home and on City property.

- **Human Waste Control**

New public restrooms should be located along San Felipe Creek to serve park visitors, and existing public restrooms along the creek should be renovated. Additional trash cans should be provided in all park areas. A targeted, public service campaign is suggested on the benefits and the proper method of disposal of trash, diapers, and other such materials.

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5. ENDANGERED & THREATENED SPECIES

5.1 History and Background Information

San Felipe Creek provides an ideal habitat for human, animal, and plant species. The fast-flowing, spring-fed waters provide an abundant source of high quality water that helps provide a solid foundation for the support of a diverse ecosystem.

For additional information on the history of the area surrounding San Felipe Creek and the City of Del Rio can be found in **Appendix A** (CP&Y Environmental Document - Sections I, II, and VIII), **Appendix C** (San Felipe Creek Commission - San Felipe Creek Vision Plan), as well as Sections 1.0 and 2.0 of this report.

5.2 Threatened and Endangered Species

A number of threatened, endangered or candidate species have been identified as occurring in Val Verde County, Texas. These species have been identified by either federal or State agencies and are currently found on these agencies databases for Val Verde County.

Two of the species most important to San Felipe Creek include the Devils River Minnow and the San Felipe Gambusia. The Devils River Minnow was listed as threatened by the USFWS on October 20, 1999. The species was the focus of the USFWS's Devils River Minnow Recovery Plan that was published in September 2005 (see **Appendix D**). The San Felipe Gambusia is a new species recently discovered in 1997. The species is known only to exist within San Felipe Creek in Val Verde County and is currently listed as threatened by the TPWD.

Additional information and discussion on threatened and endangered species known to existing in and around the project area can be found in **Appendix A** (CP&Y Environmental Document - Section V) and **Appendix D** (USFWS Devils River Minnow Recovery Plan).

5.3 Agency Consultations

San Felipe Creek provides habitat that is important to the survival of many plants, animals that are found nearby. The creek also provides an ideal environment that has been welcoming to human occupation for thousands of years.

Having previously identified the Devils River Minnow as a threatened species in San Felipe Creek the USFWS must be consulted prior to construction of improvements in or around the creek area. During this planning effort the USFWS has been included in project meetings, telephone conversations, and e-mails as part of an effort to keep the agency up to date on the latest project developments. Details of the on-going USFWS coordination efforts have been documented and outlined by CP&Y in Section VI of **Appendix A** (CP&Y Environmental Document) of this master plan.

Furthermore, as detailed in Section VII of **Appendix A**, a U.S. Army Corps of Engineers (USACE) individual permit will likely be necessary prior to initiation of any construction work in and around the creek area, including bank demolition and reconstruction.

In the future, as the City moves this project forward from the planning phase to the design, and ultimately to the construction phase(s), coordination with State and federal agencies will be critical to the success of the overall project. At a minimum, consultation with USFWS, USACE, Texas Parks and Wildlife Department (TPWD), Texas Historical Commission (THC), Texas Archeological Research Laboratory (TARL) should be anticipated. The coordination efforts should be initiated prior to the design of any proposed improvements planned for within or near the creek area.

For activities that occur in the creek itself, such as dredging or other similar activities, permits from the TPWD, USACE, and TCEQ will likely be required. Consultation and approval of the project by the USFWS, FEMA, and the local floodplain administrator must be obtained prior to beginning construction activities.

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6. INVASIVE SPECIES

6.1 Invasive Species

San Felipe Creek is host to a number of invasive species. Invasive plant species include *Arundo donax* (also known as giant reed or river cane), elephant ears, and chinaberry. Invasive animal species known to inhabit the area include armored catfish (*Hypostomus sp.*).

The presence of invasive species can be a significant issue with respect to efforts to maintain water quality within San Felipe Creek and its drainage basin. Invasive species have a negative impact on existing water quality by destroying native habitat and out-competing native species for food, and in some cases, by causing physically damaging creek area. Such impacts can lead to a loss of riparian area which serves as a filter for stormwater prior to entering the creek. For these reasons, the elimination of invasive species in the San Felipe Creek drainage basin can be an important key to improving and maintaining the water quality of San Felipe Creek.

6.2 *Arundo donax*

Giant Reed was introduced to the region from Europe in the 1600s as a source of animal feed and for use in home and shelter construction. The eradication of this invasive species would help to improve creek habitat by allowing native vegetation the ability to more easily grow in and around the creek area and would aid in increasing creek flow by eliminating a significant source of water demand.

Appendix B provides a more complete outline of the *Arundo donax* problem and offers recommendation on how to successfully eradicate this species from the San Felipe Creek drainage basin.

6.3 Armored Catfish

Armored catfish (*Hypostomus plecostomus*) are an invasive species that appear to be present in almost all portions of San Felipe Creek. Negative impacts from armored catfish include out-competing native species for food, impacting native populations by reducing the available food source and even eating the eggs of other fish as they scour the bottom area feeding on

algae and other plant materials. These fish appear to be a major contributor to bank erosion and instability due to their habitat of burrowing into and under the bank area which increases turbidity in the creek and ultimately results in bank failure. Such activities lead directly to an increase in the sediment load of San Felipe Creek and can result in a loss of suitable habitat for the threatened and endangered species that live in and around the creek.

The Armored catfish has no known predators. While elimination and control of the Armored catfish is desired, at this time there is no effective way to significantly reduce their numbers in San Felipe Creek. The City should encourage State and federal agencies to research the existing problem and develop a suitable solution to control and eliminate the fish from San Felipe Creek.

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7. HABITAT RESTORATION & PROTECTION

7.1 Existing Habitat Along San Felipe Creek

San Felipe Creek has been dissected out of limestone, shale, siltstone and clay layers to create a creek that is characterized by a mostly rocky, gravelly bottom area with an abundance of high-quality, fast-flowing water emanating from San Felipe Springs. The water in the creek is low in turbidity with very low levels of suspended solids or organic matter.

The natural bank areas of San Felipe Creek are lined with a mixture of water-tolerant pecans, oaks, junipers, grasses, and mesquites that provides a natural riparian area capable of hosting an abundance of birds and animals. However, invasive species, particularly *Arundo donax*, or Giant Reed, dominates a large portion of the riparian area in the portion of the creek from San Felipe Country Club downstream to the Rio Grande. Along some stretches of San Felipe Creek bank stabilization or bank improvement projects have resulted in creek bank areas typified by vertical or sloping walls of concrete, stone, and other materials.

Additional details on the existing habitat along San Felipe Creek is outlined in **Appendix A** (Environmental Documentation - by CP&Y), **Appendix C** (San Felipe Creek Vision Plan), and **Appendix D** (Devils River Minnow Recovery Plan - USFWS).

7.2 Critical Habitat in Need of Restoration

Over time improvements along San Felipe Creek have resulted in a reduction or loss of the natural riparian area that helps to serve as a buffer and filter for stormwater that enters the creek from the surrounding, increasingly urbanized areas. These areas are particularly evident along the portion of the creek from San Felipe Country Club downstream to the Rio Grande. Restoration of this riparian buffer for select portions of the creek will help reduce the amount of sediment and pollutants entering the creek which should aid in improving water quality in the creek.

7.3 Critical Habitat in Need of Protection

San Felipe Creek critical habitat includes the riparian areas that exist along some portions of the creek banks, the high quality water emanating from San Felipe Springs and flowing in the

creek, the quantity of water flowing in the creek, and the rocky, gravelly bottom area of the creek.

7.4 Recommended Habitat Restoration & Protection Strategies

The following strategies are recommend to help restore and protect critical habitat along San Felipe Creek:

7.4.1 *Invasive Species Eradication*

Invasive species eradication is one strategy that can play an effective part in the restoration of critical habitat along San Felipe Creek. Identified invasive species include giant reed (*Arundo donax*), elephant ears (*Alocasia macrorrhiza*), chinaberry (*Melia azedarach*), and armored catfish (*Hypostomus plecostomus*). A detailed plan for the eradication of *Arundo donax* from San Felipe Creek is outlined in **Appendix B**.

Any invasive species eradication efforts should be closely coordinated with State and federal agencies that may be willing to participate in, or offer assistance with, these on-going efforts. Federal agencies such as the Office of Homeland Security, the Border Patrol Agency, the USFWS, and the United States Department of Agriculture (USDA) should be contacted on a regular basis to see if they are interested in assisting.

In particular the USDA's Agricultural Research Service's (ARS) Beneficial Insect Research Unit (BIRU) is very active in researching and investigating new and effective control methods. These latest efforts include releasing various insects to biologically control and limit the growth of *Arundo donax*. These efforts can complement the eradication efforts outlined in Appendix B, which include cutting and chemical treatment. It is recommended that a line of communication be established with the USDA's ARS office in Weslaco, TX so that the latest information on eradication efforts can be shared between the City and the USDA:

USDA - ARS
2413 E Highway 83
Weslaco, TX 78596
(956) 969-4803
(Dr. John Goolsby - initial contact)

7.4.2 Protection of Native Vegetation

In areas of San Felipe Creek where the bank/riparian areas include natural vegetation, this vegetation should be protected and encouraged to grow and flourish. Earth disturbing activities in these areas should be confined to as small a footprint as possible and the native vegetation should be cared for in a manner that protects it from damage. Any on-going maintenance efforts, including mowing, should only be undertaken after a proper schedule and method have been outlined that does not adversely affect the long-term growth of the native vegetation.

7.4.3 Bank Stabilization / Erosion Control

For portion of San Felipe Creek that have bank erosion problems these areas should be stabilized in a manner that improves their stability and eliminates long-term erosion problems. Efforts should include the removal of existing collapsed creek walls, followed by bank improvements. Where possible, the bank improvements should mimic natural conditions as much as possible. In areas of the creek where a more structural-type solution is necessary, the use of pervious concrete, gravel pavement systems, rock gabions, and other design and construction methods that are as environmentally friendly as possible should be utilized.

7.4.4 Riparian Area and Vegetation Enhancement

To the maximum extent practical the riparian area should be allowed and encouraged along San Felipe Creek. In existing areas lacking suitable, native vegetation an organized effort to enhance and improve the vegetative cover should be undertaken.

7.4.5 Water Quality Protection Strategies (Structural and Non-Structural Best Management Strategies)

Existing habitat within and adjacent to San Felipe Creek is threatened by the effects of urbanization of the surrounding area which includes the addition of impervious surfaces, the increase in population, the increase in construction activities, and an increase in both point and non-point source pollutants. In an effort to restore and protect existing habitat, non-point source Best Management Practices (BMPs) are specific practices and activities that can be used to reduce or control impacts to a water body. By reducing or controlling these potential impacts, critical habitat within the watershed can be restored and protected.

In the case of San Felipe Creek the use of both Structural and Non-Structural BMPs can help protect water quality within the creek and aid in preserving existing habitat. Appropriate Structural BMPs have been discussed in detail in Section 4.6.2 of this plan with the recommended Structural BMPs listed in Section 4.7.1. Similarly, Non-Structural BMPs have been discussed in detail in Section 4.6.3 of this plan with the recommended Non-Structural BMPs listed in Section 4.7.2.

In summary, Structural BMPs recommended for the San Felipe Creek area include the following:

- Vegetation Enhancement & Management;
- Stream Bank Stabilization / Riparian Area Restoration;
- Pervious Pavement;
- Vegetative Filter Strips;
- Biofiltration/Bioretenion Systems;
- Hydrodynamic Separators; and,
- Water Quality Ponds.

Non-Structural BMPs recommended for the San Felipe Creek area include the following:

- Public Education;
- Community Involvement;
- Land Management/Ordinances;
- Litter/Trash Pick Up Programs;
- Pet/Animal Waste Control;
- Human Waste Control; and,
- City Operation & Maintenance Practices.

By using these BMPs the impacts of urbanization can be reduced which will help restore and preserve the critical habitat along San Felipe Creek.

8. INVENTORY & NEEDS ASSESSMENT

8.1 Existing & Compatible Land Uses Along San Felipe Creek

The San Felipe Creek drainage basin has a mixture of land uses. Within the portion of the drainage basin inside the City Limits properties include those zoned by the City as small-lot single-family residential, large-lot single-family residential, multi-family residential, commercial, commercial-historical, and industrial. A current City of Del Rio Zoning Map is included in **Appendix H**. Land areas within the basin, but outside the City Limits are not subject to the City's zoning ordinances. At the present time the majority of the land area outside the City Limits is undeveloped and currently utilized for agricultural use, while smaller portions are properties used for light industrial activities, commercial properties, and residential properties.

The San Felipe Creek drainage basin upstream of Round Mountain lies both inside and outside the City Limits and has a combined area of approximately 25,800 acres. At the present time approximately 3,162 acres (or 12%) of the drainage basin lies within the City Limits and approximately 22,638 acres (or 88%) lies outside the City Limits.

The lower end of the San Felipe Creek drainage basin, downstream of San Felipe Creek Country Club includes a variety of land uses, but is mostly dominated by residential areas, along with park and City-owned properties. South of US Highway 90 properties adjacent to the creek consist of a considerable amount of city-owned, city-controlled land.

Much of the property along and adjacent to San Felipe Creek lies within the 100-year floodplain. Property within the 100-year floodplain is subject to restrictions on any improvements proposed for the property.

The current land and properties along San Felipe Creek include a mixture of properties including single-family, city owned and controlled properties, properties within the 100-year floodplain. While properties along the creek lend themselves to a variety of improvements, the zoning of a property may need to be revised prior to initiation of the project.

8.2 Existing Park & Recreational Improvements Along San Felipe Creek

Parks and recreational improvements within a community provide opportunity for residents to gather, individually or in groups, to enjoy the outdoors, participate in leisure or athletic activities, socialize with neighbors, and come together as a community. The City of Del Rio has constructed parks and recreational improvements throughout the City to provide residents with such opportunities.

Water quality of a water body is impacted by previous development activities and on-going activities that occur on the land near or adjacent to the water body. For San Felipe Creek, especially for the stretch of creek south of US Highway 90, a significant potential for water quality impact exists from the City parks and recreational improvements already in place.

Existing development along San Felipe Creek includes a variety of improvements. Among the improvements constructed, some of the most popular and heavily used are the parks and recreational improvements that have been constructed in City parks and City-owned property located south of US Highway 90. **Figure 17** shows the existing City parks located along San Felipe Creek. These improvements include hike and bike trails, playscapes, picnic areas, baseball fields, soccer fields, swimming pools, creek-side bank improvements, sidewalks, buildings, parking areas, and other improvements typical of a municipal park site.

8.2.1 Park Improvements

Existing parks and recreational improvements are listed in **Table 8-1** on the following pages and are also shown on **Figure 18**. Many of the park improvements listed in the table and shown on **Figure 18** have been taken in part from the City's Parks, Recreation & Open Space Master Plan 2011-2020 for the City of Del Rio document prepared by TRC Engineers, Inc. and the City's Parks and Recreation Department. A copy of the plan has been included as **Appendix I**. Additional information on existing parks and recreation facilities is also included in Chapter Four - Parks and Recreation of the Del•RioPlan developed by Kendig Keast Collaborative, a copy of which is included as **Appendix J**.

Table 8-1 - Existing Park & Recreation Improvements Along San Felipe Creek¹

Park No. ²	Park Name	Amenities ¹	Quantity ¹	Condition ¹	Comments
2	Abe Barrera Memorial Park	Volleyball Courts	1	Poor	One of the oldest parks in Del Rio. Park improvements would include repairs to the existing sand court and a new volleyball net. The remaining park equipment could use repairs as well as new trash cans and new BBQ pits.
		Picnic Tables	4	Fair	
		BBQ Pits	3	Poor	
		Trash Cans	4	Fair	
		Swing Sets	1	Poor	
3	Amphitheater	Park Benches	4	1 Excellent, 3 Good	
		Trash Cans	2	Good, Fair	
		Restrooms	1	Good	
		Picnic Tables	3	Excellent	
4	Blue Hole / Horseshoe Park	Facilities included in Moore Park (#17) total			Adjacent to Moore Park. Along with Moore Park these are two of the most frequently used parks by residents coming to access San Felipe Creek.
5	Blue Star Park	Trash Cans	1	Good	Adjacent to Blue Hole/Horseshoe Park (#4) and Moore Park (#17).
6	Brown Plaza	Park Benches	26	Good	One of the original parks of Del Rio. This park continues to serve as a cultural focal point for citizens and as a community gathering place for special events and holidays.
		Trash Cans	4	Good	
		Brick Fountains	2	Good	
		Light Posts	7	Good	

1 - Summary of existing improvements were taken from Table 6-1 of the City of Del Rio's Planning & Capacity Building Study (2010-2020) and Table 2 of the Parks, Recreation and Open Space Master Plan (2010-2020). Both documents were prepared by TRC Engineers, Inc. (TBPE Firm No. F-8632). The Parks, Recreation and Open Space Master Plan has been included as **Appendix I**.

2 - Park numbers included in table are from the City of Del Rio's Park Guide Map. This map has been included as **Appendix K**.

Table 8-1 - Existing Park & Recreation Improvements Along San Felipe Creek¹ (cont.)

Park No. ²	Park Name	Amenities ¹	Quantity ¹	Condition ¹	Comments
8	Camp Del Rio	Walking Trail	1	Poor	Goals posts on soccer field are in poor condition.
		Soccer Field	1	Fair	
		Bleachers	4	Good	
		Trash Cans	3	Good	
16	Hogan Park (baseball field)	Baseball Field	1	Good	Bleacher siding in fair condition. Field has lights and is host to many youth baseball games.
		Trash Cans	2	Fair	
		Dumpster	1	Good	
		Bleachers	4	Good	
17	Moore Park	Open Space			Heavily used park, particularly during the warm weather months. Provides excellent access to San Felipe Creek. 1 Poor
		Walking Trail			
		Park Benches	13	11 Good, 2 Fair	
		Trash Cans	14	8 Good, 6 Fair	
		BBQ Pits	14	9 Good, 4 Fair, &	
		Picnic Tables	25	24 Good, 1 Fair	
		Basketball Court	0.5	Poor	
		Pool w/ Bathhouse	1	Excellent	
		Volleyball Courts	2	Poor	
		Water Fountain	1	Poor	
		Dumpster	1	Good	

1 - Summary of existing improvements and some comments were taken from Table 6-1 of the City of Del Rio's Planning & Capacity Building Study (2010-2020) and Table 2 of the Parks, Recreation and Open Space Master Plan (2010-2020). Both documents were prepared by TRC Engineers, Inc. (TBPE Firm No. F-8632). The Parks, Recreation and Open Space Master Plan has been included as **Appendix I**. Comments pulled directly from the Master Plan are included in quotations.

2 - Park numbers included in table are from the City of Del Rio's Park Guide Map. This map has been included as **Appendix K**.

Table 8-1 - Existing Park & Recreation Improvements Along San Felipe Creek¹ (cont.)

Park No. ²	Park Name	Amenities ¹	Quantity ¹	Condition ¹	Comments
20	Riverside Park	Along Creek			Arundo donax (River Cane) dominates this stretch of San Felipe Creek.
23	Romanelli Park	Open Space			Park has a significant amount of open space.
		Stone Monuments	6	Good	
		Flagpoles	3	Good	
		Park Benches	5	Excellent	
		Trash Cans	4	Fair	
		BBQ Pits	4	Fair	
		Picnic Tables	5	Excellent	
22	Roosevelt Park (baseball field)	Baseball Field	1	Good	This field serves as the home field for the Del Rio High School baseball team.
		Concession Stand	1	Fair	
		Restrooms	1	Fair	
23	Rotary Park	Open Space			This park is frequently used by area residents.
		Covered Pavilion	1	Good	
		Park Benches	7	3 Fair, 4 Poor	
		Trash Cans	4	3 Good, 1 Fair	
		Large BBQ Pit	1	Good	
		BBQ Pits	4	Good,Fair,2 Poor	

1 - Summary of existing improvements and some comments were taken from Table 6-1 of the City of Del Rio's Planning & Capacity Building Study (2010-2020) and Table 2 of the Parks, Recreation and Open Space Master Plan (2010-2020). Both documents were prepared by TRC Engineers, Inc. (TBPE Firm No. F-8632). The Parks, Recreation and Opens Space Master Plan has been included as **Appendix I**. Comments pulled directly from the Master Plan are included in quotations.

2 - Park numbers included in table are from the City of Del Rio's Park Guide Map. This map has been included as **Appendix K**.

Table 8-1 - Existing Park & Recreation Improvements Along San Felipe Creek¹ (cont.)

Park No. ²	Park Name	Amenities ¹	Quantity ¹	Condition ¹	Comments
23	Rotary Park (cont.)	Picnic Tables Playscapes Basketball Court Volleyball Courts Soccer Field	17 2 1 1 1	Fair Excellent, Poor Good Good Poor	
24	San Felipe Lion's Hut ³	Playscape Building	1 1		This park was not listed in the City's Master Plan, however it is included on the City's Park Guide Map (Appendix K).
25	San Felipe Lion's Park	Open Space Picnic Tables Trash Cans Playscape Swing Set	 6 6 1 1	 4 Good, 2 Fair Good Good Fair	
26	Severiano Perez Parkway	Open Space Park Benches Trash Cans BBQ Pits	 4 3 2	 1 Good, 3 Fair Good 1 Good, 1 Fair	

1 - Summary of existing improvements and some comments were taken from Table 6-1 of the City of Del Rio's Planning & Capacity Building Study (2010-2020) and Table 2 of the Parks, Recreation and Open Space Master Plan (2010-2020). Both documents were prepared by TRC Engineers, Inc. (TBPE Firm No. F-8632). The Parks, Recreation and Open Space Master Plan has been included as **Appendix I**. Comments pulled directly from the Master Plan are included in quotations.

2 - Park numbers included in table are from the City of Del Rio's Park Guide Map. This map has been included as **Appendix K**.

3 - San Felipe Lion's Hut amenities, quantities, and condition were not listed in the Parks, Recreation and Open Space Master Plan document.

Table 8-1 - Existing Park & Recreation Improvements Along San Felipe Creek¹ (cont.)

Park No. ²	Park Name	Amenities ¹	Quantity ¹	Condition ¹	Comments
26	Severiano Perez Parkway (cont.)	Picnic Tables Water Fountain Playscapes Swing Set Slides Light Posts	2 1 2 1 1 3	Good Poor Excellent Fair Fair Good	
	Skate Park (adjacent to Severiano Perez Parkway)	Skate Course Walking Trail Basketball Court Park Bench Trash Cans	1 1 2	Good Poor Fair Poor Fair	This park was listed in the City's Master Plan; however it is not included on the City's Park Guide Map (Appendix K). The park sets adjacent to the Severiano Perez Parkway.
28	State Park	Facilities included in Moore Park (#17) count			
	Joe Ramos Center	Basketball Court Cafeteria Recreation Room	1 1 1	Excellent Excellent Excellent	The Joe Ramos Center was listed in the City's Master Plan, however it is not included on the City's Park Guide Map (Appendix K).
	San Felipe Country Club ⁴	Golf Course	9 holes		A significant amount of Arundo donax (River Cane) is present along the banks of San Felipe Creek (East and West Forks) within the golf course property.

1 - Summary of existing improvements and some comments were taken from Table 6-1 of the City of Del Rio's Planning & Capacity Building Study (2010-2020) and Table 2 of the Parks, Recreation and Open Space Master Plan (2010-2020). Both documents were prepared by TRC Engineers, Inc. (TBPE Firm No. F-8632). The Parks, Recreation and Open Space Master Plan has been included as **Appendix I**. Comments pulled directly from the Master Plan are included in quotations.

2 - Park numbers included in table are from the City of Del Rio's Park Guide Map. This map has been included as **Appendix K**.

4 - San Felipe Country Club is a private development and not part of the City's park system.

8.2.2 Existing Hike and Bike Trail Improvements

A hike and bike trail system provides an easily accessible activity center capable of providing citizens of all ages a focus point for exercise and recreation. A developed trail system can serve as a link between existing parks and neighborhoods providing area residents a direct route between centers of activity. For the citizens of Del Rio, the trail system along San Felipe Creek provides this community connection.

The Mayor Dora Alcala Hike and Bike Trail runs along the banks of San Felipe Creek between the Moore Park area just south of US Highway 90 to a point just downstream of Tardy Dam. The trail ranges in width from approximately 6 to 10 feet. The trail is comprised primarily of asphalt with portions of the trail, through some parts of Moore Park, being constructed of flagstone. The length of trail along this portion of the creek totals approximately 5,450 feet (1.03 miles), which includes approximately 1,100 feet of flagstone trail along the right bank of San Felipe Creek between US Highway 90 and Bedell Avenue. The existing Mayor Dora Alcala Hike and Bike Trail along San Felipe Creek is shown on **Figure 18**.

8.3 Existing Infrastructure Improvements Along San Felipe Creek

In addition to park and recreational improvements, and the hike and bike trail, numerous infrastructure improvements have been installed along San Felipe Creek. These improvements include restrooms, sidewalks, parking lots, trash cans, drainage structures, drinking fountains, and other improvements typically found in park site areas.

Many of these improvements are shown on **Figure 18** and are included in the inventory of existing park improvements listed in **Table 8-1**. Additional information on many of these improvements can be found in the Parks, Recreation and Open Space Master Plan 2010-2020 by TRC Engineers, Inc. and the City's Parks and Recreation Department included as **Appendix I**, as well as Chapter 4 of the Del•RioPlan prepared by Kendig Keast Collaborative includes as **Appendix J**.

8.4 Existing Educational & Public Information Amenities Along San Felipe Creek

Signs and educational exhibits provide a simple and economical . The developed portions of San Felipe Creek have several informational signs and historical markers that provide the general public information about the creek, applicable City ordinances that may affect activities along the creek, as well as educate them on past historical events or activities that pertain to the area.



Above pictures show Historical Markers and other Informational Signs along San Felipe Creek.

8.5 Current Organized Activities and Events Along San Felipe Creek

A number of organized activities and events are held throughout the year along San Felipe Creek. Each of these activities and events have the potential to impact water quality in San Felipe Creek. Events that draw visitors to the creek or nearby parks may impact water quality within the creek both during the event and afterwards. Organized activities, including routine litter pick up and other organized events, can positively impact the water quality within the creek by keeping potential pollutants out of the creek. A summary of current organized activities and events in the San Felipe Creek drainage basin are listed in **Table 8-2** below.

Table 8 - 2 - Current Organized Activities and Events Along San Felipe Creek

Item No.	Activity/Event	Location	Comments
FESTIVALS / CELEBRATIONS			
1	Fourth of July	Amphitheater (main focus)	Annual celebration including fireworks, food vendors and parade
2	Cinco De Mayo	Brown Plaza	Celebration of Mexican heritage and culture
3	Dieciseis de Septiembre	Brown Plaza	Celebration of Mexican Independence from Spain
VOLUNTEER ORGANIZATIONS			
4	San Felipe Creek Commission	San Felipe Creek	Commissioners nominated by City Council; Operates under City Ord. 2006-010.
5	Volunteer Del Rio Program	City Wide	Program designed to connect volunteers with volunteer opportunities
6	City Litter Pick Up	City Wide	Organized annual event. Labor provided by volunteers.
ON-GOING ACTIVITIES			
7	Residential Solid Waste & Brush Pick Up	City Wide	City weekly trash collection service. Brush/yard trimmings collected monthly.
8	Recycling	City Wide	City recycling center & recycle trailer (trailer travels on designated schedule)
9	Trash Pick Up (City Parks & Rec. Dept.)	Parks	Routine park trash collection by City Parks & Rec. Dept. staff

8.6 Needs Assessment

The planning process included a needs assessment of the desired. Input with regard to the planning area was received through public meetings, a public questionnaire/survey, and from public comments.

8.6.1 Public Meetings

Public meetings were an integral part of the planning process. The meetings were intended to inform the San Felipe Creek Commissioners and the general public on the planning process and to provide one avenue for input from the Commissioners or individuals. Formal meetings included a Kick-off meeting and two subsequent planning meetings:

- Kick-Off Meeting - October 20, 2010;**
- 1st Planning/Progress Meeting - July 25, 2011;**
- 2nd Planning/Progress Meeting - October 26, 2011.**

The 1st and 2nd Planning Meetings included a San Felipe Commissioners Meeting, held during normal business hours, and a separate Public Meeting held in the evening in order to make it easier for area residents to attend the meeting. Each of the meetings was open to the general public, however most residents attended the evening Public Meeting. Each meeting included a presentation. The presentations for the meetings have been included in **Appendix L**.

8.6.2 Public Survey

A public survey was prepared and distributed in order to solicit opinions and priorities from area residents. The public survey allowed residents to prioritize their desires for the San Felipe Creek area. A blank copy of this survey form is included as **Appendix M**.

Results from these surveys have been included in **Table 8-3** on the following page. Based on these results, the overwhelming issue was the eradication of invasive species from San Felipe Creek, with over one-third of the survey respondents listing it as their number one priority for the Creek area.

Table 8 - 3 - Public Survey Results Summary

Item Rank	Avg. Rank	Total #1 Votes	Item
1	3.7	12	Remove brush and invasive species along San Felipe Creek
2	4.0	3	Additional restrooms and trash barrels along the trails and park grounds
3	4.9	3	Provide improvements that would facilitate the use of the creek for tubing and kayaking while protecting endangered species that live in San Felipe Creek
4	5.1	--	Provide greater amenities at existing parks, such as playground equipment, picnic areas, restrooms, parking
5	5.8	2	Additional pavilions and facilities for group gatherings
6	6.0	2	Expand hike & bike trails
7	6.0	1	Provide new parks and recreational facilities along San Felipe Creek
8	6.1	1	Provide facilities that can be used for outdoor group activities including festivals, concerts, etc.
9	6.2	--	Provide educational facilities to teach about the ecology of San Felipe Creek and natural areas
10	6.7	--	Retain open space for bird watching , habitat protection

8.6.3 Public Comments

Public comments were received from the public survey forms that were completed and returned by area residents. The comments included a number of suggestions and ideas that could apply to this water quality master plan. A summary of the public comments received has been included in **Table 8-4** on the following page.

Table 8 - 4 - Public Comments

Comment No.	Comment
1	The City should increase surveillance and enforce laws and regulations which punish citizens who litter...
2	Consider hosting a small vessel water parade in conjunction with a city/fundraiser event.
3	Good quality health dept-inspected food and beverage (non-alcoholic) concessions at key nodes of park development (such as food trucks), small but properly equipped kitchens (rented by contract concessioners) at 2 or 3 centrally-located food courts (Rotary Park, San Felipe Lions Park, Moore Park).
4	The "No Mow Zones" are not accomplishing their intended purpose; The "No Mow Zones" need to go away and true vegetation management principles need to be used instead.
5	Create a nature trail on the southern part of San Felipe Creek to include the area of Round Mountain.
6	Extend and identify hike and bike trails, from the San Felipe H/B Trail with a route running through the City streets that takes you near most all of the historic sites.
7	Do away with the "No Mow Zones"; these areas are nothing but a nuisance and fire hazard, and also harbor unwanted animals.
8	Separate "Protecting Endangered Species" from "Recreational Activities" (kayaking and tubing).
9	More police patrols/bike patrols.
10	This creek is the most important for my roots of family; where my family grew up; they are gone, but I am here to support San Felipe Creek.
11	Flood control; more dams.
12	Figure out where you can have commercial development to meet needs of visitors to creek.
13	Keep kayaks below Tardy Dam to protect swimmers.
14	Remove as few existing walls as possible.
15	Lighting??
16	More trees for shade in playground areas.
17	Create a dog park at one of the FEMA spaces in San Felipe Creek
18	What we have is a good start, but adding and improving the facilities, trails, river, etc... will be great to the community. It will also have a positive effect on tourism in Del Rio.

9. PROJECT ALTERNATIVES & RECOMMENDATIONS

9.1 Strategies for Selection of Alternatives & Recommendations

As outlined in Section 3.1, Project Goals, Objectives, Strategies & Priorities, the ultimate goal of the water quality protection measures presented in this Plan is to maintain or enhance the existing water quality and water quantity in San Felipe Creek. To accomplish this objective, the strategy has been to select measures that facilitate a decrease in anticipated pollutant loadings, minimize the potential for discharges into San Felipe Creek, or enhance the habitat in or near the creek.

For ease of recognition of individual projects the project area was divided into Areas A through F. These project areas are shown on **Figure 19**. The location of the individual projects are shown by number in **Figure 20**. These project numbers correspond to the numbers listed in the individual project descriptions and project cost estimates included in **Appendix G**.

9.2 Rationale for Selection of Best Management Practices

Watershed management and water quality protection measures typically include both “structural” and “non-structural” measures. As detailed in Section 4.6, in current water quality planning practice, these measures are typically referred to as “Best Management Practices” (BMPs). The EPA has adopted the following definitions for structural and non-structural BMPs:

Structural BMPs include engineered and constructed systems that are designed to provide for water quantity and/or water quality control of storm water runoff.

Non-structural BMPs include institutional and pollution-prevention type practices designed to prevent pollutants from entering storm water runoff or reduce the volume of storm water requiring management.

The approach to protect water quality outlined in this Master Plan is a combination of both structural and non-structural BMPs. Although most people’s perception of water quality protection measures is limited to classic structural BMPs, the effective use of non-structural

BMPs can reduce the need for the use of traditionally more costly structural BMPs. As activities continue to occur within the San Felipe Creek drainage basin, a combination of structural and non-structural BMPs working together will provide the most effective protection to water quality and quantity within San Felipe Creek. The following sections in this Master Plan outline specific projects and programs that can be initiated throughout the area to effectively provide a positive long-term impact to San Felipe Creek.

9.3 Control of Invasive Species

9.3.1. *Arundo donax* Eradication

Recommendations for the eradication of *Arundo donax* are detailed in Appendix B. In summary, the recommendations are to cut the cane after flowering, which typically occurs in mid- to late summer, then remove the cut stalks and shred them into pieces less than one inch in length. After waiting for new growth to occur in the next month, the cane should be sprayed with a combination of Rodeo (3% - 5% solution) and a surfactant. During the winter the dead biomass should be removed. This procedure should continue for several years until the cane is eradicated.

Cutting the cane can be accomplished by manual or mechanical means. Manual cutting can be by hand or gasoline-powered trimmer with a brush attachment. Mechanical cutting is typically by a tractor or brush-hog. Mechanical cutting is often not possible near the creek. The use of Rodeo near the creek should be under taken with care to prevent, or minimize, the amount of chemical entering the aquatic environment. When working in areas within San Felipe Creek or along the bank directly adjacent to the waters of the creek the USFWS has encouraged a wick application method using foam applicators, or similar type system, should be considered to avoid directly spraying Rodeo into the open water areas.

Arundo donax covers almost 40 acres of land from the San Felipe Country Club to Round Mountain. Based on an estimated chemical cost of almost \$200 per acre of giant reed treated, the expected cost of the chemicals is approximately \$8,000.

The use of chemicals will allow for a more complete and effective killing of the *Arundo donax*. In fact, it would likely be economically infeasible to eradicate the giant reed from

such a large area, due to the difficulty in killing the plant through only mechanical means. However, even with the use of chemicals this operation will be very labor intensive. With an expected kill rate as low as 60%, an extended, multi-year effort will be needed to significantly impact the existing spread of giant reed along San Felipe Creek.

In an effort to quantify the expected labor cost an estimate was prepared for both manual and mechanical cutting of the cane. Table 9.1 below details the expected cost of cane eradication efforts over the first five years of the program. To simplify calculations, the following year’s cost is estimated at 60% of the previous year (to simulate a 60% kill rate). The cost estimates for both the manual and mechanical cutting are included in **Appendix E**.

Table 9-1. Arundo donax Eradication Costs (for the entire 40 acres of cane estimated to be located along San Felipe Creek & for the 2 acres estimated to be located between US Hwy 90 and Round Mountain). Subsequent years assume a 60% reduction in previous years cost.

Type of Cutting	\$/acre	Year 1	Year 2	Year 3	Year 4	Year 5	Total
40 acres - Manual	\$ 43,750	\$ 1,750,000	\$ 700,000	\$ 280,000	\$ 112,000	\$ 44,800	\$ 2,930,550
40 acres - Mechanical	\$ 28,875	\$ 1,155,000	\$ 462,000	\$ 184,800	\$ 73,920	\$ 29,568	\$ 1,934,163
2 acres - Manual	\$ 43,750	\$ 87,500	\$ 35,000	\$ 14,000	\$ 5,600	\$ 2,240	\$ 188,090

The above costs show that the labor necessary to eradicate the giant reed from San Felipe Creek will be significant. Once started, this effort must be on-going, although as can be seen in **Table 9-1**, the labor expense is expected to drop significantly after the first few years of the program. However, **Table 9-1** does indicate that the elimination of Arundo donax from the section of San Felipe Creek between US Highway 90 downstream to Round Mountain is manageable. The approximately two acres of river cane in this area could be effectively managed for much less than the entire length of San Felipe Creek. By working on this section of the creek the City could, in a relatively short period of time, eradicate the cane from the area of the creek most heavily used by the general public. However, the City should continue to look toward the future and maintain a long term goal of eradicating the river cane from the portion of San Felipe Creek within the city limits.

9.3.2. Armored Catfish

The armored catfish present in San Felipe Creek out compete native species for both food and habitat. Their activities also significantly contribute to the damage of the creek banks which has a negative impact on water quality by increasing the suspended solids in the water. It is recommended that the City actively encourage on-going research and investigations into the control and elimination of this damaging pest.

9.3.3. Water Fowl

To reduce the presence of fecal coliform on San Felipe Creek it is recommended that the domestic water fowl located along the creek be relocated.

9.3.4. Nutria

Along banks of San Felipe Creek, nutria have created a by damaging the creek banks which contributes to an increase in suspended solids and materials added to San Felipe Creek. It is recommended that an active program of pest control be instituted in an effort to control the nutria and other rodents that may be contributing to the damage of the creek banks.

9.4 Recommended Water Quality Improvements

9.4.1 Structural Best Management Practices (BMPs)

As detailed in Section 4.7.1 the following structural BMPs are recommended for use along San Felipe Creek:

- Vegetation Enhancement
- Bank Stabilization
- Riparian Area Restoration
- Vegetative Filter Strips
- Pervious Pavement
- Biofiltration/Bioretenion
- Hydrodynamic Separators

9.4.2 Non-Structural Best Management Practices (BMPs)

As detailed in Section 4.7.2 the following non-structural BMPs are recommend for use along San Felipe Creek:

- Public Education
- Community Involvement
- Land Management/Ordinances
- Litter/Trash Pick Up
- Pet/Animal Waste
- Human Waste Control

The proposed improvements are intended to satisfy the recommendations for both Structural and Non-Structural BMPs. Except for some park and miscellaneous infrastructure projects included as part of the proposed projects, the overwhelming majority of projects included in this Master Plan will directly impact the water quality of San Felipe Creek.

9.5 Recommended Bank Improvements

Suspended solids play a significant role in impacting the water quality along a creek. In the case of San Felipe Creek collapsed walls and eroded banks contribute to an overall decrease in water quality in the creek. As a result, improvements to the stream bank can provide a positive impact on water quality and the wildlife that inhabits the creek. **Figure 21** details bank improvements proposed for San Felipe Creek. More details are provided in the individual project descriptions included in **Appendix G**.

Bank improvements recommended include the demolition, removal, and reconstruction of some of the existing creek bank walls, particularly those located in Moore Park. For other locations it is recommended that the existing damaged walls be removed and an improved riparian area be established. **Figure 22** outlines the different types of creek banks being proposed for construction. The emphasis is on establishing a more natural riparian area when possible, however, in traditional high traffic areas the damage to the riparian area would likely be severe making the construction of structural walls a more logical, and ecologically suitable choice.

Table 9-2. Cost Summary of Proposed Bank Improvements along San Felipe Creek
 (cost information from Individual Project Descriptions/Cost Estimates in **Appendix G**).

Project Area	Total Length of Bank Improvements (LF)	Project Costs
A	9,160	\$ 195,000
B	6,240	\$3,094,000
C	4,190	\$2,343,000
D	1,620	\$757,000
E	2,910	\$441,000
F	5,050	\$390,000
TOTAL	29,170	\$7,220,000

Along selected creek banks the use of Focused Access Features is proposed as an entry way to the creek. In most cases, these Focused Access Features are proposed for installation along stretches of the creek that have an established riparian area, or will have a riparian area established as part of the proposed bank improvements. The Focused Access Features will allow access to the creek by park site visitors without damaging the creek’s natural or improved riparian area. By targeting pedestrian foot traffic to these selected sites the bank areas along the creek will be subject to less damage by pedestrians which will result in a healthier and fully functional riparian area. By minimizing damage to the riparian area a significant savings in operational and maintenance costs for this area of the creek should be realized. **Figure 23** details the location and estimated cost of these proposed improvements. **Figure 23** also details the location of proposed Kayak Put-In/Take-Out areas. A schematic of a typical Focused Access Feature is shown in **Figure 24**. As shown, the Focused Access Feature is intended to provide access in compliance with the Texas Department of Licensing and Regulation’s (TDLR) Texas Accessibility Standards (TAS). During the design phase for the portion of the creek that includes a Focused Access Feature, it will be important to coordinate the design of the project with a Registered Accessibility Specialist (RAS) and the TDLR to ensure that the proposed design meets the requirements of the TAS and the provides the access desired by area residents and visitors to San Felipe Creek.

Along San Felipe Creek there are a number of footbridges that provide improved access to park site visitors. Many of these bridges have been in place for a significant amount of time. Over the years several of the bridges have suffered from bank erosion around the bridge footing and are in need of significant repair. **Figure 25** details the bridge improvements proposed under this master plan.

Another significant source of non-point source pollution around the San Felipe Creek area is soil and suspended matter produced by areas that have little to no vegetation. To alleviate this problem several vegetation “enhancement” projects are proposed. These projects would include the spreading of soil and compost, and in some cases the use of soil retention blankets. These projects are outlined and detailed in **Figure 26**.

9.6 Recommended Creek Side Improvements

Improvements are also proposed outside the creek bank areas of San Felipe Creek. The proposed improvements include a number of non-point source pollution BMPs including pervious concrete, bioretention/biofiltration systems and hydrodynamic separators, public education kiosks, trash cans, pet waste stations, and public restrooms. The following figures detail the proposed improvements:

Figure 27 - Proposed Projects - New Pervious Parking Areas

Figure 28 - Proposed Projects - Convert Existing Parking Areas to Pervious Pavement

Figure 29 - Proposed Projects - Bioretention/Biofiltration

Figure 30 - Proposed Projects - Hydrodynamic Separators

Figure 31 - Proposed Projects - Public Education Kiosks

Figure 32 - Proposed Projects - Trash Cans

Figure 33 - Proposed Projects - Pet Waste Stations

Figure 34 - Proposed Projects - Public Restrooms

Figure 35 - Proposed Projects - Community Gardens

Figures 27 and **28** detail the installation of pervious concrete for new parking areas, as well as the conversion of existing parking areas from an impervious driving surface to one of pervious concrete. The installation of pervious concrete near San Felipe Creek will

significantly reduce the suspended solids runoff currently entering the creek. Furthermore, the volume of runoff will be reduced and the pervious parking systems should increase the amount of water percolating into the ground. As an alternative to pervious concrete, a gravel pavement system could be used. A gravel pavement system normally uses a structural grid system, typically made of plastic, to support and contain the gravel/rock surface. An example of such a system is shown in **Figure 7**. In general, gravel pavement systems are less expensive to install than pervious concrete. It should be noted that for cost estimating purposes the master plan utilizes pervious concrete unit costs.

9.7 Recommended Hike & Bike Trail Improvements

Proposed hike and bike trail improvements are detailed on **Figure 36**. These improvements include the installation of approximately 5,750 linear feet of new hike and bike trails of pervious concrete. The proposed hike and bike trail improvements also include approximately 6,695 linear feet of hike and bike trail that will be converted from an impervious surface material, asphalt or stone, to pervious concrete. The estimated total cost for these projects is approximately \$1,123,000 that results in the improvement of over 12,445 feet of hike and bike trail. If construction costs are a concern, the installation of a conventional concrete or asphalt hike and bike trail surface, along with a properly designed and constructed vegetative filter strip, should be considered an acceptable alternative to a pervious concrete trail.

9.8 Recommended Infrastructure Improvements

A number of infrastructure improvements are outlined in this master plan. Significant among those are proposed repair and upgrade to Tardy Dam (Project Nos. D-22 and D-23). Also included are miscellaneous projects including the repair/upgrade of existing park signs, rehabilitation of existing picnic and park areas, and relocation or lowering of existing pipelines that cross San Felipe Creek.

9.9 Recommended Educational Opportunities

Educational opportunities for the community will be provided as a result of several of the proposed projects. The most significant include informational signs and kiosk to be located along San Felipe Creek. **Figure 31** provides additional details on the cost and location of the proposed kiosks.

9.10 Recommended Land Management Strategies & Opportunities

The City of Del Rio has an opportunity to effectively manage the San Felipe Creek drainage basin in a manner that promotes and establishes good land management strategies. A number of recommendations from the City's Del•RioPlan (the Comprehensive Plan) show be instituted including the identification and protection of priority conservation areas, such as the San Felipe Creek watershed, the promotion and management of wise stormwater management techniques, demonstration gardens, as well as other items outlined in Chapter 4 - "Parks and Recreation" of the Del•RioPlan.

9.10.1 Vegetative Management Areas

Along San Felipe Creek there is an opportunity for the City to better manage and promote the growth of a healthy riparian area. In the past there were areas along the creek known as "No Mow Zones" as established by the City of Del Rio's Management Plan for San Felipe Creek and the Devils River Minnow in 2003. Over the years, the term "No Mow Zone" has developed a negative connotation among area residents due to the unsightliness created by the uncontrolled weeds, trees and, bushes, as well as the presence of *Arundo donax*, that have grown up and now cover much of these areas.

The Vegetative Management Areas should include those areas where the City is committed to establishing a riparian area. Instead of "no mow" zones areas, it is recommended that the City actively manage the Vegetative Management Areas in a controlled, somewhat limited manner, in an effort to more positively promote the establishment of a functional riparian area. The City should evaluate on an annual basis the designated Vegetative Management Areas and if appropriate, should change or alter the maintenance of these areas to better nurture the riparian environment. As a guide, a Fact Sheet on the establishment and maintenance of the Vegetative Management Areas has been developed and is included as **Appendix N**.

10. PROJECT PRIORITIZATION

As outlined in **Section 9.0**, a large number of necessary and desired projects have been identified for the San Felipe Creek area. However, based on limited financial resources available the identified projects are competing for those resources. A means of prioritizing the individual projects was necessary to provide guidance on the general order of project development that will allow the City to maximize the benefits to the Creek and the local residents. **Section 12.0** of this master plan outlines project conclusions and recommendations for this Master Plan, however many recommendations on project prioritization and timing can be found throughout this section.

10.1 Project Category Prioritization

Based on the results from the public surveys outlined in Section 8.6.2, along with input received during the San Felipe Creek Commissioner’s meetings and the public meetings held as part of this planning process, the proposed individual project could be sorted into one of four major project types. The major project categories identified included: (1) Invasive Species Eradication; (2) Public Safety and Access; (3) Water Quality; and, (4) Park and Miscellaneous Improvements.

For prioritization purposes all of the individual projects have been placed in one of these four categories. It is recommended that the overall progression of project development proceed in the general order of: (1) Invasive Species Eradication; (2) Public Safety and Access and Citizen Well-being; (3) Water Quality; and, (4) Park and Miscellaneous Improvements.

PROJECT CATEGORIES

[Order of Preference →]



While it is acknowledged that due to funding levels, budget cycles, available resources, and other considerations, some projects may be moved ahead of other lower-ranked projects, the overall direction of project development should generally follow the project rankings included in this master plan.

10.1.1 Invasive Species Eradication

Based on citizen surveys and public comments Invasive Species Eradication is by far the highest ranked priority of the four identified project categories. The eradication of *Arundo donax* along San Felipe Creek will improve public safety, will improve both water quantity and water quality within the creek. Coupled with removal of the armored catfish this will improve the habitat of endangered and other species living in and around the creek, and will provide for a more usable and esthetically pleasing creek area.

10.1.2 Public Safety, Public Access & Citizen Well-being

Along San Felipe Creek there are a number of public safety issues created by collapsed sidewalks, walls, and eroded areas. In some places, public access to walk or ride on sidewalks and walkways along the creek or within the park areas has been compromised. In an effort to protect park visitors and the general public the Public Safety and Access category of projects is recommended as the second highest priority of the four project categories.

10.1.3 Water Quality

As discussed in previous sections of this master plan water quality in San Felipe Creek is of critical importance to endangered species, other animal and plant species living in and around the creek area, and public use. This category of projects includes bank improvements to San Felipe Creek, vegetation enhancement, and stormwater BMPs. The Water Quality category of project is recommended as the third highest priority of the four project categories.

10.1.4 Park & Miscellaneous Improvements

Several of the identified projects along the San Felipe Creek area include park improvement projects and other miscellaneous site improvement projects. While all of these identified projects are important, based on public survey results and comments this category ranks behind the other three major project categories. In some cases, it may be convenient to group an individual park project with other, higher priority projects, to expedite the construction of the project and to possibly benefit from reduced overhead costs.

10.2 Individual Project Rankings

In an effort to provide guidance on the prioritization of individual projects along San Felipe Creek, a ranking criteria was developed. The ranking criteria includes six individual categories. Each project was ranked from one to five (one being the worst or least desired and five being the best or most desired) for each of the six categories. An overall score was totaled and the average ranking was calculated. The projects were then listed from highest ranking to lowest ranking among the four major project categories.

Appendix F includes a summary sheet of the individual categories ranked, along with a complete listing of the ranked projects. Details of the individual ranking criteria for the six categories is included below.

10.2.1 Public Safety & Access

Public safety and public access were evaluated for each individual project identified. The individual project were ranked according to the following criteria:

- 5 - Project main purpose is to address an existing public safety issue or hazard (i.e., collapsed wall, broken sidewalk, or other hazard) or public access;
- 4 - Project will address public safety or public access;
- 3 - Project may partially, or indirectly, address an existing public safety hazard or access;
- 2 - Project only somewhat addresses an existing public safety hazard or access;
and,
- 1 - Project will likely not improve public safety, public access, or citizen well-being.

10.2.2 Long-Term Impact on Endangered Species

Endangered species are an important part of the ecology of San Felipe Creek. The Devils River Minnow and the San Felipe gambusia live in the creek and can be sensitive to impacts from activities and development near the creek. Individual projects were ranked according to the likely long-term impact the project would have on endangered species within San Felipe Creek according to the following criteria:

- 5 - Project implemented will have a major, long-term positive impact on the endangered species within San Felipe Creek;
- 4 - Project implemented will have a long-term positive impact on the endangered species within San Felipe Creek;
- 3 - Project implemented will have little to no long-term impact on the endangered species within San Felipe Creek;
- 2 - Project implemented will have a long-term negative impact on the endangered species within San Felipe Creek; and,
- 1 - Project implemented will have a major, long-term negative impact on the endangered species within San Felipe Creek.

10.2.3 Impact on Water Quality

The water quality of San Felipe Creek is important to the public that visit the creek area, endangered species that inhabit the creek, and the creek's riparian area. Individual projects were ranked according to the likely long-term impact the project would have on the water quality in San Felipe Creek according to the following criteria:

- 5 - Project implemented will have a major, long-term positive impact on the water quality in San Felipe Creek;
- 4 - Project implemented will have a long-term positive impact on the water quality in San Felipe Creek;
- 3 - Project implemented will have little to no long-term impact on the water quality in San Felipe Creek;
- 2 - Project implemented will have a long-term negative impact on the water quality in San Felipe Creek; and,

- 1 - Project implemented will have a major, long-term negative impact on the water quality in San Felipe Creek.

10.2.4 Existing Level of Degradation Within Project Area

For some areas of San Felipe Creek the existing conditions help contribute undesirable contaminants into San Felipe Creek. These contaminants are mainly in the form of soil, dirt, and other suspended solids or particulates. For each individual project area the existing level of degradation was evaluated and ranked according to the following criteria:

- 5 - A very high-level of degradation exists within the project area (i.e., no vegetation, totally exposed soil/dirt/particulates) resulting in definite, negative impacts to water quality;
- 4 - A significant level of degradation exists within the project area (i.e., little vegetation, large areas of exposed soil/dirt/particulates) resulting in negative impacts to water quality;
- 3 - Some level of degradation exists within the project area (i.e., some areas lacking vegetation, areas of exposed soil/dirt/particulates) resulting in negative impacts to water quality;
- 2 - A small amount of degradation exists within the project area (i.e., small areas lacking vegetation, small areas of exposed soil/dirt/particulates) resulting in minimal impacts to water quality;
- 1 - Very little, if any, degradation exists within the project area (i.e., good vegetation, no exposed soil/dirt/particulates) resulting in very little to no impacts to water quality;.

10.2.5 Project Cost

The estimated project costs have been summarized in the Individual Project Descriptions included in **Appendix G**. Based on these estimated project costs the following points were given to individual projects:

- 5 - Project cost of less than or equal to \$10,000
- 4 - Project cost between \$10,000 - \$50,000
- 3 - Project cost between \$50,000 - \$100,000
- 2 - Project cost between \$100,000 - \$250,000
- 1 - Project cost of \$250,000 or more.

10.2.6 Expected Impact on Required Maintenance

Maintenance of existing improvements in and around the San Felipe Creek area takes a significant amount of resources including financial, man-power, and equipment. A significant concern of City officials is the amount of maintenance that will be required for any new improvements constructed along the creek. Based on a project's likelihood to increase or decrease the requirement maintenance from existing levels, the following points were given to individual projects:

- 5 - Finished project can be expected to eliminate, or greatly reduce on-going maintenance currently provided by City crews within the project area:
- 4 - Finished project can be expected to reduce on-going maintenance currently provided by City crews within the project area:
- 3 - Finished project can be expected to maintain on-going maintenance currently provided by City crews within the project area:
- 2 - Finished project can be expected to increase on-going maintenance currently provided by City crews within the project area: and,
- 1 - Finished project can be expected to significantly increase on-going maintenance currently provided by City crews within the project area.

Table 10-1. Scoring Criteria Summary for Project Prioritization (Project Rankings)

PROJECT SCORING				
1.	Public Safety & Public Access	HIGH: Project as implemented to address an existing public safety issue or a hazard of concern to park visitors.	MEDIUM: Project as implemented may partially address an existing public safety issue/concern, although may not be primary purpose for project.	LOW: Project implementation will not likely address public safety or citizen welfare.
		5	4	3
2.	Long-Term Impact on Endangered Species	POSITIVE: Project as implemented will have a long-term positive impact on endangered species within the San Felipe Creek drainage basin.	NEUTRAL: Project as implemented will have limited or no long-term impact on endangered species within the San Felipe Creek drainage basin.	NEGATIVE: Project as implemented will likely have a long-term negative impact on endangered species within the San Felipe Creek drainage basin.
		5	4	3
3.	Impact on Water Quality	POSITIVE: Project as implemented will/should improve water quality within San Felipe Creek.	NEUTRAL/NONE: Project as implemented will have a negligible impact or no impact on the water quality of San Felipe Creek.	NEGATIVE: Project as implemented is likely to have a negative impact on the water quality of San Felipe Creek.
		5	4	3
4.	Existing Level of Degradation within Project Area	HIGH: Project Area has a high level of degradation resulting negative impacts to water quality.	MEDIUM: Project Area has some level of degradation resulting in impacts to water quality.	LOW: Project Area has very little to no level of degradation resulting in impacts to water quality.
		5	4	3
5.	Project Cost	LOW: <\$10k	MEDIUM: \$50k - \$100k	HIGH: \$250k+
		5	4	3
6.	Expected Impact on Required Maintenance	LOW: Upon completion, finished project will eliminate or greatly reduce the existing level of maintenance provided by City crews within the project area.	MEDIUM: Upon completion, finished project will maintain the existing level of maintenance provided by City crews within the project area.	HIGH: Upon completion, project will likely require an increase in the existing level of maintenance provided by City crews within the project area.
		5	4	3

10.3 Prioritization of Individual Projects

Appendix F includes a summary table of the individual projects sorted by the four major project categories outlined in Section 10.1: (1) Invasive Species Eradication; (2) Public Safety, Public Access and Citizen Well-being; (3) Water Quality; and, (4) Park and Miscellaneous Improvements. Within these major project categories the individual projects are listed from highest to lowest priority using the scoring system described in Section 10.2. In developing funding plans and project schedules, these rankings should be used as a guide to identify the projects of most benefit to the creek and creek visitors. It is acknowledged that other factors may influence the order in which projects are constructed including project timing, budgets, funding opportunities, and other issues.

10.4 Project Timelines

The establishment of exact timelines for construction of the individual projects along San Felipe Creek is difficult without also establishing a detailed annual construction budget. The annual construction budget will be dependent on City budgeting priorities and available revenue, federal and State funding opportunities including grant monies, and other opportunities for cost sharing including donations and local volunteer participation.

What can be established as part of the master plan process is an overall timeline for project completion based on the idea that individual projects fall into the category of Immediate, Short-Term, or Long-Term projects. The listing of projects in the Project Prioritization table included in Appendix F also includes a notation on whether a project is considered an Immediate, Short-Term, or Long-Term project. The following summary includes details on the projects or type of projects that are intended to fit into the selected project category:

10.4.1 Immediate Projects

Immediate Projects are those projects that are recommended for action as soon as funding can be made available. Due to the high importance placed on Invasive Species Eradication by the residents of Del Rio, through their answers on the public surveys and their comments during the public meetings, the highest priority projects are limited to the eradication of *Arundo donax* along San Felipe Creek from the Highway 90 bridge to Tardy Dam. This portion of San Felipe Creek includes Project Areas B, C, and D. Although, in general, it is

recommended that the river cane eradication proceed from upstream to downstream, which would mean that Project Area A should be the first area addressed, since most visitors to San Felipe Creek populate the Project Areas B, C, and D, it is recommended that cane eradication first begin in these areas.

10.4.2 Short-Term Projects

In most cases the projects identified as short-term projects are those that have the potential to positively impact public safety and access along the creek, or will provide a significant impact to water quality within San Felipe Creek. In reality, short-term projects may include those that are easily completed, that are in high demand by the general public, or those that have received funding from a State or federal agency. A short-term project is considered to be a project that will be started within five years.

Based on public surveys, public comments, and on-site inspections of the creek area the projects of most importance from a water quality perspective are cane eradication, bank repair and stabilization projects, and vegetation enhancement projects. A definite short-term project would be the eradication of *Arundo donax* in Project Areas A, E, and F. High ranking Public Safety projects and Water Quality projects, listed in the Project Prioritization tables in **Appendix F**, should also be considered short-term projects.

10.4.3 Long-Term Projects

In general, long-term projects are those projects not previously included as an Immediate project or a Short-Term project. These project are those that will tend to have a marginal benefit to water quality, have a high construction cost, or are projects that replace a currently functional system or improvement (e.g., an existing asphalt parking lot). While all of these projects will be a benefit to the San Felipe Creek area, the high-cost of some projects will require that they be placed on hold until funding is secured.

10.5 Estimated Project Costs

Project costs have been estimated for all the individual projects indentified. Each project is described in detail in **Appendix G**, along with a detailed cost estimate. Cost estimates presented are at the planning level and their accuracy should fall within the estimated project

contingency. Unknown or unforeseen site conditions could affect the final project costs. For future budgeting purposes the costs estimates are conservative in order to ensure adequate resources are available for planned projects. Due to the uncertainty of the exact field conditions for each individual project the project planning costs include a 25% contingency. The unit costs used in these estimates generally represent current construction costs found in the Del Rio area or within the State of Texas.

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11. PLAN IMPLEMENTATION STRATEGIES

11.1 Financing Options

When discussing the financing options for the projects outlined in this Plan it is important to remember that due to the timing of applications and program requirements, it may not be possible to implement the different projects in order of their priority.

For example if funding is obtained for trail rehabilitation and trail extensions prior to securing funding for invasive species eradication it would be advantageous to do the trail work first even though it may have a lower priority. Complete execution of the projects outlined and adopted as part of the Plan will hinge heavily on the understanding of the importance of flexibility in the implementation strategies.

Below are a list of different funding sources and options:

11.1.1 Local Funding:

- Annual Budgeting Process can provide additional funding for enhanced maintenance, annual capital improvements. It is important to realize that as facilities and activities are expanded it is important to recognize that operations and maintenance costs to the City will increase.
- Bond issuance by the City to provide funding for improvements that improve San Felipe Creek. These bonds could be secured through a tax levy or potentially funding through the local hotel-motel tax collections.
- Public-Private Partnerships include working with potential business interests, local irrigation company, or non-profit corporations. This type of partnership could be developed on a comprehensive or case by case basis. For instance, if a hotel were to be constructed within the watershed of the project area the city could apply for funding through the Texas Capital Fund for utility extensions or other public improvements. As part of this funding package the private partner could provide improvements to San Felipe Creek that would provide amenities that would benefit the public.

- Foundation Funding for environmental and/or recreational improvements. There are several foundations which can provide limited grants for public recreational improvements. Typically, these foundations base their awards on a case by case basis and often will participate as a partner in a specific project or projects.

11.1.2 State and Federal Sources:

Texas Water Development Board (www.twdb.state.tx.us)

- **Clean Water State Revolving Fund (CWSRF)** The CWSRF is a federally subsidized loan and grant program that has a set aside Green Project Reserve (GPR) to fund projects that increase energy efficiency or for addressing non-point source pollution issues. The funds can be used for planning, design and implementation of these projects. Eligible projects include the implementation of Best Management Practices including restoration of riparian habitat, improving the quality of runoff, reduction of impervious cover, bio-retention and establishment or restoration of permanent riparian buffers, floodplains, wetlands or other natural features including vegetated buffers or soft bio-engineered stream banks.

The application process is to submit a project description and cost estimate for the Intended Use Plan (IUP) by March 1 of each year. The proposed project is then ranked against other projects from around the state and in early spring the rankings are made public and applications are invited in the fall of each year. Projects are expected to be completed within 3 years after the loan/grant closing.

- **Development Fund-2 (D-Fund 2)** The D-Fund 2 account is a loan program using state authorization. Eligible projects include design, permitting, and construction of drainage, flood control and/or water quality improvements and treatment works such as permeable surfaces. There is no set time for submitting an application and potential projects are processed on a first come, first served basis.

Texas Commission on Environmental Quality (www.tceq.state.tx.us)

- **Section 319 Nonpoint Source Storm Water Quality Funding and BMP's** is a grant program administered by the Texas Commission on Environmental Quality (TCEQ) for projects that implement plans that are designed to improve water quality from nonpoint

sources of pollution. The grants are for 60% of project costs and can be used for design and construction of eligible project components. The TCEQ calls for applications in the early summer and awards grants in the early fall. If a grant is awarded it must be completed within 3 years after the award. Matching funds can come from local sources or through the CWSRF. Other federal grant programs are usually not eligible as a source of matching funds.

Texas Department of Transportation (TxDOT) (www.txdot.state.tx.us)

- **Transportation Enhancement Program** TxDOT administers the federally funded program, which provides opportunities for non-traditional transportation related activities. Projects should go above and beyond standard transportation activities and be integrated into the surrounding environment in a sensitive and creative manner that contributes to the livelihood of the communities, promotes the quality of our environment, and enhances the aesthetics of our roadways. Projects undertaken with enhancement funds are eligible for reimbursement of up to 80 percent of allowable costs. Eligible projects can be for pedestrian and/or bicycle improvements as well as to mitigate pollution from highways.

Texas Parks and Wildlife Department (TPWD) (<http://www.tpwd.state.tx.us/>)

- **Outdoor Recreation Grant** The 82nd Texas Legislature has suspended all Texas Recreation and Parks Account (TRPA), and all Large County & Municipality Recreation and Parks Account funding for the FY 2012-2013 biennium. If funds are restored for the next biennium this program can provide up to 50 percent of allowable costs up to a maximum of \$500,000. Eligible projects include park and recreation amenities including playgrounds, open space, play fields, hike and bike trails and protection of unique habitat. This is a competitive program and applications are accepted twice a year and grant awards are made in January and August of each year.
- **Trail Grant Program** is a federally funded program that provides up to \$200,000 for trail improvements with the local sponsor required to provide a minimum match of 20% for a total project cost of \$250,000. These funds can be used for trail restoration, rehabilitation, or resurfacing; development of trail-side and trail-head facilities; provision of features which facilitate access and use of trails by persons with disabilities; land acquisition by easement or

fee simple title; educational signage; environmental mitigation to mitigate or minimize impact to the natural environment.

U.S. Fish and Wildlife Service (<http://www.fws.gov/>)

- **Habitat Conservation Plan (HCP)** provides a 75% grant with a 25% local matching requirement. Through the development of regional HCPs, local governments incorporate species conservation into local land use planning, which streamlines the project approval process and facilitates economic development. Established in fiscal year 2001, the Habitat Conservation Planning Assistance Grants program provides funding to States to support the development of HCPs. Planning assistance grants may support planning activities such as document preparation, public outreach, baseline survey's and inventories.

Texas Department of Agricultural (<http://www.texasagriculture.gov/>)

- **Infrastructure Development Fund** is a federally funded program administered by the Texas Department of Agriculture to assist rural communities in promoting economic development by making grant funds available to assist in infrastructure development to expand employment opportunities. Starting in 2010, applications are accepted at any time and awarded monthly. A Webinar overview of the 2010 TCF program changes is available online through the Texas Capital Fund program link at <http://www.texasagriculture.gov/>. The standard maximum award is \$750,000 with two jumbo awards of \$1,000,000 offered each program year. The minimum award is \$50,000. The sponsor has 3 years to complete the project. This program could assist a new or expanding business by helping to cover the costs for water quality protection measures to protect San Felipe Creek.

U.S. Department of Commerce (<http://www.eda.gov/>)

- **Economic Development Administration** provides grant funding for public works projects that are tied to job creation or job retention. There funding can be used for infrastructure development similar to the Infrastructure Development Fund. Grants can be between 50-80 percent of the costs of the project.

North American Development Bank/Border Environment Cooperation Commission (NADB/BECC) (www.nadb.org/) (<http://www.cocef.org>)

- **Community Assistance Program (CAP)** provide grant and loan funding for infrastructure projects within 100 km of the international border. The funding for these grants are from portfolio earnings at the NADB and are not an ongoing program. Grants are for 90% of the project costs up to a maximum grant of \$500,000. The current request for project proposals ends February 3, 2012.

Environmental Protection Agency (EPA) (<http://www.epa.gov/>)

- **Urban Waters Program** The goal of these Urban Waters Small Grants is to fund research, studies, training, and demonstration projects that will advance the restoration of urban waters by improving water quality through activities that also support community revitalization and other local priorities. Grants are limited to \$60,000 and can be used for community education, planning or design. A \$2,500 local match is required.
- **Border 2012 Initiative** is a program funded by the EPA and administered by the Border Environment Cooperation Commission (BECC) and is limited to areas located within 100 km. of the international border. Program funds can be used for activities that advance the goals of the group including water quality protection. Grants are limited to a maximum of \$100,000. While no matching funds are required applicants are strongly encouraged to leverage the funding through cooperative agreements with local, regional or state partners.

11.2 Resource Allocation Options

It is anticipated that there will be a limit to the availability of local resources to fund the proposed projects. The success and completion of the projects outlined in the final Master Plan will ultimately depend on the ability to secure combinations of financing from grants, low interest loans and donation from foundation funds.

It will also be important to focus on leveraging federal, State and local funds to maximize the return on investment and minimize local costs associated with the proposed projects outlined in the final Master Plan.

11.3 Adaptive Land Uses Along San Felipe Creek

A significant focus of this planning effort included the identification of adaptive land uses most appropriate for the San Felipe Creek area. The adaptive land uses would need to ensure the protection of endangered species, protect the integrity of the established floodplain, and allow public access to the creek area. Other factors that affect public use and development along San Felipe Creek include, but are not limited to, the public's understanding of the value of the creek and the need to protect the resource, public safety, impact of invasive species on creek use, zoning regulations, and existing adjacent land uses along the creek. These factors will influence the potential public and private uses of property along San Felipe Creek and will directly impact the potential adaptive land uses.

Existing policy issues will have a direct impact on adaptive land uses along San Felipe Creek including the 100-year floodplain boundary, current City ordinances, public-private partnerships, development compatibility with surrounding neighborhoods, incorporation of FEMA Buyout Properties into the City park system, financial commitments for public education and safety, and the encouragement of eco-tourism and biological diversity.

As property along the San Felipe Creek area is developed it will be necessary to maintain a focus on and a commitment to the protection of water quality and threatened and endangered species. Existing City ordinances will likely need to be amended and new ordinances adopted to incorporate requirements for appropriate structural and non-structural water quality best management practices, land management strategies and techniques. It is recommended that the City consider that following criteria in developing ordinances to protect water quality within the planning area:

- Adopt buffer zones and setbacks consistent with the Regional Plan and existing agreements with U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department.
- Require riparian restoration for projects that affect the banks of the creek.
- Allow for new development to implement off site riparian restoration and structural and non-structural BMP's that would accomplish the goals of the Regional Plan.

- A pollution prevention plan should be filed with the City to assure that there is no pollutant runoff from a site during construction.
- New development must show that a minimum of 80% of the increased Total Suspended Solids (TSS) annual loading can be removed prior to runoff leaving a site after the completion of construction. The measures to control the discharge of pollution should be consistent with Best Management Practices identified in the guidance documents from the US Environmental Protection Agency (EPA), US Department of Agriculture and the Texas Commission on Environmental Quality (TCEQ). These documents can be found at the following web sites:
<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>
<http://www.tceq.texas.gov/waterquality/nonpoint-source/mgmt-plan/index.html>
<http://directives.sc.egov.usda.gov/viewerFS.aspx?hid+21433>
- Alternative engineering solutions to achieve compliance can be provided by the developer as part of the site development plan. This will allow for individual design solutions to be developed for an individual site.
- If a site has 20% or less of impervious cover other permanent BMP's are not required. In reviewing the proposed site plan the use of pervious materials to reduce impervious cover should be noted. This exemption should be noted in the county deed records, with a notice that if the percent impervious cover increases above 20% or land use changes, the exemption for the whole site as described in the property boundaries may no longer apply and property owner must notify the City of the change.
- Because of the nature of the area there should be some flexibility in allowing mixed use developments. Since the development alternatives discussed in this section are for both permanent and seasonal uses there should be some flexibility in zoning regulations to accommodate these uses.

The potential commercial land use of the San Felipe Creek area identified during this planning process included food trailers or other “mobile” vendors. Because of their mobility, these businesses could be located within the 100-year floodplain provided they are not permanent structures and have the ability to be moved outside the floodplain on short notice. If the City

decides to allow this type of development along San Felipe Creek it is recommended that the following guidelines be considered: a stabilized pad and utility services should be available to the individual vendors, trash pickup should be the responsibility of the vendors, those vendors selling food and drink should provide seating areas, vendors should have the ability to relocate within one hour, appropriate water quality best management practices should be implemented, and density should be limited. Should development of the San Felipe Creek area include recreational vehicle parks the City should consider requiring full utility hook-ups for each vehicle, a limitation of the length of time an individual vehicle can use the facility, and detailed emergency evacuation procedures during emergency situations.

Appendix Q includes a more thorough discussion on possible adaptive land uses along San Felipe Creek.

11.4 Strategic Partnerships

Another important factor in the success of the Plan will be the continued fostering of strategic partnerships. The continued cooperation and success of these working relationships will be one of the driving forces behind securing funding for the individual projects. An example of the importance of one of these strategic partnerships would be the U.S. Fish and Wildlife Department. Their understanding of the different projects outlined in the Plan and the prioritization of the different projects will help solidify agency funding as well as assistance should the various regulatory constraints set in place to protect the endangered species create roadblocks for any of the proposed projects.

In addition to the strategic partnerships with the different local, State, and federal agencies it will also be important to continue building and nurturing working relationships with local volunteer groups and local community organizations. The expansion of City cosponsored group activities must be addressed through policy decisions by the City Council. If the decision is to expand group activities and festivals along San Felipe Creek sufficient resources will need to be allocated on an ongoing basis to meet the capital and operational costs associated with the programs and/or events. A policy decision will need to be made by the City Council if there will be a service fee to partially or fully recover those costs.

12. CONCLUSIONS & RECOMMENDATIONS

12.1 Conclusions

San Felipe Creek has been the focal point of residents and visitors to the Del Rio area for thousands of years. The creek itself and the endangered species that live in the creek are particularly vulnerable to activities that occur in and around the creek area. To keep the creek and its surrounding areas healthy and vibrant for use by the creek's animal inhabitants, as well as local residents and visitors an organized effort of creek improvements and site development should be undertaken. By following an organized plan, including the recommendation in this Master Plan, San Felipe Creek can be protected from harm and this area improved to allow the creek to once again become the focal point of this region of Texas.

12.2 Recommendations

Detailed recommendations have been included throughout the Master Plan. The following is a summary of the major recommendations and includes a reference to the appropriate section of the Master Plan that discusses in detail the particular recommendation:

- **Coordinate** any planned improvement projects or other activities with local, State, and federal agencies (5.3); in particular the presence of a federal endangered species in the creek, the Devils River minnow, makes active coordination with the USFWS essential to the success of any planned project in and around the creek area (3.5.6);
- **Elimination of invasive species** including *Arundo donax* (6.1, 9.3.1) and Armored catfish (6.2, 9.3.2); including coordination of efforts amongst State and federal agencies, particularly the efforts of the USDA's Agricultural Research Service's (ARS) Beneficial Insects Research Unit (BIRU) in Weslaco, TX;
- **Water quality best management practices (BMPs)** including structural BMPs (4.7.1, 9.4.1) and non-structural BMPs (4.7.2, 9.4.2);
- The following **Improvement Projects** should be pursued including Bank Improvements (9.5), Creek Side Improvements (9.6), Hike & Bike Trail

Improvements (9.7), Infrastructure improvements (9.10), public education opportunities (9.9), and Land Management Strategies (9.10);

- **Project prioritization** which in general should follow the general order of: (1) Invasive Species Eradication; (2) Public Safety and Public Access improvements; (3) Water Quality improvements; and, (4) Park and Miscellaneous improvements; the developed individual project priority rankings should be used as a guide to determine the projects of highest-priority (10.2, 10.3);
- **Project time-frames** have been outlined as Immediate, Short-Term, and Long-Term; the timing of projects will most likely be determined by project funding, however, the projects should be completed in the most aggressive time-frame possible (10.4); and,
- **Project funding** should actively be pursued from all possible sources including local, State, and federal sources, the development of public/private partnerships, as well as individual and institutional donations (11.0).

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FIGURES



APPENDIX A



APPENDIX B



APPENDIX C



APPENDIX D



APPENDIX E



APPENDIX F



APPENDIX G



APPENDIX H



APPENDIX I



APPENDIX J

APPENDIX K



APPENDIX L



APPENDIX M



APPENDIX N



APPENDIX 0



APPENDIX P



APPENDIX Q

