1.0 INTRODUCTION

The City of San Marcos (COSM) and Texas State University (TSU), hereafter referred to as the Applicants, are planning to conduct certain activities in and around Spring Lake and the San Marcos River, from the headwaters in Spring Lake downstream to headwaters of the San Marcos River (Spring Lake) to the confluence with the Blanco River, and have filed an application under 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act). This area is located within the City of San Marcos in eastern Hays County, Texas (Figure 1). Suitable habitat for five federally-listed species, the fountain darter (*Etheostoma fonticola*), the San Marcos salamander (*Eurycea nan*a), and the Comal Springs riffle beetle (*Heterelmis comalensis*), Texas blind salamander (*Eurycea rathbuni*), and Texas wild-rice (*Zizania texana*) is known to occur in parts of the area. A habitat conservation plan has been included as part of the application. This plan (Section 6.0 of this document) provided for the minimization and mitigation of impacts to fountain darter, the San Marcos salamander, and the Comal Springs riffle beetle to the maximum extent practicable.

In accordance with the Act and 50 CFR 17.22, this environmental assessment/habitat conservation plan has been prepared to address impacts to listed species as a result of the proposed activities. This document describes the impacts to fountain darter, the San Marcos salamander, and the Comal Springs riffle beetle that would likely result from the proposed activities, steps the Applicants would minimize and mitigate such activities to the maximum extent practicable, funding available to implement those steps, and alternatives that have been considered. Under the proposed alternative, the Applicants would provide mitigation measures and seek the issuance of a permit for incidental take of fountain darter, the San Marcos salamander, and the Comal Springs riffle beetle.

2.0 PURPOSE AND NEED FOR ACTION

The purpose of this Environmental Assessment/Habitat Conservation Plan (EA/HCP) is to consider and evaluate potential impacts of the project on the human environment and to minimize and mitigate for adverse impacts to the fountain darter, the San Marcos

salamander, and the Comal Springs riffle beetle while allowing otherwise lawful development to proceed. The EA/HCP includes an evaluation of the environmental impacts for issuance of a section 10(a)(1)(B) permit for the proposed alternative and the other alternatives that were considered.

The permit would authorize incidental take of the fountain darter, the San Marcos salamander, and the Comal Springs riffle beetle associated with the proposed activities along Spring Lake and the San Marcos River. This EA/HCP will establish the conditions under which the Applicant will meet the requirements for a section 10(a)(1)(B) permit under the Act.

Issuance of this permit also requires the USFWS review and approval of two additional separate documents: (1) a recreational master plan for the San Marcos River to be completed by December 2010; and (2) a watershed management plan for the San Marcos River and its tributaries to be completed by December 2011.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 VEGETATION

The upper San Marcos River watershed lies within two biotic provinces, the Balconian (Edwards Plateau) and the Texan (Blackland Prairie) (Blair 1950) (Figure 2). The plant community on the Edwards Plateau is predominately an oak-juniper association well suited for use as rangeland. Dense growths of oaks commonly occur on limestone outcrops, juniper on marly slopes, and elm and hackberry interspersed with oak are common along stream bottoms. Mesquite is sporadic and is usually associated with prickly pear cactus and agarita. In open areas, grasses are dominant. The most important climax grasses include switchgrass, several species of bluestems and gramas, indian grass, Canada wildrye, curly mesquite, plains lovegrass, and buffalograss. The rough, rocky areas typically support a tall or midgrass understory and a brush overstory complex composed of live oak, Texas oak, shinnery oak, juniper, and mesquite (Correll & Johnston 1970).

Blair (1950) describes the Texan province as a large ecotone between eastern forest and western grasslands. It supports three grasslands, the Blackland, Grand, and Coastal prairies. The Blackland Prairie is the region below the Balcones Escarpment but removed from the river bottom. This is a true prairie with little bluestem as the dominant climax grass. Other important grasses are big bluestem, indian grass, switch grass, side-oats grama, hairy grama, tall dropseed, silver bluestem, and Texas winter grass.

Riparian

The riparian woodlands of these two regions (Balconian and Texan) are similar. Mesic woodlands are found along streams and rivers and will support a high diversity of plants. The mesic woodlands of the Balconian and Texan provinces include live oak, cedar elm, hackberry, pecan, and cypress trees. Plants commonly encountered in surveys of the area near the San Marcos River are: bedstraw, southern dewberry, and rescue grass away from the bank; box elder, pecan, hackberry, wild onion, red-seeded plantain, scouring rush, and elephant ear near the water's edge; bushy honeysuckle, poison ivy, bull briar, and bur clover on slopes near the river (Longley 1975).

Aquatic Macrophytes

There is a high diversity of plants within the San Marcos River (Lemke 1989). This diversity of aquatic plants decreases further downstream as the river becomes more turbid due to distance from spring openings and nonpoint source runoff. The stretch of river from Spring Lake to IH-35 is more conducive to the establishment of rooted plants relative to downstream segments (Lemke 1989). Stands are dominated by hydrilla, hygrophyla,, arrowhead (*Sagittaria platyphylla*), pondweed (*Potamogeton illoensis*), fanwort *(Cabomba caroliniana*) and Texas wild-rice. Diversity decreases from the IH-35 to the San Marcos WWTP outfall. Elephant ear stands continue to dominate a wide margin of river bank throughout the reach.

Aquatic vegetation can be degraded by sedimentation, scouring, non-native species, and changes in water quality such as increased turbidity, decreased dissolved oxygen, and

temperature fluctuations. These impacts can be caused by many factors including a decrease in spring flow, storm water and nonpoint source runoff, increased flooding (due to increased impervious cover), and erosion. Additionally, changing or declining vegetation is likely to impact associated wildlife resulting in a decrease of native species populations.

3.2 WILDLIFE

In the Balconian biotic province, there are 57 species of mammals, 16 species of lizards, 36 species of snakes, and 15 species of salamanders (five are endemic to the Balconian and all five are subterranean forms). The Texan province has 49 species of mammals, 16 species of lizards, 39 species of snakes, five species of frogs, and 18 species of salamanders (Blair 1950). The 10 most common species of birds found along the San Marcos River and its watershed are grackles, red-winged blackbirds, mourning doves, European starlings, rock dove, cardinals, house sparrows, mockingbirds, domestic ducks, and Wigeons (Casey, et al. 1998). Other birds observed include great blue herons, green herons, belted and ringed kingfishers, common ground and Inca doves, downy woodpeckers, American crows, killdeer, Carolina wrens, and red-tailed hawks (River Stewardship Program 1998-2002). Fishes typically found in the San Marcos River include smallmouth and largemouth bass, channel catfish, darters, yellow bullhead, tilapia, sunfishes, mosquitofish, perch, carp, shiners, and gar. A drop net sampling in the San Marcos River by Bio-West in 2002 found rock bass, black bullhead, yellow bullhead, Mexican tetra, Rio Grande perch, blacktail shiner, roundnose minnow, fountain darter, suckermouth catfish, redbreast sunfish, green sunfish, warmouth, bluegill, longear sunfish, spotted sunfish, largemouth bass, gray redhorse, Texas shiner, iron color shiner, Texas logperch, dusky darter, sailfin molly, and tilapia (Appendix A). Reptiles commonly observed in the watershed include the gray rat snake, earth snake, coral snake, copperhead, diamondback water snake, anoles, spiny lizards, snapping turtles, red-eared sliders, river cooters, and stinkpot turtles. Common amphibians include several species of salamanders, bullfrogs, cricket frogs, and Gulf coast toads. Some of the mammals commonly observed in the watershed include white-tailed deer, beaver, nutria, opossum,

raccoon, cottontail rabbit, striped skunk, cotton rat, armadillo, free-tailed bats, and the fox squirrel.

3.3 LISTED, PROPOSED, AND CANDIDATE SPECIES

The San Marcos salamander and Texas wild-rice are endemic to the San Marcos system, while the fountain darter and Comal Springs riffle beetle are endemic to both the San Marcos and Comal River ecosystems. Due to their limited distribution, impacts occurring from land development in their respective watersheds, and the potential loss of spring flow from the Edwards Aquifer to these rivers, the USFWS listed fountain darters, San Marcos gambusia, Texas wild-rice, and Comal Springs riffle beetles as endangered, and San Marcos salamanders as threatened. Texas blind salamanders, also endangered, make their home in the aquifer, not in the river directly, and therefore will not be covered in the SMRHCP. This species will be addressed in the watershed management plan.

San Marcos salamander (*Eurycea nana*)

This small salamander (4-6 cm) is found only in the San Marcos River, specifically in algae found in the headwaters. A member of the family Plethodontidae, it is slender, with translucent brown skin, small yellow spots, and well-developed external gills. It has 16-17 costal grooves and is distinguished from *E. neotenes*, the only other member of the genus, through its locality, smaller size, uniformly light brown dorsal coloration, and generally more slender build. There are four toes present on the fore limbs and five on the hind limbs. It is carnivorous, feeding on small snails, crustaceans, and fly larvae. Exact details of its reproduction are unknown although it lays eggs and probably breeds year round as the population structure remains largely unchanged throughout the year (USFWS 1995). The San Marcos salamander was listed as a threatened species on July 14, 1980.

The San Marcos salamander is believed to be found near all major spring openings and have also been found in moss and dense mats of filamentous blue-green algae (*Lyngbya sp.*) in Spring Lake, particularly in the uppermost portion by the River Systems Institute. The vegetation serves the dual purpose of providing protection from predators and well as sheltering a plentiful food supply for the salamanders. They are also occasionally

collected from beneath rocks in sand and gravel areas of the lake. Salamanders have not been observed in areas without flow, so adequate flow is deemed necessary for its survival. Additional parameters include the uniform characteristics of the springs which include constant temperature, slight alkalinity, and clarity (Nelson 1993).

Texas wild-rice (*Zizania texana*)

Texas wild-rice, an aquatic perennial in the family Poaceae, was listed as endangered April 26, 1978 and listed by the state of Texas April 29, 1983. Its ribbon-like leaves, measuring one to two meters, are generally submerged, occasionally rising above the water line to flower and seed. The plant grows in masses, forming clumps that root near the center of the river. Reproduction occurs clonally with shoots emerging from the end of stolons. It requires clear, flowing water with a constant temperature to thrive. Historically found in Spring Lake, the current range of Texas wild-rice extends from the upper reaches of the San Marcos River (just below Spring Lake dam) to just below the WWTP. (USFWS 1995) It is generally absent from the area below the Rio Vista railroad bridge to Rio Vista dam as this area is deep, highly modified and disturbed. Historically, the plant was abundant throughout the waterway as well as irrigational side channels. However, a 1967 survey of the upper part of the river revealed only one plant (Emery 1967). TPWD does annual monitoring of this species and has been working on its stabilization. The average coverage from 1989-1994 has been 1,374.3 m^2 (pers. comm., Jackie Poole, TPWD 2005).

The main threats to Texas wild-rice are direct disturbance and reduced spring flow. Secondary threats include exotic plant species which can reduce available habitat, introduced herbivores such as nutria (*Myocastor coypus*), waterfowl, and the giant ramshorn snail (*Marisa cornuarietis*), water quality degradation, and a lack of genetic diversity (USFWS 1995).

Fountain darter (*Etheostoma fonticola*)

The fountain darter is a small fish (2.5-4 cm) in the family Percidae. The critical habitat of the fountain darter begins at Spring Lake and continues to the confluence with the

Blanco River. Fountain darters can also be found in the Comal River located in New Braunfels, Texas (USFWS 1995). Compared to other darter species, they have an extended breeding period; however their overall fecundity is believed to be lower (Hubbs 1985). This species is sexually dimorphic and reproduces oviparously. Females deposit eggs in vegetation which are then fertilized by the male. Prey includes zooplankton and aquatic insect larvae.

Fountain darters require clean and clear water, relatively constant water temperatures, and most importantly, adequate spring flows. An adequate food supply is necessary, as is undisturbed sand and gravel substrates with rock outcrops and submerged vegetation. Fountain darters are most commonly found in areas with the filamentous green algae, *Rhizoclonium sp.* and the moss *Riccia sp.*. Young darters tend to remain in vegetated areas with low flow until they are strong enough to handle faster currents. Like most other endangered species, the fountain darter is faced with problems of habitat loss and degradation, and more recently acquired an additional burden of increasing parasitism (Mitchell et al. 2000, McDonald 2003). An exotic trematode has been detected on the gills of the fountain darter in high enough quantities to restrict the darter's ability to pull in oxygen. Believed to use an exotic snail as a host, the trematode has become more common as the snail populations have grown, thus increasing its threat to the fountain darters.

Comal Springs riffle beetle (*Heterelmis comalensis*)

This small beetle is in the family Elmidae and was first collected in 1976 (Brune 1981). It is completely aquatic in both the adult and larval forms. Adults are approximately 1/3 of a centimeter long and usually found near the surface of the water in depths of two to ten cm. Females are slightly larger than males, and unlike other riffle beetle species, the Comal Springs riffle beetle appears unable to fly. It is restricted to the Comal and San Marcos river systems. Greatest population densities are found from February to April (Bosse 1988). Adults feed on algae and detritus scraped from rocks and aquatic vegetation. Without sufficient water flow, this species is unable to respire properly, thus flow is a limiting factor to its survival and choice of habitats. They appear to be very

limited in distribution, found only at or nearby the openings of spring flows in the San Marcos and Comal spring systems (Nelson 1993).

In addition to the listed species, many other native species, some uncommon, occur in the San Marcos River system. Two species of caddisfly (*Protoptila arca* and *P. alexanderii*) which have been found from Spring Lake dam to IH-35, may be unique to this area (pers. comm., Dr. David Bowles, TPWD, May 1999). Uncommon species of fish found in the San Marcos River include the Guadalupe bass **(***Micropterus treculi),* dusky darter *(Percina sciera apristis*), and *Poecilia formosa* (mollies). Cagle's map turtle (*Graptemys caglei*) is also reported in the San Marcos River, although downstream of the proposed project area.

3.4 WETLANDS

The SMRHCP deals directly with activities on the San Marcos River. All necessary precautions will be taken to protect the integrity of the river and its tributaries during the implementation of the SMRHCP. No other jurisdictional wetlands are involved.

3.5 GEOLOGY AND SOILS

The dominant geological feature of the watershed is the Balcones Fault Zone represented in this area primarily by the San Marcos Fault, a major fault that runs through Spring Lake. The area east of the fault is rolling prairie and the area west the fault is the Edwards Plateau.

The geology of the San Marcos area is cretaceous-aged rock with stream and river areas covered by recent alluvium and colluvium. West of the San Marcos fault, which is the part of the Balcones Escarpment and Fault Zone running through Spring Lake, the surface geology is predominately limestone of the Buda Formation with outlying areas exposing Del Rio and Georgetown Formations as well as the Edwards Group (DeCook 1960). The Balcones Escarpment and Fault Zone is not only the boundary of two geographic regions, but it is significant for its association with many springs and caves that occur along its length. Ezell's Cave, Deadman’s Cave, Wonder World Cave, Windy

Cave, Primer's Fissure, and Johnson's Well are some of many entrances into caverns of the formation.

Northeast-trending faults of the Balcones Fault Zone cross Hays County, but are more numerous in the southeastern part of the county. San Marcos Springs Fault forms a part of the escarpment separating the Gulf Coastal Plain from the Edwards Plateau. San Marcos Springs Fault and Mustang Branch Fault almost completely offset the Edwards Aquifer by juxtaposing Edwards Aquifer limestone against nearly impermeable upper confining units along parts of their traces across Hays County. These faults are thought to be barriers, or partial barriers, to groundwater flow where the beds are juxtaposed (United States Geological Survey 1995).

Faults are common throughout the watershed and many sinkholes and other recharge features have been formed in the upper part of Sink and Purgatory Creek drainages. These were formed from outcrops of Edwards limestone being dissolved by groundwater and the overlying beds then collapsing. The sinkholes are commonly filled with rocks of the Georgetown or Del Rio Clay Formations; in places, rocks as young as the Eagle Ford Group and Austin Group have slumped into the depressed areas (Fisher 1974).

The Edwards Aquifer is composed of the seven informal members of the Kainer and Person Formations of the Edwards Group, together with the overlying Georgetown Formation. The major factors controlling porosity and permeability in the Edwards Aquifer outcrop are faulting, stratification, and karstification. Zones of faulted, fractured, and dissolutioned limestone, along with layers of burrowed, honeycombed, and occasionally cavernous limestone, are common in the Edwards Aquifer outcrop. The karst features of the Edwards Group rocks in Hays County are characterized by resistant terrain of dense limestone, sparsely dotted with sinkholes and caves, which can greatly enhance porosity and permeability.

The surface geology of the San Marcos River begins with outcropped sections of the Person Formation (Edwards Group) and the Georgetown Formation at the San Marcos

Springs. Beginning at the headwaters, quaternary colluvium mantles the hillsides. Floodplain areas located further downstream are comprised of quaternary alluvium. Underlying the alluvium is a bed of montmorillonitic clay of the Taylor Group and a chalky limestone of the Austin Group. These latter two groups, along with quaternary alluvium, form the floor of the San Marcos River (Rose 1972).

The upper San Marcos River watershed is primarily composed of Edwards Plateau soils (95%) and the remainder is Blackland Prairie. The Edwards Plateau is shallow and rocky with large areas of exposed limestone, while the Blackland Prairie is dark calcareous clay with occasional acidic sandy loams (Blair 1950). Drainage of the upper San Marcos River watershed is naturally divided into four subwatersheds: Sink Creek, Sessom Creek, Purgatory Creek, and Willow Springs Creek. The subwatersheds have the following general soil series associations: Comfort-Rock, Eckrant-Rock, Heiden clay, Doss silty clay, Gruene clay, Krum clay, Medlin-Eckrant and Tinn clay. Most of these soils are low in nitrogen and phosphorus, high in potassium, and very high in calcium (Texas A&M University 1974). The San Marcos River is located primarily in the Tinn clay, Lewisville silty clay, Heiden clay and Oakalla soil types (USDA 1984). The soils surrounding the river are silty and clayey loams typically found on stream terraces and in floodplains. They are typically well-drained and flooded more than once every two years for brief periods.

Frequency and volume of flooding have been increasingly controlled in the San Marcos River since 1983 by the construction of five flood control structures in the San Marcos watershed at the following locations: Site One -Sink Creek at Freeman Ranch; Site Two -Sink Creek at Hillard Road; Site Three -Sink Creek at Lime Kiln Road; Site Four -Upper Purgatory Creek at the San Marcos Baptist Academy, and; Site Five -Lower Purgatory Creek at Purgatory Creek greenspace. The Natural Resources Conservation Service stated that decreased flooding has no effect on Oakalla soils and associated vegetation (pers. comm., Michael Raney, NRCS, 1995). These soils have a moderate permeability (2 in/hr) with high water capacity. The hazard of erosion in these types of soils is considered slight (United States Department of Agriculture Soil Conservation Service

1984). The Oakalla soils are probably a primary constituent of the muddy substrate often found in vegetated areas of the river. Other less dominant soils within 100 m of the river have slight-to-moderate erosion potential.

From its headwaters at the springs to near its confluence with the Blanco River, the San Marcos River flows mostly over gravel or gravel/sand bottom (Crowe 1994), with many shallow riffles alternating with deep pools. However, there is some variability in the substrate, and in areas with lower flow, sediment/mud accumulates. Sediment-dominated substrates are also found near eroded banks and by storm water drainage points.

3.6 LAND USE

Land uses along the upper San Marcos River include: public and institutional (33%), vacant land (31%), residential (20%), commercial (9%), parks/open space (5%) and industrial (2%) (City of San Marcos Horizons 1996). Residential areas are found all along the river from the headwaters to the Blanco confluence. Public land use includes a golf course and city parks. Commercial land use consists of one restaurant adjacent to Rio Vista dam. Most of the land adjacent to the river below the WWTP is agricultural. The segment of river from Spring Lake to just below IH-35 flows through an urban area, and its tributaries cut through primarily urban and suburban lands.

3.7 WATER RESOURCES

The San Marcos River flows primarily southeastward for about 110 km before joining the Guadalupe River near Gonzales, Texas. The upper San Marcos River is the segment from Spring Lake to the Blanco River confluence (which measures approximately 6.5 km). It is rapidly flowing and clear in this segment. Its watershed is located in Hays and Comal counties, Texas and measures 244.45 km^2. The river is primarily fed by a series of springs collectively known as the San Marcos Springs which are first magnitude with an average flow of 170 cubic feet per second (cfs) (USFWS 1995). These springs are fed by the freshwater portion of the Edwards Aquifer which originates west of Uvalde in Kinney County and extends to Bell County near Belton, paralleling the Balcones

Escarpment for most of its length. Groundwater divides in the Edwards Aquifer exist in the west near Brackettville and in the east near Kyle, so the San Antonio segment of the Aquifer is hydrogeologically separated on either side. The segment of upper San Marcos River below Spring Lake varies from 5 to 15 m wide and up to 4 m deep. The segment of river below the Blanco River confluence has few attributes of a spring-fed stream (U.S. Fish and Wildlife 1995).

Figure 3 illustrates the location of the river's four tributaries. Sink Creek, the largest tributary, discharges large quantities of storm water runoff from the north into Spring Lake. Spring Lake dam causes water to back up into Sink Creek about 1.5 km. Sessom Creek discharges into the river just below Spring Lake dam. Purgatory Creek and Willow Springs Creek are normally dry except during periods of high rainfall. Purgatory Creek and Sink Creek both contain springs of appreciable size. Purgatory Creek Springs, located in the upper end of Purgatory Creek, flow for about a half kilometer down the streambed and are impounded behind a series of small privately constructed dams. Sink Spring, located in the Sink Creek drainage a little over a kilometer northeast of San Marcos Springs, flows only to the surface where it is held in the spring basin (Longley 1975).

Most recharge to the Edwards Aquifer is from Edwards Aquifer outcrops in the Balcones Fault Zone in northern Bexar County and southern Comal and Hays counties (Edwards Aquifer Authority, www.edwardsaquifer.org). The rugged, scenic limestone hills of the Edwards Aquifer outcrops are the site of rapidly encroaching residential and commercial development. Increased development brings a greater threat of contamination to the Edwards Aquifer. The aquifer could be contaminated from spills or leakage of hazardous materials, leaking septic systems, or storm water runoff from the rapidly developing urban areas that surround, or are built on, the intensely faulted and fractured karstic limestone outcrops characteristic of the recharge zone. Furthermore, some of the hydrogeologic subdivisions that compose the Edwards Aquifer have greater effective porosity and permeability than others, and in areas where they crop out provide direct avenues for contaminants to enter the aquifer.

Ogden (1986) stated that mean historic river flows are steadily decreasing. Spring flow was recorded as 46 cfs during August of 1956, when aquifer levels reached a record low after seven year of drought. Some of the springs toward the top (east) portion of Spring Lake have ceased flowing during minor droughts. Total discharges representative of these droughts include 64 cfs in September of 1984, 80 cfs recorded in October, November, and December of 1989, and 76 cfs in August of 1996. Conversely, the all-time maximum-recorded discharge at the springs was 451 cfs in March of 1992 (USGS, www.usgs.gov)

3.8 AIR QUALITY

Hays County is currently a full attainment area for all air quality criteria pollutants (U.S. Environmental Protection Agency [EPA] 2006). Ozone is the primary concern. The TCEQ San Marcos monitoring station which operated from April 3, 2007 to November 1, 2007 showed only four dates in that time period where ozone reached the "moderate" level (75 ppb to 89 ppb) (Texas Commission for Environmental Quality [TCEQ], 2008) . This level was maintained for a maximum of three hours before dropping back below 74 bbp into the "healthy" range. The highest ozone level reached at the San Marcos monitoring station for the year 2007 was 81 ppb (May 11, 2007; 2:00 p.m.). The yearly average was 25 ppb with a standard deviation of 15.4 ppb.

3.9 WATER QUALITY

Water quality includes chemical and physical parameters. Some important chemical parameters are dissolved ions, trace elements, pH, nutrients, dissolved oxygen, and organic contaminants (i.e. compounds of petrochemicals or pesticides). Physical parameters include water temperature and turbidity. Water quality in the Edwards Aquifer has been monitored since the 1930s and has been found suitable for all uses, including human consumption (USGS 1987). Rainfall and streams enter sinkholes and cavities throughout the recharge zone and flow directly into the aquifer. There is minimal layering of soil and rock to filter contaminants from the entering waters. The aquifer currently has low contamination levels because a majority of the water in the

Edwards Aquifer originates as precipitation in rural areas (Brune 1981). The potential of the Edwards Aquifer to rapidly transmit large volumes of water with little filtration makes it highly susceptible to pollution (Slade et al. 1985). Consequently, if recharge for the San Marcos Springs has a high local component, and high-density development continues to increase over the recharge zone, water quality will be seriously threatened. The TCEQ has identified the Edwards Aquifer as being one of the most sensitive aquifers in Texas to groundwater pollution (Texas Water Commission 1989).

Water quality monitoring of sites along the San Marcos River by various researchers reveals generally stable values for most parameters. The river's water temperature ranges from 70°F to 72°F, slightly higher than the 67.3° average annual air temperature at San Marcos.

Minor variance in San Marcos River water quality includes a natural gradient of slightly increasing water temperature from the headwaters to the lower reaches toward the Blanco River confluence, as well as fluctuations in dissolved oxygen concentration due to the presence or absence of macrophytes and algae, time of day, etc. However, water quality can be rapidly impacted by events such as decreasing flows, surface runoff, point and nonpoint source pollutants, and urbanization, which can increase water quality variance significantly.

A continued increase in pumping of the Edwards Aquifer could affect water quality in several ways. For example, decreased aquifer levels result in decreased spring discharge, which lowers water levels in the river. The normally constant water temperature is affected as depths decrease, particularly in the shallower areas downstream. Brackish waters in the Edwards Aquifer, which lie close to San Marcos Springs, could move into the freshwater section of the aquifer and deteriorate water quality. Lowered springflow would also result in decreased dilution ability and a decrease in dissolved oxygen. Dissolved oxygen could be further reduced by the increased decay of plants as water levels drop (Rothermel 1987). The impacts of nonpoint source pollution would increase as discussed in Section 2.1 (Assessment of Threats).

3.10 CULTURAL RESOURCES

San Marcos is part of the Central Texas archeological region; a distinct cultural-geographic area encompassing the eastern half of the Edward's Plateau, the Llano Uplift, most of the Lampasas Cut Plains, the Comanche Plateau, the southern end of the Grand Prairie, and the Blackland Prairies bordering the Balcones Escarpment (Prewitt 1981). Surveys and excavations around the San Marcos River have revealed artifacts dating from approximately 11,500 years ago through modern day. The cultural time periods represented are the Paleo-Indian, Archaic, Late Prehistoric, and Historic Periods. The type of settlement type and density of artifacts is dependent on proximity to water and other resources. The floodplains are rich with deeply buried deposits, while hilly areas contain shallow deposits (pers. comm., Dr. James Garber, Tx State, August 1998).

The high degree of urbanization along the river means archaeological sites are usually highly disturbed. Prior archeological surveys conducted for the City prior to construction projects indicate the ground is disturbed to roughly 50 cm. Archaeologists will be consulted for any aspect of SMRHCP implementation which requires soil disturbance to insure the integrity of any culture resources present.

3.11 SOCIOECONOMICS

San Marcos is part of the Austin-San Marcos Metropolitan Statistical Area which is growing at an annual rate of 7.7%. Hays County is expected to more than double by 2020 due to the growth of San Marcos and Texas State, and the continued urbanization of northern Hays County as Austin grows southward (CAMPO 2002). As previously stated, the population of the City has grown 20.8% in the last ten years bringing the current population to just over 38,000 people and is expected to keep growing at an accelerated rate reaching over 70,000 by 2020 (COSM 2005). This rapid growth has spawned a healthy real estate market, including multifamily, single family and commercial development, although it is worth noting the student population size largely drives the rental market.

Major employers in San Marcos include Tx State, the City, Tanger Outlets, Prime Outlets, San Marcos Consolidated Independent School District, Hays Consolidated Independent School District, Hays County, Central Texas Medical Center, and Chartwells. The unemployment rate for the year 2000 held steady at 2.4%, consistently below the state average of 4.8%. Twenty-four institutions of higher learning in a 50-mile radius provide San Marcos with a steady supply of skilled workers. Tourism is important, bringing approximately 5.1 million visitors to the area annually.

SECTION 4.0 ALTERNATIVES INCLUDING THE PREFERRED ALTERNATIVE

In considering the proposed alternatives, note that Tx State owns the property surrounding the headwaters of the San Marcos River (Spring Lake) that extends from Bert Brown Road to Spring Lake dam and the spillway by Clear Springs Apartments. They also own property at the origin of Sink Creek (Rattlesnake Cave), which flows into Spring Lake, and the area called upper and lower Sewell Park which starts immediately downstream of Spring Lake dam and the spillway to the beginning of City Park. The following discussion includes projects/activities (Projects 1-10) that are ongoing or proposed by Tx State and primarily take place in the Spring Lake and Sewell Park area (Figure 4). The City is proposing several projects/activities (Projects 11 - 15) in and along the San Marcos River from the sand bar at the Sessom Creek confluence to IH-35. These projects will be associated with the various City parks that border the river: City, Bicentennial, Children's, Rio Vista and Ramon Lucio (Figure 5).

Projects as described in the Preferred Alternative (Section 4.1) will be denoted in their respective headings as to whether Tx State or the City is responsible for their undertaking.

4.1 ALTERNATIVE 1 - Preferred Alternative

The preferred alternative is the full implementation of the SMRHCP presented in section 6.0, and the issuance of a permit under section 10(a)(1)(B) of the Endangered Species Act

to authorize incidental take of fountain darters, Comal Springs riffle beetles, and San Marcos salamanders during the implementation of said plan. Issuance of the permit will allow for continuation of current activities and completion of the projects by Tx State and the City as detailed below.

4.1.1 MANAGEMENT OF SUBMERGED & FLOATING AQUATIC VEGETATION IN SPRING LAKE (TX STATE)

Tx State currently harvests submerged vegetation from Spring Lake with a harvester boat and cuts vegetation from around spring openings, the underwater archaeological site, along the wall by the River Systems Institute, and in the fountain area (Figure 6). The vegetation is removed in order to enhance viewing from the Aquarena Center's glass-bottom boats and prevent entanglement of plant material in the boat propeller. Each week about five springs are cut, thus returning to cut the same springs every two to three weeks. During summer algal blooms, the springs are managed more frequently (up to four springs per day), but mostly to remove algae. Tx State employees fin the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they shear vegetation to a height of 30 cm, and then to one meter over the following three-meter radius. Plant material is not collected, but is carried away by the current. This plant material is monitored by student workers at the Tx State Outdoor Recreation Center and contract workers hired by the City to ensure it does not accumulate within critical habitat ranges. Cumulatively, about 6 m of vegetation around each spring opening is modified. Mosses are not cut. The volume of plant material removed varies by the amount of time between cuttings, and season.

The harvester boat removes a range of 15 to 20 boatloads of plant material a month from Spring Lake. Each boatload measures about 12.5 m^3. Plant material is cut and picked up by the harvester, visually checked by driver for fauna caught in the vegetation, then carried to a compost site. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake. The compost site can be accessed from Aquarena

Springs Drive by driving northwest on Laurel Ridge and taking a right at the shed where the golf course crew stores their mowers. The pile is located between the River Systems Institute and the San Marcos Treatment Center. The harvester clears the top meter of the water column, cutting vegetation from sections one, two, and three once a week. Vegetation mats are removed from sections four and five on an as-needed basis (Figure 6). Total area cut equals about nine surface acres.

One permanent full-time person (Spring Lake Area Supervisor) is responsible for running the harvester and managing the removal of vegetation around the spring openings. This person also inspects and maintains equipment, assists with the composting program, coordinates volunteer activities, and will participate on the monitoring team in accordance with the SMRHCP. The Spring Lake Area Supervisor also schedules cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants are collected by hand and shaken prior to removal from the river to dislodge any aquatic species caught in the plant. The plants are deposited into dump trucks and taken to the Aquarena Center compost area.

Tx State employees are trained to recognize the listed species through the Diving for Science program (Appendix B), and avoid contact with them.

4.1.2 SEDIMENT REMOVAL IN SPRING LAKE (TX STATE)

Monitoring of the San Marcos River since 1990 reveals that sediment production has increased from 160 m^3/yr to 920 m^3/yr due to a combination of upstream flood control dams and sediment inflow increases (Earl and Wood 2002).

Tx State proposes to remove accumulated sediment in Spring Lake (Figure 7) through the use of hydrosuction. Sediment will be suctioned through a PVC end piece (4"diameter) using a five horsepower compressor, and the PVC end piece will be covered by 1mm mesh screen to minimize suctioning biota. The sediment will then flow through a fire hose and be released into a tank. Water will be drained from the removed sediment and returned to the river. The drained sediment will be removed and mixed into an existing

compost site located near the City of San Marcos Animal Shelter off of Riverside Drive and Highway 80. No contaminant analysis will be done due to cost. This location lies outside of any FEMA floodplain. One diver will suction sediment for two hours twice a week (4 hours total), and no more than 45 m^2 per week. Even if the entire area cannot be completed within four hours/week, the diver will move downstream to the next site. While the diver is working, the area will be marked with flagged rebar at each corner of the plot to keep the diver within the designated area.

Although landscape controls will be established to control the various sources of sediment in the watershed, this project will remain long-term because such small areas are suctioned at a time. Most areas will accumulate more sediment by the time all designated sites are finished, and so the process will be reiterative.

4.1.3. TRAIL SYSTEM (TX STATE)

Tx State plans to construct a bike/hike trail (one kilometer) along the northwest side of Spring Lake from Laurel Drive to Saltgrass (Figure 8). This new section of trail will connect to the existing trail that begins at the Texas Rivers Institute. The trail is proposed to be pervious concrete, 3 m wide, with an additional 2/3-meter clearance of vegetation on each side. More than half of the proposed trail will lie on top of existing dirt or gravel driveways/roadways.

4.1.4 SCUBA IN SPRING LAKE (TX STATE)

Several different SCUBA diving classes are held in Spring Lake, some in the Designated Training Area and some in the natural lake. Non-Texas State classes use the Designated Training Area (approximately 2,140 m^2 - Figure 8) for six to ten check-out dives occurring at the end of each semester for its beginning and advanced classes. Each class (two total) averages 10 to 12 students, although the class limit is 16. Each class does three 30-minute dives over a two-day period. Texas State will offer basic and advanced dive classes with multiple sessions occurring year round. Open water sessions for these classes will be limited to three sections not to exceed 16 students at any time. All Texas State basic and advanced training dives will be confined to the Designated Training Area.

Another class taught in the Designated Training Area is the Tx State Criminal Justice Department's underwater rescue and crime scene diving class. This class is limited to 16 students working on videotaping and photographing simulated crime scenes as well as performing staged underwater rescues. Employees of Aquarena Center also teach Diving for Science in the Designated Training Area as a two-day class with a 20-person maximum. It can be taught weekly, although it usually occurs only twice a month with an average of eight people per class. The program averages 350 trainees per year and 4,000 divers will have gone through the program by the end of 2008. Upon completion of the Scientific Diving class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae, and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates all volunteer diving.

Outside the Designated Training Area, the Archaeology Department at Tx State plans to teach an underwater archaeology field course. They will hold the class in the area that has historically been used by divers to uncover artifacts (Figure 8). Students (maximum of 16) will work within defined borders (Four 2 m x 2 m grids) and sift through the substrate for artifacts. Prior to taking this class, students would have to take and pass the Diving for Science class.

4.1.5 DIVERSION OF WATER FROM SPRING LAKE (TX STATE)

Tx State has three surface water right certificates as explained below and further detailed in Appendix C.

Spring Lake (Certificate 18-3865) covers:

- Tx State has a 100 ac-ft/yr irrigation water right. A pump house located adjacent to green #8 (Figure 9) diverts 100 ac-ft/yr of water for the purpose of irrigating the 70-acre Aquarena golf course. The water is pumped at a maximum of 150 gpm. A 0.25"mesh screen covers the intake. Fountain darters have not been

observed when the screen is cleaned, however there is a possibility for capture of adults against the screen, but not pulled into the pipeline.

- Tx State has a 513 acre-feet/year municipal water right that is not currently utilized.

- Tx State has a 534 ac-ft/yr industrial permit with a maximum permitted diversion rate of 600 gallons per minute. Tx State only uses 250 ac-ft/yr of this industrial permit for two chiller plants (East Chill Plant and Cogen Plant). The water is pumped from an intake site located just above the Spring Lake dam. To access this intake site, a pipeline has been bored from the existing site and extended to the Freeman Building area, where it is pumped to the chiller plants. A 0.25 mesh screen is used at the intake. Fountain darters have not been seen on the screen when cleaned. Cooling tower water is held in a reservoir. A majority of this water evaporates and the remainder is periodically released into the City of San Marcos sanitary system.

- Tx State also has 64,370 acre-feet hydroelectric at the Saltgrass location. They do not exercise this right and have transferred 33,108 acre-feet to the Texas Water Trust (see Appendix C). This action was being taken in cooperation with the Texas Parks and Wildlife Department.

- Tx State is authorized to impound 150 acre-feet in Spring Lake.

- There was an artificial waterfall used in shows by the previous owner located in the Designated Training Area that is permitted for 700 acre-feet/year. This right will not be exercised by Tx State.

San Marcos River (Certificate 18-3866) covers:

- Tx State has a 20 acre-feet irrigation right used to irrigate a ten-acre field by the Armory.

- Tx State 60 acre-feet industrial used to fill and replenish seven off-channel reservoirs (old fish hatchery ponds) for biological research and related educational purposes.

Oyster Creek (Certificate 18-3892) covers:

- Tx State has a 587 acre-feet impoundment right. This certificate is jointly owned with adjacent property owners. The impoundment, located at the Muller Farm east of IH-35, is used solely for recreation.

- Tx State also has groundwater rights through the Edwards Aquifer Association (EAA). They are authorized to pump 1237.5 acre-feet/year which is subject to EAA drought restrictions. Tx State pumps 128 million gallons/year from two wells adjacent to Jackson Hall that is used for campus drinking water. Tx State also obtains 19 million gallons from the City. A partially-capped artesian well is located behind the Freeman Aquatic Building with a 666.8 acre-feet/year water right. Ninety gpm flows from this well into the wet-lab in Freeman and into Sessom Creek.

4.1.6 MANAGEMENT OF AQUARENA GOLF COURSE & GROUNDS (TX STATE)

The primary area of concern in the management practices for the Aquarena golf course and grounds is the use of pesticides, fertilizers, and water. The following table (Table 1) lists types of pesticide or fertilizer, location and frequency of use, and amount used:

Pesticide/Fertilizer	**Area Treated**	**Amount Used**	**Frequency**
Roundup Pro (herbicide)	Flower beds, golf course, grassy areas, along paved areas	12 - 18 gals	Every 2 - 4 months
Ronstar (herbicide)	Golf course	125 - 200 lbs	Annually

Logic (fire ants)	Parking lots	9 lbs	As needed
Award (fire ants)	Beds, grassy and along paved areas	25 -50 lbs	As needed
Fore (fungicide)	Golf course	90 oz	Annually
Rubigan A.S. (fungicide)	Golf course	128 - 256 oz	Annually
Fertilizer*	Golf course	75 –500 lbs	Monthly

* NxPro 21-2-14; Nature Safe 8-3-5; Acu-Actinite 6-3-0/1

Other management practices include mowing and landscaping. Greens are mowed almost daily, with the remaining areas mowed weekly. Native plants are used for landscaping of the grounds and golf course. Pesticides and fertilizers are used in both the golf course and grounds. Chemicals are stored in a storage area at the maintenance work site across the street. The area of impact for potential run-off is shown in Figure 9. Chemicals that are less aggressive toward aquatic species will be incorporated in the development of an Integrative Pest Management (IPM) plan for the golf course. Extreme care is used in the application of chemicals. The amount used is calculated for complete absorption by the plant material which avoids runoff into groundwater and surface water. Timing of application is monitored to avoid distribution two days prior to rain events, or if annual application is required, this is done during summer months when rain events are least likely.

4.1.7 SALTGRASS PERVIOUS PARKING LOT (TX STATE)

Saltgrass has installed a 16-space overflow and employee parking lot located immediately to the north of the original parking lot (Figure 8). The lot measures 545 m^2 including the 8.7 m^3 sedimentation/filtration basin. The basin was built to hold storm water for 24 hours. The water first filters through the parking lot, which consists of pave stones underlain with 0.5 m of a sand and gravel mix, then travels through a French drain system to the detention pond. The sand in the lot is underlain by 15 cm of clay which acts as an impermeable liner.

4.1.8 BOATING IN SPRING LAKE AND SEWELL PARK (TX STATE)

Canoeing/kayaking classes are occasionally held in Spring Lake and Sewell Park. Classes in Spring Lake are restricted to the glass bottom boat runs, and the Sewell Park lessons occur by the Outdoor Recreation Center, downstream of the Texas wild-rice stands. The glass-bottom boat runs are areas that are mowed by the harvester, so canoeists will not be impacting vegetation during their classes, and Texas wild-rice will be specifically avoided. In addition, they will enter and exit the canoes/kayaks on the deck around the Landing or Designated Training Area (Figure 8) to avoid impacting the flora and fauna along the bank. The classes are made up of 16 to 20 students in eight to ten canoes and are supervised. The students will be in the lake for one hour per class. Only one class is held each semester at a maximum (four classes annually). Canoes and kayaks are also occasionally used for research and maintenance projects on the river.

4.1.9 MANAGEMENT OF AQUATIC VEGETATION IN SEWELL PARK (TX STATE)

Tx State is interested in managing the submerged vegetation in Sewell Park below University Drive to enhance the aesthetics and enjoyment of recreational activities, such as tubing, swimming, and canoeing. Tx State proposes clearing at least the top 30 cm of the water column of plant material through the use of divers (SCUBA and snorkel) in areas that are a minimum of one meter in depth within the recreation corridor (defined as the central 5 m of the river). Two divers, using machetes, will cut the vegetation and allow it to drift downstream. Plant cutting will occur a minimum of three meters away from Texas wild-rice stands. Cuttings will be pushed downstream and monitored to ensure they are not collecting on stands of Texas wild-rice. The City will contract the removal of the mats that result from drifting plant material. Cutting will be limited to 30 m of river per day and edge habitat will be strictly avoided. High-growth vegetation will be replaced with low-growth native vegetation, such as arrowhead and fanwort, in the recreation corridor with the hope of eventually discontinuing the cutting of vegetation in the river. Replanted vegetation will be planted in the cleared areas at about one per 30 cm^2 and caged to prevent predation. Exotics will continue to be removed from the sites

until native plants are established. Fifty percent successful replacement is our annual goal.

Reports and maps will be submitted to the USFWS annually describing date, location, type and amount of plant material cut. Replacement stands will be measured annually and compared to baseline measurements. Tx State will also submit an annual report, including maps, describing dates and duration of re-vegetation efforts. This report will also include the amount and type of vegetation planted and methods used. A more detailed schedule of planting goals will be included as part of the recreation master plan.

4.1.10 REMOVAL OF ACCUMULATED PLANT MATERIALS IN SEWELL PARK (TX STATE)

Tx State will gather plant fragments that are caught up in rooted plant stands, including Texas wild-rice, in Sewell Park. Employees of the Outdoor Recreation Center will be trained by the WPD to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. On Texas wild-rice stands, two Tx State employees will lift (not push) the floating material from the top of the Texas wild-rice stands and allow it to float downstream or remove the plant material and compost it in the Tx State compost area by the Spring Lake maintenance shop. Downstream accumulations of plant material will be removed by the City to avoid impacts to Texas wild-rice further downstream.

4.1.11 RECREATION IN SEWELL PARK (TX STATE)

Several types of recreation occur traditionally on the San Marcos River, in upper and lower Sewell Park (see Figure 4 for general location). These include: swimming, snorkeling, SCUBA, boating, tubing, and wading. All these activities impact listed species and their habitat, some to a greater degree than others, although exact impacts are unknown. Damage to wild-rice stands by recreationists, and particularly dogs, through direct contact was documented by Breslin (1997). The University runs an Outdoor Recreation Center in Sewell park which rents equipment to river users. Users also bring in their own equipment and utilize the existing concrete walkways in Sewell park to enter

the river . Use of the park is limited to the students, faculty, and staff of Texas State University- San Marcos although not strictly enforced. Dogs are forbidden in the park which is enforced by Outdoor Recreation Center staff.

4.1.12 SESSOM CREEK SAND BAR REMOVAL (CITY)

For decades, a sand and gravel bar has been building with each major rain event at the confluence of Sessom Creek and the San Marcos River (Figure 10). The bar is currently about 2/3 m deep, 7 m wide, and 21 m long (98.5 m^3). Over time it has widened, deepened, and constricted the river channel; furthermore, the continued expansion has covered a stand of Texas wild-rice. The bar has become vegetated with both littoral and terrestrial plants, and is used heavily by recreationists as it provides a shallow swimming area. Tx State and the City propose removing the portion of the bar closest to the confluence, and leaving the downstream third of the bar to maintain deflection of flow away from Texas wild-rice downstream. A backhoe will be used to remove the dry-land portion of the sand bar, digging to the depth of about one meter. The dredge spoils will be spread in native plant beds in Crook Park located outside of the floodplain. During the removal, silt fence will be placed around the area so that loose sediment is collected and removed and does not move downstream. Sandbags will be stacked on both sides to stabilize the silt fence. No removal of the sandbar in the "wet area" will be done. Natural river processes should redistribute the remainder of the sandbar in the wetted area over time. A separate project has been constructed (Section 6.5.5) to minimize additional deposition to this area. To avoid the undercutting of downstream Texas wild-rice stands due to increased flow from the re-opened river area, a hydrologist from Tx State is working to determine the amount of scouring that will occur as a result of the removal of the upper two-thirds of the sandbar. The hydrologist will complete the study prior to any work being performed on this project. The USFWS will review the resulting report to determine the extent of project implementation.

4.1.13 MANAGEMENT OF AQUATIC VEGETATION BELOW SEWELL PARK (CITY)

The river is heavily used for recreation from Sewell Park to Rio Vista dam. As a result, the City is interested in managing submerged vegetation in the river to enhance the aesthetics and enjoyment of recreational activities, such as tubing, swimming, canoeing, and fishing. The City proposes clearing plant material from the top 30 cm of the water column through the use of divers (SCUBA and snorkel) in areas that are a minimum of one meter in depth (see Figure 5 for general location). Areas less than one meter in depth will not be cut. Two divers, using machetes, will cut the vegetation and allow it to drift downstream. The City will push the mats downstream beyond Rio Vista dam and monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation. Cutting will be limited to 30 m of river per day and only the recreation channel will be cut (central third of the channel); edge habitat will be strictly avoided. Divers will cut sites approximately once a month working from upstream to downstream and, upon reaching Rio Vista dam, will start over at City Park. In addition, the City will replace high-growth vegetation, such as hydrilla and hygrophila, with low-growth native vegetation in the recreation corridor with the hope of eliminating the need for cutting vegetation in the river. Replacement stands will be measured annually and compared to baseline measurements. Fifty percent successful replacement is our annual goal. A more detailed schedule of planting goals will be included as part of the recreation master plan. Low-growth native plants, such as arrowhead, Ludwigia (*Ludwigia repens*), and *Cabomba caroliniana*, will be planted in the cleared areas at about one per 30 cm^2. Exotics will be continually removed from the sites until the native plantings are established. Reports will be submitted to the USFWS annually describing date, location, type, and amount of plant material cut. The City will also submit an annual report, including maps, describing dates and duration of re-vegetation efforts. This report will also include the amount and type of vegetation planted and methods used.

4.1.14 SEDIMENT REMOVAL BELOW SEWELL PARK (CITY)

The City proposes to remove sediment from the river bottom at various locations from City Park to Rio Vista dam (Figure 11). Sediment has accumulated at these locations due

to the urbanization of the watershed. As a result, the river is losing depth and width. The City would like to maintain river depth and width for recreational purposes (Earle and Wood 2002). Hydrosuction will be used to remove accumulations of sediment. Sediment will be suctioned by a 5-hp compressor through a PVC end piece (ten cm diameter), then through a fire hose and released into a tank. The end piece will be covered by 0.25-inch mesh screen to prevent suctioning biota greater than 0.25 inches in diameter. The water will be held in a tank to allow the sediment to settle out prior to being returned to the river. The sediment will be mixed into city compost piles. In the event that contaminants are detected, the City will cease sediment removal activities and work with the Service to determine under what conditions they may proceed within the terms of the SMRHCP. Contaminated sediments that are made mobile by the dredging activity may release otherwise "dormant" toxins and pose additional threats to listed species. The area of sediment removal will be limited to 9 m^2 per day. Suctioning will take about two hours each day, five days per week. Divers will stake the area before beginning work. Divers will begin at City Park and end at Rio Vista dam and begin the cycle again. The same area will not be revisited for at least three months.

Although landscape controls will be established on the various sources of sediment in the watershed, this project will remain long-term. Suctioning such small areas means it will take a long time to complete all proposed sites from City Park to Rio Vista. Most areas will be covered again by sediment by the time the divers finish all the sites, and the process will begin again.

4.1.15 PERMANENT ACCESS POINTS/BANK STABILIZATION (CITY)

Permanent access points will be combined with bank stabilization for the locations designated in Figure 12. They will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. In these areas, the bank is eroding due to natural river dynamics in combination with intense recreational use. The City plans to stabilize banks in six areas (City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park and Cheatham Street underpass).

The City Park project will be 370 m^2, and the remaining projects will measure about 100 m^2. (See Appendix D -REP's report)

Natural rock will be used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation will be planted in areas adjacent to the access/stabilization areas in order to discourage river users from entering the river in places other than the access point. Prior to each construction period, the area will be swept clean of darters and exclosures will be put into place to keep darters out of the construction area. No work outside this area will occur. If additional areas along the river require stabilization, the City will contact the USFWS for consultation.

4.1.16 CONSTRUCTION OF SEDIMENTATION PONDS (CITY)

The City proposes to construct two sedimentation ponds along the river to help reduce the amount of contaminated materials that enters the river as a result of rain events (Figure 13). The ponds will also reduce runoff velocity which will help to reduce bank erosion, and subsequently the amount of sediment that enters the river. Proposed sedimentation ponds will be constructed by excavating and stabilizing specified area, and building a controlled-release structure. Water source for the ponds is solely runoff from rain events. Specific details for all ponds will be submitted to the USFWS as each pond is contracted for design. Each construction area will be surrounded by silt fence/rock berm to minimize runoff. Sediment controls will be monitored daily during construction and the construction area will be covered with a tarp in the event of rain.

The first proposed area is located beside Hopkins Street bridge (Figure 13). This area receives a large amount of street runoff from three different storm drains. The pond will be designed to remove sediment and street pollutants from runoff prior to entering the river. The size, shape, and depth cannot be designed until the volume of water discharging from the storm drains has been determined. The City will detain as much as possible for treatment purposes. Sedimentation ponds require maintenance as the ponds fill with sediments over time, the amount of which would depend on the number of rain

events occurring. The area is easily accessible and sediment will be dredged and carried to the City's existing composting site at the WWTP.

Also proposed is the restoration of an existing wetland south of Cheatham Street and east of Rio Vista Annex (Figure 13). The San Marcos River yields water to this area via a small channel that runs alongside Rio Vista dam. This backwater area does not reconnect directly with the San Marcos River. It does overflow into the river during heavy rain events. It harbors many exotic aquatic plants and is fairly narrow. The City would like to widen this wetland, remove existing non-functional concrete structures, and establish native vegetation and nesting boxes to enhance habitat and attract a wider diversity of wildlife. Depending upon the success of these projects, the City would like to continue developing ponds to address pollutants. As more are planned, the City will work with the USFWS to amend the HCP as necessary to cover any additional activities for incidental take.

4.1.17 RECREATION IN CITY PARKS- DOWNSTREAM OF SEWELL PARK TO I-35 (CITY)

Several types of recreation occur traditionally on the San Marcos River. These include: swimming, snorkeling, SCUBA, boating, tubing, wading, fishing, and recreating with dogs. All these activities impact listed species and their habitat, some to a greater degree than others, although exact impacts are unknown. Damage to wild-rice stands by recreationists, and particularly dogs, through direct contact was documented by Breslin (1997). Wild-rice is further impacted through fragmentation of other vegetation which then floats downstream collecting on wild-rice stands. Fountain darters likely are impacted through increased turbidity and accidental contact. While there are multiple hardscaped access points throughout City parks, numerous desire trails exist and contribute to bank erosion where recreationists enter and exist at whim.

The most prominent recreation feature of the river past Sewell Park is the Noon Day Lion's Club "Toob" Rental which is housed in the City's recreation hall in City Park (see Figure 5). Tubes are rented for a fee with proceeds gifted back to the community through

the Lion's Club. There are several other small businesses which rent tubes but these are minor contributions to the overall number of rentals. Parking around the river is limited to City Park and at Rio Vista Park. No new parking is planned.

Plans to minimize impacts from the preferred alternative to covered species are detailed in Section 6. 0, along with proposed mitigation actions. This completes the discussion of projects included within the preferred alternative. The applicants believe this preferred alternative represents the best choice and would like to pursue this plan, thereby proceeding with the permit application.

4.2 ALTERNATIVE DEVELOPMENT PLAN - Projects with no take

An alternative to the full implementation of the proposed SMRHCP and issuance of the permit is the completion of only those projects which do not have any associated take. No permit would be needed with this alternative; therefore no permit application would be filed.

This alternative, while eliminating the issue of additional take due to new projects, does not allow for the restoration of the riverine habitat. Not addressing this problem area could actually increase take over the long-term for the listed species. As another example, removal of exotic aquatic vegetation may have direct take during the actual process, but allowing the continued existence and growth of non-native vegetation will directly affect the quality of habitat available for the listed species and could cause long-term damage to the populations.

The deleterious effects associated with recreational use of the river will continue. The establishment of permanent access points and bank stabilization measures provide a pertinent example of how the projects proposed in the Preferred Alternative can decrease long-term take of listed species. While the installation of these access points may cause immediate take due to turbidity and habitat disturbance, they cut down on the bank

erosion caused from users exiting the water at will thus reducing sedimentation, habitat loss, and turbidity in the long-term. The long-term decrease in take occurring as a result of the implementation of those projects whose construction may include immediate take, will be lost under this alternative.

The following projects/activities, taken from the descriptions in section 4.1, would be implemented under this alternative: trail construction (4.1.3), Saltgrass pervious parking lot (4.1.7), boating in Spring Lake & Sewell Park (4.1.8), permanent access points/bank stabilization (4.1.15), and the construction of sedimentation ponds (4.1.16).

After consideration, the applicant rejects this alternative as being an inferior option to the preferred alternative. The applicant would prefer to take steps to reduce long-term take and employ mitigation measures for activities on the river. Furthermore, the applicant believes that the overall effect of the suite of projects presented in the preferred alternative will be a net improvement in the quality of the river environment and any negative effects of project implementation are short-term in nature and thus acceptable risks.

4.3 ALTERNATIVE 3 - No Action

In this alternative none of the proposed projects or monitoring would be implemented. No permit application would be processed. On-going take due to current activities in the river would continue with no mitigation measures employed. As stated in the rejection of alternative 2, the applicants believe the short-term negative effects of construction and other modifications are heavily outweighed by the long-term positive change which will be brought about by the employment of the preferred alternative. The applicants respectfully decline the “no action” alternative.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 ALTERNATIVE 1- PREFERRED ALTERNATIVE

5.1.1 ON-SITE IMPACTS OF THE PREFERRED ALTERNATIVE

5.1.1.1 VEGETATION

Management of Aquatic Vegetation in Spring Lake

Onsite impacts of the proposed action of aquatic vegetation management will result in the loss of vegetation in the top meter of the water column. Entire plants are not removed during this activity. Vegetation within a six-meter radius of each spring opening is altered. The "lost" plant materials may accumulate and form mats atop other vegetation (including Texas wild-rice), limiting access to sunlight and higher velocities of water.

Sediment Removal in Spring Lake

Onsite impacts include fragmentation of aquatic plants as a diver works within a plant stand, and increased turbidity at the suctioning intake sites and about 30 m downstream. The turbidity may last as long as 20 minutes afterward. Divers will not spend more than four hours per week at one site, and will not return to the same area more frequently than once a month. This should minimize negative impacts on the integrity of the plant stands.

Trail System

The new section of the trail (one kilometer) joining the Texas Rivers Institute to the Sessom Drive sidewalk will only require 20% (about 700 m^2) woody vegetation clearance.

SCUBA in Spring Lake

Due to the training and supervision divers receive at Aquarena, they should cause minimal impact to vegetation in Spring Lake (outside of the submarine theatre). There is no vegetation within the 10 ft x 10 ft area used for the archaeology classes. Algal mats in the submarine theatre will be highly disturbed during checkout dives. The range of the student diver skill levels as well as types of training make this inevitable.

Diversion of Water From Spring Lake

The diversion of water from Spring Lake will have no significant impact on terrestrial vegetation. Generally, emergent and submergent aquatic plants could become stressed as water levels decline due to temperature increases and decreasing dissolved oxygen levels. Diversion of water during times of low spring flow may increase this stress to a detrimental level both in Spring Lake and further downstream as less water flows into the river from Spring Lake. During the normal flow regime, there should be negligible impacts. Low flow impacts are discussed in section 6.4.5 of this document.

Management of Aquarena Golf Course & Grounds

Pesticides and fertilizers are used to enhance the growth of turf grasses at the expense of a diverse representation of native plants. Pesticides and fertilizers also impact aquatic vegetation as they absorb into the groundwater or run off into the slough, Sink Creek, and Spring Lake. Pesticides may negatively affect the growth of submergent and emergent aquatic vegetation as well as riparian vegetation, by reducing the diversity of plants and allowing non-natives to spread more rapidly. Fertilizers impact aquatic vegetation by enhancing algal growth. As the algal mats senesce, the oxygen levels in the water body often decrease. This can lead to suppressed plant growth and fish kills.

Saltgrass Pervious Parking Lot

This area was primarily grass and trees before the lot was built. The trees were maintained, but the grass and shrub undergrowth were removed.

Boating in Spring Lake & Sewell Park

Impacts to vegetation through canoeing could occur if participants are careless with their equipment. Tx State would like the option of conducting canoeing classes in Spring Lake in the area close to the docks by the submarine. Classes are currently being conducted by Tx State by the dock next to the Outdoor Recreation Center in Sewell Park. That includes training on avoiding impacts to listed species a condition of any classes conducted or allowed by Tx State. Canoeists will be prohibited from entering areas of Texas wild-rice

as they travel downstream. However, impacts are probable as most participants are novices and not always in total control of the canoes. It is possible that students will occasionally stray off course and damage vegetation with their paddles.

Management of Aquatic Vegetation in Sewell Park

Onsite impacts of the proposed action of aquatic vegetation management will result in the loss of vegetation in the top 30 cm of the water column. This impact will be limited to the recreation corridor. This activity will not directly cause the removal of entire plants from the river. Turbidity is another impact resulting from stirring up the sediment during plant cuttings and may have a temporary effect on photosynthesis. As the turbid water moves downstream, it could have a similar effect on plant stands offsite. Other offsite impacts may result from the loss of minor amounts of plant fragments that may become entangled in plant stands further downstream. The mats shade plant stands and could cause reduced growth.

Removal of Accumulated Plant Materials in Sewell Park

Onsite impacts of accumulated plant removal will result in positive benefits to the wild-rice stands in Sewell Park. Removing accumulated plant material will help prevent the wild-rice from being covered by floating mats which can potentially interrupt photosynthesis, growth, and reproductive efforts. Turbidity is another impact resulting from stirring up the sediment during plant removal and may have a temporary effect on photosynthesis.

Sessom Creek Sand Bar Removal

In addition to the elimination of existing vegetation in the immediate construction site, there is the potential for impacts to existing stands of Texas wild-rice. Removal of the sand bar will change the velocity and path of stream flow and may cause scouring and movement of sediments until the river has reached equilibrium after the bar is removed. This change in hydrological pattern may also dislodge Texas wild-rice plants at the root ball, or cause mounding of moving sediments at the root ball.

Management of Aquatic Vegetation Below Sewell Park

Aquatic vegetation management will result in the loss of vegetation in the top 30 cm of the water column. This impact will be limited to the recreation corridor and to areas deeper than one meter. All management activities will remain a minimum of three meters away from Texas wild-rice stand. Cut vegetation will be removed upstream of Rio Vista. Below Rio Vista, floating mats will be monitored to avoid impacts to stands of Texas wild-rice. This activity will not directly cause the removal of entire plants from the river. The action of cutting plants will stir up the sediments, which may temporarily reduce plant photosynthesis. As the turbid water moves downstream, it could have a similar, but decreased effect on plant stands downstream as sediment particles move away from each other. Other offsite impacts may result from the loss of minor amounts of plant fragments that may become entangled in plant stands further downstream. The mats shade stands of Texas wild-rice and other native plants, which could cause reduced growth.

Sediment Removal Below Sewell Park

The process of suctioning sediment will not permanently impact terrestrial vegetation, but will have an impact on aquatic vegetation both onsite and offsite. Aquatic plants are easily fragmented and uprooted, this will therefore be a direct impact of removing sediment if the areas to be suctioned have vegetation present. These fragments may accumulate and create a mat that could shade aquatic plants downstream or get caught in stands downstream causing further fragmentation and uprooting. Turbidity created by disturbance of the sediment will temporarily shade plant stands both onsite and offsite.

Permanent Access Points/Bank Stabilization

Access points will be constructed in areas along the river that are impacted as a result of public use. These access points will focus traffic through a narrower corridor and vegetation will be established in areas that were formerly used by the public to enter the river. As a result, any environmental consequence on both terrestrial and aquatic

vegetation will be positive. Any existing aquatic or terrestrial plants in the immediate construction site will be eliminated permanently.

Areas requiring stabilization are heavily impacted by recreationists entering and exiting the river. The river bottom is therefore denuded of vegetation. Aquatic vegetation directly in the stabilization site will be replaced with some type of stabilization material. The current vegetation at all sites is hydrilla or bare substrate. Bank areas along the stabilization site that are impacted as a result of construction activity will be restored with a higher density of native riparian vegetation. There are no offsite impacts on vegetation.

Construction of Sedimentation Ponds

No negative impacts are expected with the exception of removal of vegetation at site. Any existing aquatic or terrestrial plants in the immediate construction site will be eliminated, but restored with native wetland vegetation.

5.1.1.2 WILDLIFE

Management of Aquatic Vegetation in Spring Lake

Onsite impacts to wildlife include the potential injury and/or death of any wildlife in the top meter of the water column that are pulled up by the harvester. Uninjured fauna not returned to the water by the observer will not survive. The workers removing vegetation around the springs will be removing a limited area of potential habitat for various fauna, but leaving *Riccia, Rhizoclonium,* and *Lyngbya* will reduce the impact of spring gardening on listed species.

Sediment Removal in Spring Lake

Wildlife disturbance by divers will be limited to one diver suctioning sediment for two hours each day, and no more than 9 m^2 per day. Turbidity will disrupt downstream feeding and breeding behaviors for a slightly longer period of time. The water clears within 30 m downstream of the disturbed site.

Trail System

The installation of a nature trail and the resultant trail users may cause disturbance to wildlife in the areas surrounding the trail. Increased human traffic in the area leads to increased litter and ground compaction which can also potentially harm wildlife.

SCUBA in Spring Lake

Divers outside the submarine theatre should have minimal impact on wildlife due to the training and supervision they receive. Some disturbance is expected as divers swim through the area due to movement of the water that may result in occasional turbidity. Archaeology classes will directly disturb wildlife in their 10 ft x 10 ft unvegetated working area and cause turbidity both on and offsite that should last for approximately one-hour and 20 minutes (class time plus 20 minutes for dissipation). Divers within the submarine theatre will disturb wildlife through their physical presence and resulting turbidity. Turbidity inside and outside the submarine theatre may last for a maximum of about two hours each day. The turbidity dissipates within 30 m of the theatre.

Diversion of Water From Spring Lake

Wildlife in the project area is dependent upon Spring Lake and the river for water. Diversion of water during low spring flow may decrease the quality and quantity of water available for consumption, as well as decrease the quality of habitat for aquatic life. During the normal flow regime, there should be negligible impact. Additionally, pumping could injure and kill wildlife caught up in the pump system.

Management of Aquarena Golf Course & Grounds

The direct impacts of pesticides on wildlife occur through contact with the chemicals, which could lead to reproductive problems, decreased life span, or death. Indirect impacts occur through consumption of prey that have accumulated pesticides, reduction of native plant stands in both diversity and abundance, which means the loss of refuge and food sources for the wildlife dependent upon these habitats. As a result, wildlife representation may be reduced in numbers and diversity as a result of runoff and

groundwater contamination. These chemicals are known to be toxic to aquatic amphibians, aquatic arthropods, cold-water fishes, and terrestrial amphibians.

Saltgrass Pervious Parking Lot

The loss of the undergrowth, replacement of grass with pavers, and the introduction of cars and people made this area unsuitable for wildlife. In addition, the area north of the lot may experience increased disturbance from parking lot traffic. Aquatic wildlife may be impacted by diminished water quality.

Boating in Spring Lake & Sewell Park

Canoeists in Spring Lake and Sewell Park will impact wildlife through their presence; however these affects should be temporary and slight. Inexperienced paddlers can tear up vegetation and stir up sediments thereby destroying or lowering the quality of potential habitat. Animals in the immediate vicinity would temporarily relocate, possibly interrupting normal behaviors associated with eating, breeding, or avoiding predators.

Management of Aquatic Vegetation in Sewell Park

Onsite impacts include the potential injury and/or death of any animals in the top 30 cm of the water column as plants are being trimmed. Turbidity during plant removal, and for a short period afterwards, may reduce feeding and breeding behaviors. Turbidity could be carried downstream as an offsite impact as well.

Removal of Accumulated Plant Materials in Sewell Park

Onsite impacts include the potential injury and/or death of any animals in accumulated vegetation. Turbidity during plant removal, and for a short period afterwards, may reduce feeding and breeding behaviors. Turbidity could be carried downstream as an offsite impact as well.

Sessom Creek Sand Bar Removal

Onsite impacts of the sand bar removal will be a disturbance of the sediment and the turbidity which will come from that activity. This is, however, a one-time removal,

therefore the effects will be short term. It is expected that the turbidity resulting directly from the removal will carry downstream and settle out within about 20 minutes.

Management of Aquatic Vegetation Below Sewell Park

Onsite impacts include the potential injury and/or death of any animals in the top 30 cm of the water column as plants are being trimmed. Turbidity during plant removal, and for a short period afterwards, may reduce feeding and breeding behaviors. Turbidity could be carried downstream and have a similar impact. Any animals using the vegetation as a shelter will be forced to seek other shelter which may temporarily increase the chance of predation and reduce feeding opportunities.

Sediment Removal Below Sewell Park

Wildlife disturbance by divers will be limited to two hours per day. Turbidity will disrupt downstream fauna for a slightly longer period of time. The water clears within 30 m downstream of the disturbed site. As a result of turbidity and the disturbance of habitat, aquatic wildlife both offsite and onsite will be impacted.

Permanent Access Points/Bank Stabilization

Wildlife is minimally impacted through the removal of habitat in the areas chosen as access points. However, this is offset by the restoration of most of the existing access points (public desire trails) back to native riparian habitat.

Any aquatic species that are typically found along the river's edge will lose up to 650 m^2 of their habitat area. This will cause the animals to move to new locations and increase the numbers in remaining suitable habitat. Increased numbers could cause increased competition and susceptibility to predation.

Construction of Sedimentation Ponds

Creation of beneficial habitat for waterfowl and wetland species is the only anticipated impact associated with the construction of sedimentation ponds.

5.1.1.3 LISTED, PROPOSED, & CANDIDATE SPECIES

Management of Aquatic Vegetation in Spring Lake

During the removal of aquatic vegetation in Spring Lake, onsite impacts that may occur include the potential injury or death of fountain darters in the top meter of the water column that are pulled up by the harvester and not subsequently observed and returned. This should be minimal as the darters spend a majority of their time near the substrate (Schenk & Whiteside 1976). The Spring Lake Management Supervisor visually checks the vegetation as it is pulled up onto the harvester. Workers around the springs will be removing a limited amount of potential habitat for fountain darters, but leaving *Riccia*, *Rhizoclonium*, and *Lyngbya* ensures the availability of the fountain darter's preferred habitats. One of the habitat requirements of the San Marcos salamander is clean, clear water (Tupa & Davis 1976), so turbidity could potentially affect feeding or breeding behaviors, however, suspended sediments move downstream in around 20 minutes (pers. comm., Ron Coley, Assistant Director of Aquarena Center, 1998).

Sediment Removal in Spring Lake

Fountain darters and salamanders may be disturbed by the presence of divers in the water and the resulting turbidity. These effects should be temporary, limited to the time the divers are in the water and the machinery is running plus an additional twenty minutes for the water column to clear. The divers will not be suctioning areas around the springs or near stands of Texas wild-rice. Take may occur during suctioning if a darter or salamander is caught on the screen covering the orifice, or if smaller biota (riffle beetles), larvae, or eggs are suctioned through the screen.

Trail System

The proposed trail will open up sections that are currently difficult to access. An increase of trail users could increase the amount of litter in Spring Lake. Erosion could occur through loss of vegetation if trail users stray off the trail, thus increasing sedimentation into the lake.

SCUBA in Spring Lake

Minimization measures should reduce take of listed species outside of the submarine theatre. Archaeology classes will directly impact any listed species within their working area and have indirect impacts as a result of turbidity from the movement on the substrate. This disturbance will continue while the work is in progress and for about 20 minutes after the classes are finished. The various dive classes will disturb fountain darters within the submarine theatre. Both the physical presence and resulting turbidity of the divers will interrupt the feeding and breeding behavior of fountain darters within the submarine theatre during the classes and for a limited time after (approximately 20 minutes).

Diversion of Water From Spring Lake

For reasons previously mentioned, the diversion of water during periods of low spring flow may negatively impact listed species in Spring Lake as well as downstream. The San Marcos salamander is found around spring openings and in the spillway adjacent to Clear Springs Apartments. As lake levels drop, flow over the spillway decreases. If flow over the spillway ceased, the salamander population would be negatively affected. If water becomes more stagnant and water quality decreases, salamander and fountain darter populations in Spring Lake may be stressed as a result of low amounts of available oxygen in the water, and a change in food and refuge type and quantity. Additionally, listed species could be entrained in the pump system and injured or killed.

Management of Aquarena Golf Course & Grounds

The use of pesticides and fertilizers on Aquarena grounds, although tightly controlled, could impact listed species through a general decrease of water quality if runoff of chemicals occurs. Pesticides in high concentrations would be toxic and could cause a multitude of health problems including or leading to death through direct exposure or through accumulation in the food web. Fertilizer runoff can lead to algal blooms causing oxygen deficiency and turbidity.

Saltgrass Pervious Parking Lot

The existing take minimization measures have reduced pollutant levels to nondetectible amounts and no impacts to listed species are expected.

Boating in Spring Lake & Sewell Park

Canoeing in Spring Lake and Sewell Park should not affect the listed species in the river if participants remain in the designated areas away from known populations of listed species. Should participants leave the approved areas, damage may occur to Texas wild-rice by canoe paddles breaking and possibly uprooting plants.

Management of Aquatic Vegetation in Sewell Park

During the removal of aquatic vegetation in Sewell Park, and areas below Sewell Park, onsite impacts include the potential injury and/or death of any fountain darters in the top 30 cm of the water column. The workers will fin the 9 m^2 area prior to cutting to avoid fountain darters. Divers will be weighted to remain stationary and will move carefully from one location to another. However, darters are found near the substrate, so some may be injured or killed during this process.

Removal of Accumulated Plant Materials in Sewell Park

Onsite impacts include the potential injury and/or death of any listed species in accumulated vegetation. Turbidity during plant removal, and for a short period afterwards, may reduce feeding and breeding behaviors. Turbidity could be carried downstream as an offsite impact as well.

Sessom Creek Sand Bar Removal

The area currently covered by the sandbar was historically Texas wild-rice habitat and is adjacent to an existing stand of Texas wild-rice. Although the removal of the sand bar should restore the area's suitability as habitat for this species, the project may have immediate impacts on the adjacent stand. Changes in velocity and direction of flow may cause scouring of the sediments and potentially dislodge Texas wild-rice roots. There is also the potential for sediments to become trapped on the wild-rice plants. Increases in

turbidity may temporarily affect animal behavior, but the water column should be clear within approximately 20 minutes after construction activities.

Management of Aquatic Vegetation Below Sewell Park

During the removal of aquatic vegetation in Sewell Park, and areas below Sewell Park, onsite impacts include the potential injury and/or death of any fountain darters in the top 30 cm of the water column. The workers will fin the 9 m^2 area prior to cutting to avoid fountain darters. Divers will be weighted to remain stationary and will move carefully from one location to another. However, darters are found near the substrate, so some may be injured or killed during this process.

Sediment Removal Below Sewell Park

Although fountain darters are found largely at the base of plant stands, they may be impacted through disturbance of the stand and turbidity. However, the limited area being managed on daily basis allows darters to easily escape to nearby stands and avoid continued disturbance. Fountain darters downstream of the disturbed area may also be impacted by turbidity. Disturbed sediment may also flow over Texas wild-rice stands, thus causing some temporary shading. Take may occur during suctioning if a darter or salamander is caught on the screen covering the orifice, or if smaller biota (riffle beetles) are suctioned through the screen.

Permanent Access Points/Bank Stabilization

Fountain darters are often found in edge habitat. Projects such as these reduce the amount of available habitat and increase numbers of darters in remaining habitat. Increased numbers could cause increased competition and susceptibility to predation. Existing habitat along the bank will be removed for construction of the proposed access ramp/stairs. However, edge habitat will be restored in the areas that are currently used by the public to enter the river.

Construction of Sedimentation Ponds

No negative impacts on listed species are expected.

5.1.1.4 WETLANDS

There are no jurisdictional wetlands other than the river itself. The on-site effects to the San Marcos River due to the implementation of the projects in the preferred alternative are detailed in Section 5.1.1.7 Water Resources.

5.1.1.5 GEOLOGY& SOILS

There will be no on-site effects on geology due to the implementation of the projects in the preferred alternative. In regards to soil on-site effects will be limited to the following: the substrate type may change as a result of sediment removal, for example, a previously silty/mud substrate may be returned to a cobble/gravel substrate. Sediment removed from the substrate will be tested for the presence of metal and non-metal contaminants before it is used for compost. In the case of the pond construction, soil will be removed from specific areas, but the composition and type will not change. During the construction of the parking lot at Saltgrass 2/3 of a meter of soil was removed and replaced with a layer of clay and sand/gravel mix on top of the clay.

5.1.1.6 LAND USE

There will be no on-site effects on existing land use if the projects in the preferred alternative are implemented.

5.1.1.7 WATER RESOURCES

Every project considered in this habitat conservation plan will have some on-site impact to water resources as the whole of the San Marcos River is a water resource, however, impacts to flow and actual water quantity are expected to be minimal.

Management of Aquatic Vegetation in Spring Lake

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Sediment Removal in Spring Lake

Onsite impact from sediment removal will be minimal. Suctioned areas will become slightly deeper which could possibly change flow direction and velocity however these changes will be subtle given that only small quantities of sediment will be removed at one time.

Trail System

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

SCUBA in Spring Lake

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Diversion of Water From Spring Lake

On-site effects to water resources from the diversion of water from Spring Lake may decrease water quantity during times of low spring flow.

Management of Aquarena Golf Course & Grounds

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Saltgrass Pervious Parking Lot

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Boating in Spring Lake

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Management of Aquatic Vegetation in Sewell Park

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Removal of Accumulated Plant Materials in Sewell Park

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Sessom Creek Sand Bar Removal

Water flow not increase or decrease but will widen stream bank, slowing flow, expanding the channel and change the impact of flow downstream.

Management of Aquatic Vegetation Below Sewell Park

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Sediment Removal Below Sewell Park

Onsite impact from sediment removal will be minimal. Suctioned areas will become slightly deeper which could possibly change flow direction and velocity however these changes will be subtle given that only small quantities of sediment will be removed at one time.

Permanent Access Points/Bank Stabilization

There will be no on-site effects on water resources use if the projects in the preferred alternative are implemented.

Construction of Sedimentation Ponds

Onsite effects to water resources from construction of sedimentation ponds will include the slowing and detainment of flow into the river. The overall quantity of water entering

the river will not change however it will first be detained and sediments allowed to settle before reaching the river.

5.1.1.8 Air Quality

There will be on-site effects on existing air quality if the projects in the preferred alternative are implemented.

5.1.1.9 WATER QUALITY

Water quality control measures will be implemented as a part of every project that could impact water quality. The long-term on-site effects of the preferred alternative should be a net increase in water quality over the project area and beyond.

Management of Aquatic Vegetation in Spring Lake

Onsite impacts from removal of vegetation around the springs, in Sewell Park, and below Sewell Park include the increase of suspended solids during and after the activity (about 20 minutes maximum), and the loss of plant fragments during both activities. However, skimming the lake and pushing mats of accumulated vegetation past Rio Vista dam should reduce the impact of the plant fragments in the water column. In addition, stands of Texas wild-rice downstream of Rio Vista will be monitored for mat accumulation.

Sediment Removal in Spring Lake

Onsite impact from suctioning sediment is a temporary increase in suspended solids during and after the activity; lasting throughout the actual suctioning and for about 20 minutes past. There is also a potential for the release of associated contaminants into the water column.

Trail System

Water quality may be impacted from trail construction as a result of pedestrian-related erosion in off-trail areas and from a potential increase in litter as the number of users increases.

SCUBA in Spring Lake

SCUBA in Spring Lake has a slight risk of increased turbidity as diving activities are carried out due to the potential of stirring up the substrate. However, the risk is slight in areas outside the submarine theatre as these divers are experienced and have passed the scientific diving course before they are allowed to dive outside the theatre. Divers in the submarine theatre will be stirring up sediments on the substrate that will flow downstream about 30 m resulting in turbidity in the theatre area for most of the two-day period that check-out dives are occurring. Students in the archaeology class will also be stirring up sediments three times each semester for two-hour periods.

Diversion of Water From Spring Lake

On-site effects to water quality from the diversion of water from Spring Lake may decrease water quality during times of low spring flow. Water quality in the lake as well as downstream may decrease due to decreased turnover of water, increased plant decomposition, and concentration of pollutants resulting from less dilution.

Management of Aquarena Golf Course & Grounds

The use of chemicals in the management regime impacts water quality through encouragement of plant growth (particularly algae) which can reduce oxygen to anoxic levels in the backwater areas of the river.

Saltgrass Pervious Parking Lot

Modifications to Saltgrass parking lot have improved water quality through the removal of pollutants from the parking lot run-off into the river. Measures of the effluent show that pollutants have been reduced to no detectible concentrations according to EPA standards (Appendix E). In fact, water quality impacts were lessened by the removal of existing sewer and gas lines, capping of a sewer manhole (which has overflowed during major rain events), and the construction of a curb around the lot to prevent runoff of water from the lot and Ed J.L. Green Drive from entering Spring Lake.

Boating in Spring Lake

Canoeing in Spring Lake and Sewell Park has a slight risk of increased turbidity as those activities are carried out because of the presence of people in the river. Stirred sediments from paddles and overturned canoes could also create turbidity about 30 m downstream of the site of impact. The suspended sediments would then flow out of the area and a short distance downstream with no permanent impact on water quality.

Management of Aquatic Vegetation in Sewell Park

Onsite impacts from removal of vegetation in Sewell Park include the increase of suspended solids during and after the activity (about 20 minutes maximum on site disturbance), and the loss of plant fragments during both activities. These plant fragments may accumulate into large mats which could impact water quality both onsite and offsite as a result of decomposition and limiting flow in areas of the river.

Removal of Accumulated Plant Materials in Sewell Park

Onsite impacts from removal of vegetation in Sewell Park include the increase of suspended solids during and after the activity (about 20 minutes maximum on site disturbance), and the loss of plant fragments during both activities. These plant fragments may accumulate into large mats which could impact water quality both onsite and offsite as a result of decomposition and limiting flow in areas of the river.

Sessom Creek Sand Bar Removal

Water quality will be impacted during removal due to an increase of sediment in the water column and possible bank breakdown from construction equipment on the bank. These effects will only be occurring only during the time of actual removal.

Management of Aquatic Vegetation Below Sewell Park

Onsite impacts from removal of vegetation include the increase of suspended solids during and after the activity (about 20 minutes maximum on site disturbance), and the loss of plant fragments downstream. These plant fragments may accumulate into large

mats which could impact water quality both onsite and offsite as a result of decomposition and slowing of flow through matted areas.

Sediment Removal Below Sewell Park

Onsite impact from suctioning is a temporary increase in suspended solids during and after the activity; about two and one half hours each time. There is also a potential for the release of associated contaminants into the water column.

Permanent Access Points/Bank Stabilization

Erosion controls used during construction will help to minimize impacts on water quality. There may be some turbidity in the area of construction and downstream as a result of sediment disturbance while finishing construction of the ramp/stairway/pier into the river. Placing stabilization material will stir up sediment and cause temporary turbidity. The area should clear in around 20 minutes after activities cease. The sediment will be carried downstream about 30 m before settling out.

Construction of Sedimentation Ponds

Due to the use of strict erosion control methods, there should be no impact on water quality during the construction of these ponds. The ponds will provide a positive long-term benefit to water quality of the river.

5.1.1.10 CULTURAL RESOURCES

Although significant archaeological sites are known to occur in the proposed project areas (pers. comm., Dr. Brit Bousman, Tx State, January 2001), the majority of projects do not involve disturbance of the substrate, thus no serious impacts to cultural resources are expected through the preferred alternative. Minor exceptions are noted below.

Saltgrass Pervious Parking Lot

The project was cleared through the Texas Antiquities Committee and Texas Historical Commission.

Sessom Creek Sand Bar Removal

No impacts are expected on cultural resources from the sandbar removal. However, this project will be cleared through the Texas Antiquities committee and Texas Historical Commission prior to beginning the project.

Permanent Access Points/Bank Stabilization

All proposed sites will be submitted to the Texas Historical Commission to determine whether they are historically significant before excavation begins.

Construction of Sedimentation Ponds

All proposed sites will be submitted to the Texas Historical Commission to determine whether they are historically significant before excavation begins.

5.1.1.11 SOCIOECONOMICS

The implementation of the projects presented in the preferred alternative will have a positive overall on-site effect in the San Marcos River and its associated habitat. The culmination of the proposed project improves the overall quality of life for San Marcos residents.

5.1.2 OFF-SITE IMPACTS OF THE PREFERRED ALTERNATIVE

Positive off-site impacts of the preferred alternative include a reduction in erosion and sedimentation, improved water quality, reduction in the spread of exotic plants, and improved habitat for native species. Using the strict definition of the project area as ending at the IH-35 crossing of the San Marcos River, there may be a temporary increase in turbidity downstream of this site when removing sediment or vegetation, or when doing any sort of construction along the river banks past Sewell Park (permanent access points, bank stabilization, and/or sedimentation pond creation). Vegetation fragments from harvesting do travel outside the project area, however, downstream stands of wild-rice are monitored for floating vegetation build-up. Any chemical or fertilizer run-off

(surface or groundwater) from the golf course treatments which makes it to the river will continue downstream or be adsorbed by the substrate, thus underscoring the need for strict control of these substances by Tx State. SCUBA in Spring Lake, boating in Spring Lake and Sewell Park, the parking lot modifications at Saltgrass, and repairs and maintenance of the dam at Spring Lake should have no negative off-site effects.

The Sessom Creek sand bar removal project has no off-site impacts. The diversion of water from Spring Lake has effects outside of the project area due to a possible decrease in flow. Diversion of water will be reduced during times of drought to protect listed species in the immediate area and downstream.

5.1.3 CUMULATIVE EFFECTS OF THE PREFERRED ALTERNATIVE

The preferred alternative will result in an increase in water quality due to a long-term decrease in the amount of sedimentation and pollutants. Listed species should benefit from decreased competition and improved habitat as exotic vegetation is removed from the river and littoral areas are restored. Sand bar removal will enhance flow to that section of the river. Bank stabilization and the installation of permanent access points will protect the banks from erosion and reduce sediment deposition in the river. Mitigation measures employed in the projects will help to offset take. Public education components within the SMRHCP will raise awareness of vulnerable species and the necessity for protecting the river environment. Cultural resources in this archaeologically rich area will be respected and preserved wherever possible. There will be a loss of riparian edge due to the impervious cover resulting from the installation of permanent access points and bank stabilization efforts. This is off-set by the restoration projects occurring along the rest of the riverbank in the project area which will decrease the use of desire trails and restrict uncontrolled access thus minimizing erosion in this highly disturbed area. All projects will be scheduled to avoid cumulative impacts from overlapping projects.

5.2 ALTERNATIVE 2 - PROJECTS WITH NOTAKE

This alternative would involve the implementation only of those projects which are identified as having no take of listed species. These projects are: Saltgrass pervious parking lot (4.1.7), boating in Spring Lake & Sewell Park (4.1.8), and the construction of sedimentation ponds (4.1.15).

5.2.1 ONSITE IMPACTS OF NO-TAKE PROJECTS

No onsite impacts are expected to wetlands, geology or soils, existing land use, air quality, cultural resources, or socioeconomics from the no-take projects. The onsite impacts of these three projects (Saltgrass pervious parking lot, boating in Spring Lake & Sewell Park, and sedimentation pond creation) are previously described as follows: vegetation (5.1.1.1), wildlife (5.1.1.2), listed species (5.1.1.3), water resources (5.1.1.7) water quality (5.1.1.9), and socioeconomics (5.1.1.11).

5.2.2 OFF-SITE IMPACTS OF NO-TAKE PROJECTS

There should be no off-site impacts of the no-take projects with the exception of the possibility of a slight and temporary increase in turbidity during the construction of the sedimentation ponds.

5.2.3 CUMULATIVE EFFECTS OF NO-TAKE PROJECTS

The cumulative effects of these projects will be minor improvements to the habitat in and surrounding the San Marcos River. The parking lot and the creation of sedimentation ponds will lower the amount of chemical runoff reaching the river. The canoeing should have no effect.

While this no-take alternative does not impact listed species, the long-term effects on the system of not completing the other projects is detrimental. Pursuing this alternative does nothing to address the removal of exotic species or sediment in the river, and does little to improve the habitat for the listed species. Permanent access points and bank stabilization will not be implemented and thus the erosion and sedimentation occurring now would continue. Recreational usage will continue without monitoring or restriction. While take

may be reduced through this alternative, so are the benefits associated with pursuing the preferred alternative.

5.3 ALTERNATIVE 3 - NO ACTION

The no-action alternative results in no project implementation.

5.3.1 ON-SITE IMPACTS OF NO ACTION

There would be no on-site impacts directly related to the projects if the no action alternative is taken. If no action is taken, however, none of the benefits are conferred either. No habitat restoration will occur nor will any mitigative efforts be enacted to offset current damage.

5.3.2 OFF-SITE IMPACTS OF NO ACTION

There would be no off-site impacts related to the projects if the no action alternative is taken. However, failure to implement the projects would have offsite impacts such as the spread of exotic species and increased sedimentation of the river.

5.3.3 CUMULATIVE EFFECTS OF NO ACTION

With the no action alternative, all negative aspects of construction and project implementation are removed, however all positive benefits are lost as well. The long term benefits of project implementation are decreased erosion, sedimentation, and runoff; removal of invasive exotics resulting in improved habitat for native species; improved recreational access; improvement and restoration of the riparian edge; and an overall improvement in the quality of life associated with the San Marcos River. Not implementing any part of the SMRHCP could result in the spread of invasive exotic vegetation, loss of species diversity, increased sedimentation leading to the shallowing of the river, continued bank erosion, and continued loss of riparian edge through recreational use. Furthermore, no additional planning would be mandated for watershed protection or recreational usage of the river corridor.

6.0 HABITAT CONSERVATION PLAN

This section contains the Applicant's HCP for the proposed projects. The SMRHCP complies with the "Five Point Policy" of the Service's HCP Handbook, which requires integration of the following five components into an HCP: 1) biological goals and objectives; 2) adaptive management; 3) monitoring; 4) permit duration; and 5) public participation. The biological goals and objectives of the SMRHCP are discussed below. Adaptive management is discussed in Item 6.3, monitoring in 6.1, permit duration in Section 8.0, and public participation is discussed in Section 9.0.

The biological goal of the SMRHCP is to contribute to the long-term survival and recovery of the San Marcos River listed species (Section 1.0). To achieve this, the Permittees have incorporated several of the recovery goals in the San Marcos/Comal (Revised) Recovery Plan as mitigation measures to be implemented upon approval of this permit. The proposed projects will cumulatively impact 201,770 m^2 for each year of operation; and result in the take of 8,646 fountain darters, 2,445 San Marcos salamanders, and 252 riffle beetles each year.

The following measures are proposed to avoid or minimize the impacts of "take" for each of the proposed projects as listed. A low flow protocol specific for each project is also described, however the trigger flow (100 cfs) is the same for all projects and is based on TPWD's Report No. 16, An Evaluation of Springflows to Support the Upper San Marcos River Spring Ecosystem, Hays County, Texas (Saunders et al. 2001).

A. MANAGEMENT OF SUBMERGED & FLOATING AQUATIC VEGETATION IN SPRING LAKE (TX STATE)

Take Minimization Measures. All lake management activities are coordinated through the Spring Lake Area Supervisor. As aquatic vegetation is harvested, it is checked by the driver of the harvester boat for fish and other fauna, which are returned to the lake as quickly as possible. Only vegetation within the top meter of the water column will be harvested. This depth amount will not be exceeded. More importantly, only 15 cm of vegetation within that meter can be cut at one time.

Limiting the layers of cut vegetation to 15 cm at a time allows the driver to thoroughly monitor fauna caught up in the vegetation and minimize the number of fountain darters taken. The Spring Lake Area Supervisor or one of the trained alternates (list of drivers will be included in the quarterly report) will always be the person driving the harvester to ensure the best possible protection of listed species and boat maintenance. The harvester will avoid areas of Texas wild-rice, both because of its endangered status and because it serves as potential habitat for the fountain darter. The harvester will not cut outside of designated areas without consultation with and approval from the USFWS. The Spring Lake Area Supervisor will keep records of each harvest to include the following: date, operator name, volume of harvested vegetation, hours spent harvesting, and number, location, and condition of any listed species observed, and the size of area cut during each harvest. These records will be submitted to the City of San Marcos Parks and Recreation Department's Watershed Protection Division (WPD) to be included in an annual report to the USFWS.

During harvesting, fragments of cut vegetation escape downstream (approximately 30 cm^3 per cutting). The fragments form mats of vegetation (which also include natural vegetation fragments) and threaten Texas wild-rice stands by becoming entangled and dragging the inflorescence below the surface, thus disrupting the cycle of sexual reproduction (Power 1996). The mats also shade plants, suppressing growth. The floating mats of vegetation can decay and sink to the bottom, adding to the increasing sediment buildup. To minimize these impacts, the harvester will skim the lake after cutting to pick up floating vegetation, again checking for the presence of fauna. In addition, Tx State student workers will remove floating vegetation from upper and lower Sewell Park on a weekly basis before it accumulates into a mat over Texas wild-rice stands.

To further reduce the opportunity for take, stands of exotic plants (such as *Hydrilla*) and nuisance native species (*Typha* spp.) that require continual cutting will be replaced with short-growth natives (such as *Sagittaria platyphylla*, *Ludwigia repens*,

and *Vallesneria americana*) as soon as possible after cutting, thus markedly decreasing the need to harvest vegetation or garden the spring openings. The long-term goal is control of exotics throughout listed species critical habitat. Exotic plants will be removed mechanically. Removed vegetation will be carried to the surface in mesh bags and shaken onto screens to dislodge fauna; native fauna will be returned to the river. Vegetation will be taken to an established compost site located about half a kilometer northwest of Spring Lake behind the boat barn, outside of the floodplain. The native aquatic plants will come from the USFWS-approved sources (such as the San Marcos National Fish Hatchery and Technology Center, the City of San Marcos wetland nursery, and/or Aquarena wetland nursery). Plant removal and replacement trials have been performed in Spring Lake with moderate success (pers. comm., Scott Wood, Spring Lake Area Supervisor, Tx State, May 2001). Aquarena staff has observed the primary threat for successful plant restoration is herbivory on the new plants by nutria. Herbivory can be controlled by caging plants as needed. This replacement strategy will be accomplished in consultation with TPWD and the USFWS. The WPD and Tx State managers will monitor this project.

To minimize possible take associated with spring gardening, the number of springs to be gardened will be reduced from fifteen to ten (Figure 6). Prior to gardening, workers will fin the area around each spring to reduce the number of fountain darters at the site. While removing vegetation around the springs, workers will work slowly to give fauna an opportunity to leave the area. The vegetation cut by these workers is minimal, so after cutting, it will be allowed to drift downstream. *Riccia.*, *Rhizoclonium*, *Lyngbya*, and other low growth natives will not be removed as these are preferred habitats for the fountain darter and San Marcos salamander and are full of amphipods (prey item). Substrates devoid of vegetation are unsuitable for the San Marcos salamander (USFWS 1995). Workers will stay on schedule to avoid the removal of large amounts of vegetation that will accumulate downstream. Even if large spans of time pass between cuttings, Tx State will not cut more than the designated five springs per week. Also, rocks will be added to the area around the spring openings to provide additional refuge for salamanders. Finally, all employees

assigned to projects within Spring Lake will be trained to recognize the San Marcos River listed species.

Low Flow Protocol. When flows are decreased, the force of the springs may be insufficient to clear cut vegetation from Spring Lake. Therefore, at flows below 100 cfs, the harvester will clear only the top 60 cm of the water column. This is still sufficient to avoid damaging the propeller on the glass-bottom boats; however, the tourists' view is diminished. In addition, cutting will be reduced to a 1.5-meter radius around the spring. At flows below 75 cfs, underwater gardening activities and harvesting will cease.

B. SEDIMENT REMOVAL IN SPRING LAKE (TX STATE)

Take Minimization Measures. Tx State would like to remove sediment from two areas (totaling 4,330 m^2) in Spring Lake (Figure 7). Divers will not suction more than 45 m^2 per week, or suction longer than two hours twice a week to minimize disturbance of aquatic biota. The use of mesh (0.25 inch) over the intake of the suction apparatus and removing silt slowly and methodically should reduce take. The hose has a control valve so the diver can shut off suction if a listed species is observed in the vicinity or if the diver observes an individual trapped on the mesh. Divers will wear a weight belt to minimize movement within the plant stand, and allow them to stand on the substrate while suctioning. Divers will be trained to recognize all stages of listed species from larvae to adult. Fountain darters present in the area to be suctioned will be counted, and vegetation will then be finned before turning on the pump to encourage listed species to move out of the area. By observing the stakes that define the area of sedimentation, the diver will stay at least three meters away from stands of Texas wild-rice.

The San Marcos salamander is more abundant around the spring openings; they are not often found in silty areas such as the submarine theatre and fountain area (Nelson, 1993), and therefore the springs will not be suctioned. An observer will be on the bank to monitor the pumped water for presence of listed species, as well as for the

safety of the diver. Records of the location and size of the area suctioned, numbers of listed species observed prior to and after finning, number of species suctioned, date, operator name, and time spent suctioning will be kept and included in an annual report to the USFWS. It will also be noted if any listed species are detected on the screen. Percent coverage and type of plant will also be recorded to monitor changes in plant composition as a result of suctioning silt. The records will be submitted to the WPD and included in the annual USFWS report and, if deemed necessary by the USFWS, the activity will be modified. If a reduction in native plant species is observed within the site, suctioning will be restricted to exposed substrate. The affected plant stand will continue to be monitored to determine if the cause of the change was induced by suctioning or by other environmental factors.

Low Flow Protocol. As flow decreases, turbidity associated with suctioning may reside in an area for a longer period of time thus having a larger impact on feeding and breeding behaviors of listed species. Divers will record the length of time of residual turbidity and terminate hydrosuction if the area remains turbid for four hours or longer. During flows less than 100 cfs, silt removal will cease.

C. TRAIL SYSTEM (TX STATE)

Take Minimization Measures. A vegetative buffer of at least three meters between the trail and the lake will be established to slow storm water runoff. Tx State will monitor the trail for impacts resulting from increased access and take action to resolve said impacts. Signs will be posted notifying trail users of trail courtesies, such as always remaining on the trail, not disturbing natural features, refrain from littering, and keeping dogs on leashes. Tx State employees that work on underwater projects will gather any litter they find while working. Finally, no chemicals will be used to maintain surrounding landscape.

D. SCUBA IN SPRING LAKE

Take Minimization Measures. Divers are not allowed outside the submarine theatre until they have passed the Scientific Diving course (Appendix B), which ensures that they have good buoyancy control, knowledge of listed species, and an awareness of the sensitive nature of this spring system. They are instructed to avoid contact with any listed species, stay off the lake bottom, and not disturb potential habitat, such as stands of vegetation. Divers have to pass a test in which they pick up items without touching the substrate with any part of their body except their hands, balance on a giant oyster model, and swim through a series of hoops without touching the sides. Even with this training, groups are not allowed to dive outside of the submarine theatre without supervision by the Spring Lake Management Supervisor. In fact, only six divers are allowed in the lake at a time for two hours, and never more than 12 per day. These requirements for all divers in Spring Lake will minimize direct take of listed species outside the submarine theatre.

The submarine theatre contains a large population of fountain darters (in some spots, as many as 30 per square foot were observed by Bob Orso, March 1998). The only vegetation in the theatre is floating algal mats, and Bob observed as many darters outside the mats as within them. This abundance of darters will serve as the baseline to determine future take. No other listed species were observed during this survey. Counts will be collected by the WPD to be included in an annual report for the USFWS. This report will also include the number of classes that occur in the submarine theatre and number of students per class, date and duration of class, and description of Science Diver projects.

Low Flow Protocol. As spring discharge decreases in Spring Lake, conditions such as turbidity caused by divers may not clear out as rapidly and may therefore have a more significant impact on the breeding and feeding behaviors of listed species. To avoid increasing impacts on listed species, classes in the submarine theatre will be observed for increased impacts when the flow drops to 100 cfs. If impacts such as increased or lengthened turbidity are noted, classes will be on hold until flow velocity

increases. As flow levels drop to 75 cfs, all programmatic diving activities in the lake will be cancelled.

E. DIVERSION OF SURFACE AND GROUND WATER (TX STATE)

Take Minimization Measures. The cumulative impact of diversions of water along the river could cause take due to increased stress for listed species during times of low flow. Tx State minimizes the amount of water used for irrigation of the golf course by calculating water use on science-based irrigation management that incorporates evapotranspiration data. This allows Tx State to use only the amount of water that is needed to maintain the course. However, as river flow drops to 100 cfs, Tx State will restrict irrigation to only the tees and golf greens.

To minimize take that could occur as a result of biota being pulled in at the intake sites (6"PVC pipe), a 0.25" mesh basket has been placed over the intake site at the slough, and a 0.25" mesh screen is used over the intake site for water pumped above the dam for golf course irrigation. Additional minimization measures include the use of rainwater collection systems to be installed on any proposed Tx State facilities in the Spring Lake watershed to help reduce irrigation needs.

Tx State has transferred 33,108 acre-feet of their authorized 64,370 acre-feet hydroelectric rights to the Texas Water Trust in accordance with the Memorandum of Agreement with the Texas Parks and Wildlife Department (Appendix C). See Section 4.1.5 for complete details on Tx State water rights.

Low Flow Protocol. Pumping for irrigation purposes will cease when flow falls below 100 cfs. The 20-acre feet irrigation right from Certificates 18-3866 can be used only if river flow exceeds 128 cfs. Otherwise, Tx State will obey all TCEQ permit restrictions.

F. MANAGEMENT PRACTICES FOR THE AQUARENA GOLF COURSE AND GROUNDS (TX STATE)

Take Minimization Measures. Only the greens and tees of the golf course are treated with herbicides, fungicides, and insecticides (Table 1). These chemicals are applied by spot treatment rather than broadcast. The largest portions of the golf course, the fairways, are not treated. Herbicides, fungicides, and insecticides are applied on a monthly basis or less often as needed. Also, pesticides that have a selective pest focus are used, rather than chemicals that kill a wide range of plants and animals. In addition, weather is considered prior to pesticide application, i.e. wind velocity and direction, and rain forecast. The grounds are watered before pesticide/herbicide/fertilizer application to avoid runoff into nearby water bodies.

Low Flow Protocol. During low flows, the use of fertilizer and chemicals throughout Aquarena will be restricted to greens and fire ant mounds.

G. SALT GRASS PERVIOUS PARKING LOT

Take Avoidance Measures. Runoff from the parking lot surface soaks through the layer of sand and into a sedimentation/filtration basin before entering Spring Lake. The layer of clay helps prevent the mixing of the infiltrant with groundwater. The runoff is tested quarterly and within one hour after 2-year rain events to ensure the effectiveness of the basin (Appendix E). Runoff is analyzed for total petroleum hydrocarbons, hydrocarbon constituents, and whole effluent toxicity. If monitoring samples show concentrations of TPH above the action level of 5.0 mg/L, Tx State will clean out the filtration pond and put in new sand with carbon to increase absorption of organics. Since the inception of the program in 1997, monitoring samples (taken four times/year) have measured <5.0 mg/L with one exception in 1998 (Tx State correspondence with Allen White, USFWS). Tx State has reduced the sampling program to one monitoring sample per year with the permission of the USFWS, because most samples did not have any detectable pollutants. The maintenance schedule for this BMP is in Appendix E and will be adhered to by Tx

State as part of the required take avoidance measures. Signage will be established to enhance public awareness of storm water runoff toxicity and treatment.

Low Flow Protocol. During times of low flows (<100 cfs), there will be few rain events and therefore little to no outflow from the parking lot into Spring Lake. Monitoring has shown that it requires several consecutive rain events to saturate the bed of sand prior to getting any outflow. The four years of monitoring have shown no detectable pollutants (Appendix E).

H. BOATING CLASSES IN SPRING LAKE AND SEWELL PARK (TX STATE)

Take Minimization Measures. Prior to entering the water, students will receive a listed species lecture from qualified personnel that teaches recognition and appropriate behavior. The canoes will use the lanes mowed by the harvester. The instructors will keep the classes at least six meters away from Texas wild-rice stands in order to protect important habitat for the fountain darter. Aquarena personnel will monitor the classes once a month to ensure compliance. Classes will exit and enter canoes from the boat dock at the Outdoor Recreation Center in Sewell Park and from the boat dock next to the submarine theatre at Spring Lake to avoid bank disturbance. It is possible that despite these precautions, a canoe can overturn or wander off course, thereby harassing a fountain darter or damaging Texas wild-rice.

Low-flow Protocol. If flows drop below 100 cfs, classes will not be held in Spring Lake or Sewell Park.

I. RECREATION IN SPRING LAKE AND UPPER/LOWER SEWELL PARK (TX STATE)

Take Minimization Measures. Several types of recreation occur traditionally on the San Marcos River. These include: swimming, snorkeling, SCUBA, boating, tubing, wading, and dogs. All these activities impact listed species and their habitat, some to a greater degree than others. In an effort to minimize the impacts of these activities,

Tx State will train the University Police and student workers to recognize listed species and activities that pose a threat to listed species. The University Police and student workers will monitor the Spring Lake area for trespassers and suspicious activities. Officers will also patrol Clear Springs Apartment parking and the softball field by University Police and Tx State maintains existing signage at the Spring Lake dam restaurant and at Clear Spring Apartments that identifies and discusses the need to protect the listed species in the San Marcos River, as well as stating that dogs will not be allowed in the park. Tx State will add two signs in Lower Sewell Park identifying Texas wild-rice and the need to protect the stand in that area. One sign will be located by the stand of Texas wild-rice and the other will be located near the Outdoor Recreation Center. The Outdoor Recreation Center is located in Lower Sewell Park and rents river equipment, such as tubes and canoes.

Additionally, Tx State will ensure each resident of the Clear Springs Apartment complex receives an information sheet that the resident will sign and return to the apartment manager. This information sheet will also be posted at the Outdoor Recreation Center. During its hours of operation (12 – 6 daily), the Outdoor Recreation Center ensures that no dogs are present in Lower Sewell Park.

In an effort to limit the access to the east side of the river where the spillway is located, the University Police Department will ensure only residents of Clear Springs Apartments park in the parking lot around the apartment.

Low flow protocol: Tx State and the City are working together to gather data on the impacts of recreation on fountain darters. USFWS will be consulted on the results of this research to develop measures to reduce the potential impacts.

J. MANAGEMENT OF AQUATIC VEGETATION IN SEWELL PARK (TX STATE)

Take Minimization Measures. Managing the height of submergent plants through hand "gardening" minimizes impacts on fountain darter habitat, as well as minimizes

turbidity that could affect downstream populations. The procedure used here is the same as the procedure used by the underwater gardeners in Spring Lake with the exception that many areas downstream of Spring Lake can be snorkeled rather than using SCUBA. Divers will check the vegetation for darters and other fauna prior to and after removal. The vegetation is "shaken" underwater, put into mesh bags, and carried to the surface to be added to compost area.

Low Flow Protocol. At flows below 100 cfs, cutting of vegetation will cease.

K. REMOVAL OF ACCUMULATED PLANT MATERIAL IN SEWELL PARK (TX STATE)

Take Minimization Measures. Workers will gently pull plant materials off and away from Texas wild-rice to minimize damage to stands. Accumulated plant mats will be pushed downstream of IH-35. Stands past IH-35 will be visually monitored to avoid mat build up. Fountain darters could be present in the accumulated vegetation.

Low-flow Protocol. This project will continue at all flow levels as low flows exacerbate plant fragment buildup.

L. SESSOM CREEK SAND BAR REMOVAL (CITY)

Take Minimization Measures. During the removal of the sandbar, silt fence with stacked sandbags on both sides will be used to minimize sediment transport downstream. The silt fence will encircle the entire project area. All removed material will be transported by truck to the City compost site located behind the City of San Marcos Animal Shelter. Removal of the sand and gravel bar will be accomplished during the summer when flows are low to further reduce sediment transport from the removal site.

Low-flow Protocol. This project will occur during low flows to minimize downstream turbidity. As water levels lower in the river, habitat can be reduced and stress may increase on aquatic fauna due to decreased refuge and water quality.

Therefore, it is important at this time, to eliminate additional stress on listed populations.

M. MANAGEMENT OF AQUATIC VEGETATION BELOW SEWELL PARK (CITY)

Take Minimization Measures. Managing the height of submergent plants through hand gardening, as opposed to dredging, greatly minimizes impacts on fountain darter habitat, as well as minimizes turbidity that could affect downstream populations. The City's proposed procedure for aquatic management is the same procedure used on the spring openings in Spring Lake, except many areas downstream of Spring Lake can be snorkeled rather than using SCUBA. Potential impacts to stands of Texas wild-rice which grow close to the working area will be avoided by not cutting plants within 1.5 m of wild-rice stands. Vegetation will be finned and checked for darters and other fauna prior to removal and checked again once removed to make certain all live organisms are returned to the river. Harvested vegetation will be pushed downstream past IH-35 to minimize the formation of vegetation mats over most of the wild-rice stands.

Low Flow Protocol. During low flows, cutting of vegetation will cease. As water levels lower in the river, habitat can be reduced and stress may increase on aquatic fauna due to decreased refuge and water quality. Therefore, it is important at this time, to eliminate additional stress on listed populations.

N. SEDIMENT REMOVAL BELOW SEWELL PARK (CITY)

Take Minimization Measures. Divers will not suction more than 45 m^2 per week or suction longer than two hours a day to minimize disturbance to aquatic biota. The use of a screen over the intake of the suction apparatus and having the divers remove silt slowly and methodically should reduce take. The hose has a control valve so the diver can shut off suction if a listed species is observed in the vicinity or if the diver believes an individual(s) is trapped on the mesh. Fountain darters present in the area to be suctioned will be counted, and vegetation will then be finned before turning on

the pump. Finning will encourage the darters to move out of the area. Divers will be trained to recognize all stages of listed species from larval to adult and will wear weight belts to minimize movement within a plant stand. In addition, placement of stakes around the area to be suctioned will keep divers at least three meters away from stands of Texas wild-rice. An observer will be on the bank to monitor the effluent for presence of listed species, as well as for the safety of the diver. Records of the location and size of the area suctioned, numbers of listed species observed prior to and after finning, number of species suctioned, date, operator name, and time spent suctioning will be kept. Percent coverage and type of plant will also be recorded to monitor changes in plant composition as a result of suctioning silt. Records will be submitted to the USFWS for annual review and, if estimated take is exceeded, the activity will be modified. If a reduction in native plant species is observed within the site, suctioning will be restricted to open substrate as the plant stand recovers. The plant stand will continue to be monitored to determine if the cause of the change was induced by suctioning or by other environmental factors.

Low-flow Protocol. When flows decrease to below 100 cfs, turbidity in the area will not clear as readily. Divers will not be able to see what they are doing, thereby making the procedure more difficult and increasing the chance of suctioning fountain darters in the area, or missing the stakes and encroaching on a Texas wild-rice stand. Lingering turbidity would also increase the amount of time fauna are detained from feeding and breeding. Therefore, during flows less than 100 cfs, silt removal will cease.

O. PERMANENT ACCESS POINTS/BANK STABILIZATION (CITY)

Take Minimization Measures. Stringent erosion controls will be used during construction. Access points will only be constructed in areas that have high public use and will not be placed within 30 m of Texas wild-rice stands. The area will be disturbed before work begins to disperse biota. Silt fence will be placed along the bank to minimize sediment runoff into the river. The use of stone terraces will help to control soil erosion and compaction from high foot traffic that occurs in these

areas. If any further access points or bank stabilization is needed, the City will involve the USFWS prior to beginning planning of the project.

Low-flow Protocol. Construction of access points during low flows would reduce the amount of silt entering the river. However, since low flows typically occur during the summer when there are a high number of recreation-types on the river, construction will most likely be accomplished during the fall and winter. As water levels lower in the river, habitat can be reduced and stress may increase on aquatic fauna due to decreased refuge and water quality. Therefore, it is important at this time, to eliminate additional stress on listed populations.

P. CONSTRUCTION OF SEDIMENTATION PONDS (CITY)

Take Avoidance Measures. These projects only pose a potential threat to listed species during the construction phase. The flow of silt downstream as a result of construction can be minimized through the use of silt fence and rock berm that will border the construction area. These areas will be checked daily to ensure integrity of silt fences. In addition, excavated soils will be covered with a tarp to reduce soil loss during a rain event until construction is complete and the area has been revegetated.

Q. RECREATION FROM SEWELL PARK TO IH-35 (CITY)

Take Minimization Measures. Several types of recreation occur traditionally on the San Marcos River. These include: swimming, snorkeling, SCUBA, boating, tubing, wading, fishing, and dogs. All these activities impact listed species and their habitat, some to a greater degree than others. In an effort to minimize the impacts of these activities, the City has recently hired a full-time park ranger and has several part-time park rangers who will be trained to recognize listed species and will monitor actions that constitute ordinance violations such as having dogs off-leash in the park. The city will not put river access structures within 50 feet upstream of downstream of Texas wild-rice. Additionally, signs will be installed adjacent to Texas wild-rice stands to keep the public informed as to the location and sensitivity of these stands.

The City is proposing bank stabilization structures in this HCP; these structures will also be used as access points and the City will thickly vegetate areas between these structures for the purpose of controlling public access thus partially protecting in-stream and riparian habitat from recreational impacts.

Low flow protocol: Tx State and the City are working together to gather data on the impacts of recreation on fountain darters. USFWS will be consulted on the results of this research to develop measures to reduce the potential impacts.

The section 10a)(1)(B) Incidental Take Permit is being obtained and will be used at the discretion of the Permitees. The Permitees retain the right to terminate the permit at any time prior to the occurrence of authorized take.

The following measures are proposed to mitigate the impacts of "take" for each of the proposed projects as listed:

A. To address the Conservation Goal: Determine nature and extent of local threats on the San Marcos River watershed and reduce pollution loadings to San Marcos River aquatic habitats -Recovery Action 1.2/2.8 -pages 58 -59 U.S. Fish and Wildlife Service. 1995. San Marcos/Comal (Revised) Recovery Plan; Tx State and City will:
1. Identify and minimize impacts of recreation in the San Marcos River upon the listed species. Use existing data from studies of recreational activities (e.g. Bradsby 1994 and Breslin 1997) to summarize existing impacts on listed species and their habitat. Controls for these impacts will be developed in the Recreation Management Plan. Types of controls include maintaining access points in the least sensitive areas of the river, establishing riparian vegetation to encourage the public to use developed river access points, and maintaining a recreation corridor to minimize recreation activities in sensitive edge habitat and Texas wild-rice.

2. Develop and implement a watershed management plan for the San Marcos River system by summer 2011. Information on the characteristics of the San Marcos River

watershed will be compiled to include the size, topography, slope, runoff patterns, soil types and characteristics, land use patterns and acreage, and climatic characteristics. The following threats to the San Marcos River aquatic system and listed species will be assessed: tourism enterprises and recreational use, urbanization, pesticide and herbicide use in the San Marcos River watershed, including drainage into the aquifer, point and nonpoint discharges, catastrophic spills, and other negative impacts on water quality in the San Marcos River aquatic ecosystem. Existing water quality protection provisions for both ground and surface water will be assessed.

The City WPD will complete the watershed management plan assisted by a Tx State doctoral student. The same doctoral student will also be dedicated to the completion of the recreation master plan.

3. Texas State will develop an Integrated Pest Management Plan for the golf course that will outline both minimum levels of chemicals that should be used and less harmful chemical and non-chemical alternatives. Plan should also address application time and frequency. The IPM will be reviewed by the contaminants position at the Service.

Interim mitigation: Upon approval of the SMRHCP, the City and Tx State will implement a non-native plant replacement program for the recreational corridor, as defined in the SMRHCP, from upper Sewell Park to Rio Vista dam. Non-native species of aquatic, littoral, and riparian plants will be replaced with native species to enhance listed species habitat from Spring Lake to Rio Vista dam. The divers that will be suctioning silt will first remove non-native aquatic plant species from the area to be worked that day. The exotic aquatic plants will be shaken and bagged for removal from the system in the same manner as the underwater gardeners at Spring Lake. The removal of non-native littoral plants (primarily Elephant Ears) is described in Appendix G. The area will be “weeded” until the natives become established at the site. The names of the divers, date, hours worked, location, plant type, and square meters removed will be recorded each time. The riparian zone will be restored to about 15 m in width. Areas devoid of vegetation will be planted at a ratio of three hard mast trees to one soft mast

tree, with 20% of the vegetation consisting of fruit-bearing shrubs. Vegetation such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, and buttonbush will be used. Fencing may be required for the first two years to allow for the establishment of the species. This will restore about 22 acres of woodland habitat along the San Marcos River.

To prevent increased sedimentation in the San Marcos River, Tx State will monitor construction sites to ensure the continuing integrity of temporary BMPs within the City and Tx State's jurisdiction. These measures will help to decrease sedimentation, and decrease the need and frequency for the sediment-removal project.

B. To address the Conservation Goal**:** Restore damaged habitats and enhance marginal habitats for riverine integrity (Recovery Action 2.9/page 59 -U.S. Fish and Wildlife Service. 1995. San Marcos/Comal (Revised) Recovery Plan); Tx State and City will:

1. Eroding areas and desire trails (trails made by users in undesirable locations) along the river will be replanted with native vegetation;
2. The terrestrial riparian zone through the entire permit area will be enhanced through the removal of non-native vegetation and the replanting of native trees and low growth vegetation;
3. Areas subject to rapid sedimentation will have increased depth;
4. The non-native littoral and submergent aquatic plant stands will be removed and replaced with native plants (as described in 6.5.1); and,
5. The systematic removal of nutria from the Spring Lake/slough area.

These measures will help to restore damaged habitat and enhance marginal habitat for listed species within and along the river from Spring Lake to IH-35.

Opportunity trails and eroding banks from upper Sewell Park (Spring Lake dam to University Drive) to IH-35 will be vegetated with black willow, bald cypress seedlings, native oaks, elms, etc., and understory plants, such as roughleaf dogwood, hawthorn,

agarita, Turks cap, Mexican buckeye, flaming sumac, Texas mountain laurel, yaupon holly etc. These areas will be revegetated in conjunction with each bank stabilization and permanent access point project proposed in the SMRHCP until all public riparian areas have been restored. Riparian restoration will begin in Sewell Park with the removal of non-native tree species, such as ligustrum, Chinese tallow, and chinaberry. The riparian zone will be increased to 90 m where available area allows and maintain a minimum of 15 m. These areas will be fenced off for two years for trees and one year for faster-growth vegetation to allow establishment of native vegetation. Non-native plants will be mulched and used as compost. Littoral and aquatic plants will be replaced in association with the silt removal and aquatic vegetation management projects proposed in the SMRHCP (see 6.5.1).

C. To address the Conservation Goal**:** Produce educational materials and inform a variety of audiences about the need to protect the unique and fragile San Marcos River and Edwards Aquifer. Recovery action 4.1 -page 59 - U.S. Fish and Wildlife Service. 1995. San Marcos/Comal (Revised) Recovery Plan); Tx State and the City will:

1. Use a variety of approaches to inform and educate the public in order to reach all age groups, from policy makers to school children. Educational programs and events will explain the uniqueness and fragility of the San Marcos River, and the problems associated with ensuring the survival of the Edwards Aquifer, the San Marcos River ecosystem, and their unique flora and fauna. The listed species will be the focus, with the objective of obtaining public support and involvement in their conservation. Programs and materials will focus on the human benefits and costs of protecting or not protecting these ecosystems upon which the species depend and illustrate the social and economic benefits of conservation. Programs will center around the Texas Rivers Center, the San Marcos Nature Center, and other educational and public outreach initiatives to show the interrelatedness of the contributing and recharge zones of the Edwards Aquifer to the integrity of the spring systems, the quality of local drinking water, recreation, and downstream economies. Specifically, brown bag monthly talks, programs for schools and clubs, live and static exhibits, nature walks and talks, briefing materials for public policy makers, information packets for teachers, signage, brochures, public service

announcements, textbook covers, cinema ads, flyers in utility bills, and other materials will be used and/or developed to reach these goals. The programs and materials will be developed to meet the needs of a culturally diverse community. The nature center staff will be composed of a maintenance worker and Tx State student workers. This staff is currently located at the San Marcos Nature Center at Crook Park, with long-term plans to move to a facility to be constructed in one of the City park preserves over the recharge zone within San Marcos.

D. To address the Conservation Goal**:** Encourage public participation in conservation efforts that directly or indirectly benefit listed species**.** Recovery Action 4.2 -page 59 - U.S. Fish and Wildlife Service. 1995. San Marcos/Comal (Revised) Recovery Plan); Tx State and the City will:

1. Use several existing avenues of involvement for public conservation efforts. Plans will be put in place to continually increase and refine public participation opportunities.

Current activities include:

- **River Cleanups (City) -** The public is invited to walk the banks, canoe, or SCUBA to pick up trash. Information about the listed species is available through posters, literature, and conversation with biologists at this event. The public learns about listed species habitat prior to cleaning the river and what areas to avoid. There is a spring and autumn cleanup sponsored by the City of San Marcos.

- **Nature Center (City) -** The City owns a Nature Center located on two acres with wildscape plots featuring a wide diversity of native plants. WPD staff works with the public and teaches groups about the need for native plants in an urban environment. The Wildscape includes a riparian zone used for public education of how buffer zones act to maintain riverine integrity. The Nature Center is designed to extend traditional learning to the outdoor classroom. Goals and programs include but are not limited to:

    - Using nature as a laboratory for hands-on activities and a unique learning

experience

- Field studies integrating scientific concepts with math, language arts, and liberal arts
- Offering curriculum developed in accordance with the Texas Essential Knowledge and Skills (TEKS) standards
- Developing a wildlife habitat that promotes and exhibits the uniqueness of our natural surroundings and native inhabitants
- Demonstrations, outreach efforts, collaborations and civic involvement
- "Be an TPWD Outdoor Kid" Day Camps
- Backyard Habitat Planning and Certification Workshops

❖ **Tx State Conservation Day** - Tx State sponsors a public effort to remove exotic plants and replant natives in and along Spring Lake. During the first part of the day, Tx State professors discuss the sensitivity of the Spring Lake and its listed species. Through this effort, the public learns about the value of natives to the integrity of an ecosystem.

❖ **Listed Species Exhibit (Tx State)** - Aquarena Center currently displays two endangered (fountain darter and blind salamander) and one threatened species (San Marcos salamander) through permits issued to Dr. Glenn Longley. The San Marcos salamanders and the fountain darters are displayed in custom-designed wall tanks capable of holding and sustaining 40 individuals each. The Texas blind salamanders are held in three separate tanks each capable of sustaining 12 individuals (36 total). Each system includes an electronic digital controller for constant temperatures, chillers and heaters, chamber filters for cleaning, and UV sterilizers.

The animals are monitored weekly by Dr. Longley's staff as well as daily attendance by trained Aquarena Center staff. Caretakers locate each animal, monitor for signs of distress (i.e. rapid breathing, color changes, erratic swimming, etc.), and generally assess the health of each individual.

Additionally, tanks are visually monitored for cleanliness, water quality (cloudiness, levels), and air system function. Water testing for chemical balance and partial water changes are done on a regular basis, as is maintenance to the pumps and filters. The Aquarena Center Aquarium Operations Manual is attached in Appendix H.

Activities planned for the future:

- **"Living on the Recharge Zone" -** hands-on classes to be promoted by the neighborhood associations to teach residents about the recharge zone and ways to best protect the resource.
- **Outdoor activities** designed to make citizens more comfortable with nature and give a deeper appreciation of the outdoors
- **Bank, littoral, and riparian restoration projects -** involve the community in the mitigation measures proposed in the SMRHCP. What individuals participate in -they protect.
- **Rainwater harvesting -** holding workshops at homes whose owners intend to put in a system for others to see and learn about this process.
- **Participatory Management** -presentation of problems to community in the form of charettes, for example, and obtaining solutions from within the community rather than imposing outside ideas.
- **Aquifer/River awareness events -** holding festivals or putting in booths at existing city events, i.e. RiverFest, Sights and Sounds, YouthFest, to promote community awareness.
- **Naturescapes for businesses** - promoting wildscapes at local businesses to reduce use of chemicals and water and enhance diversity.
- **Green living workshops** - teaching the public the various ways to reduce their impact on natural resources.
- **Wildflower planting/native gardening** - offering advice and a volunteer assistance program for those who wish to landscape with natives

The possibilities of programs are endless, and will grow as is practical for the nature center staff and the support they are able to garner.

E. To address the Conservation Goal**:** Provide for collection of genetically representative material from wild populations for maintenance of captive breeding program. Recovery Action 1.4 -page 63 - U.S. Fish and Wildlife Service. 1995. San Marcos/Comal (Revised) Recovery Plan); Tx State and the City will:

1. Assist the Service in this effort by providing infrastructure and collection as needed to fulfill the requirements of the Contingency Plan as described/referenced in the Recovery Plan. The Recovery Plan was one of the first ecosystem-based recovery plans in the nation and identifies the recovery goal for these species as: "to secure the survival of all five species and the ecosystem upon which they depend". A portion of the plan focuses on the need to provide secure genetically representative material of wild populations in a captive setting. Specifically, the plan calls for the following: Task 2.7 "Establish and maintain captive stocks…." Task 2.11 "Maintain and implement a contingency plan to bring species into captive refugia…."

Specific mitigation that must be implemented prior to the occurrence of take from the removal of the Sessom Creek sand and gravel bar:

1. The City and Tx State have attempted to obtain U.S. Army Corps of Engineers approval to remove the sand and gravel bar at the confluence of Sessom Creek and the San Marcos River since the 1980's, but the project was never approved due to the lack of follow-up to abate future gravel deposits. To obtain approval, Tx State and the City developed the Sessom Creek Diversion Project, which will serve to minimize future sediment deposits. The immediate goal of the project is to divert storm water from Sessom Creek into campus ponds located at the corner of Sessom Drive and University Drive. This would allow settling of coarse sediments in a separate water body and minimize the amount of sediment that is currently entering the San Marcos River at the confluence of Sessom Creek.

Long-term goals include the establishing the area as a public education spot along the nature trail and involvement of local schools. The project will include mitigation measures such as planting Texas wild-rice in a cleared section of the sand and gravel bar, and setting this area aside as a natural space restricted from recreational uses. It is hoped that this project will serve as a model of what can be done with Best Management Practices (BMPs) in a highly urbanized watershed and, if this project is successful, similar practices will be addressed for the other tributaries of the San Marcos River.

6.1 MONITORING

The City will hire a full-time position to monitor the implementation and impacts of proposed projects on listed species. The Tx State will provide a doctoral student to assist the WPD staff in the development of the Watershed Management Plan and to act as the primary for the development of the Recreation Master Plan (Section 6.5.1). The WPD will work with the Spring Lake Area Supervisor on Spring Lake projects. The WPD and Tx State students will implement and/or manage the City and Tx State proposed projects and associated mitigation. Interns may be used, as available, to assist in the implementation of the SMRHCP. A full listing of responsibilities for each entity is presented in Appendix I.

Monitoring for each of the mitigation measures is outlined below.

Mitigation Measure A

1. Recreation plan: Research and maps to be completed by spring 2009; draft to be completed by August 2010 and final plan completed by December 2010. Implementation will begin after review of plan by the USFWS and Environmental Review Committee.

2. Watershed plan: Research to be completed by summer 2009; draft to be completed by summer 2010; and final product by summer 2011. Implementation will begin after review of plan by the USFWS and Environmental Review Committee.

3. Interim mitigation: The removal of non-native plants will be tracked on an areal basis and by species. The areas of removal will be revisited each month to "weed" the areas as needed until native species become established. A goal of 50% establishment of native plants will be set based on the success rate of re-establishment of natives in Spring Lake test plots.

Mitigation Measure B

1. Plant removal and replacement will be documented to include the date, location, size and type of species removed and planted, square meters of modified area, and the percent of project area restoration completed. The WPD will return to the modified areas monthly to track regrowth of non-natives and growth of replacement plants. At least a 50% replacement success rate is expected. All areas will be continually maintained by the WPD and the Tx State workers.

Mitigation Measure C

1. Within the first year of SMRHCP implementation, monthly programs will be offered to the public, information will be placed on a website, live and static exhibits will be in place, and drafts for materials to reach school children K-5 will be developed. Ensuing years will show continued development of the measures previously stated. The number of people reached through programs, etc. will be tracked, as well as gender and ethnicity whenever possible, to ensure comprehensive outreach. This mitigation measure will be monitored by tracking the number of individuals, agencies, and institutions from the community involved in outreach efforts. This number should grow by at least 1% each year.

Mitigation Measure D

1. The number of individuals involved in these efforts will be tracked. The number of opportunities offered will not be as important as the number of people reached through their involvement in conservation efforts. Each conservation program/project will be written up in detail for submission to the USFWS, and will include questionnaires that attempt to measure the increase in public awareness as a result of the program/project.

Questionnaires can also be sent out in mail outs, such as city utility bills, to get a more general response. Monitoring will place more importance on increased awareness than on increasing numbers of participants.

6.2 REPORTING AND COMPLIANCE

Annual progress reports will be sent to the USFWS and the Environmental Review Committee for Aquarena Center, which consists of the following members:

Dr. Francis L. Rose, Professor, Biology
Dr. Brit Bousman, Assistant Professor, Anthropology
Mr. William (Pat) Fogarty, Associate Vice President, Facilities
Dr. Alan Groeger, Associate Professor, Biology
Dr. Glen Longley, Director, Edwards Aquifer Research & Data center
Doyle Mosier, Representative, Texas Parks & Wildlife
Dr. Walter Rast, Aquatic Station Director, Biology
Ms. Alisa Shull, Representative, USFWS
Dr. Thomas Simpson, Assistant Professor, Biology
Mr. Brad Smith, Director, Grounds Operations

The Environmental Review Committee was formed to review proposed activities of university students, faculty, staff, and the public to assure natural resources at Aquarena Center and the surrounding area are protected. If monitoring shows that any conservation goals are not being achieved, the WPD will consult with the USFWS and adaptive management measures will be employed to ensure fulfillment of conservation goals. Periodic informal consultation may be held with the USFWS for more frequent updates, and to discuss upcoming activities, questions, or problems.

The annual report will provide information on SMRHCP measures implemented during the previous year, funding expended on SMRHCP measures, and expected implementation during the next year. The annual report will include a chart exhibiting each project on a timeline to facilitate tracking the progress of proposed measures.

During the implementation of the SMRHCP, modifications may need to be made to the reports or timelines. Any such changes, i.e. report content or format changes, deadline extensions, etc., will be included in the annual report.

6.3 ADAPTIVE MANAGEMENT

According to Service policy [65 Fed. Reg. 35242 (June 1, 2000)], adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when determined appropriate.

The primary reason for using adaptive management in HCPs is to allow for change in the management strategies that may be necessary to reach the long-term goals or biological objectives of the HCP. Under adaptive management, the management activities under the HCP can be monitored and analyzed to determine if they are producing the required results. If the desired results are not being achieved, then adjustments in the management strategy can be considered.

Adaptive management strategies for each mitigation measure are described below.

<u>Mitigation Measure A.</u>

If timelines are not met for the specified plans, then management of aquatic plants within the recreation corridor and sediment removal projects as described in the SMRHCP will cease, but interim mitigation measures will continue to be implemented. If the success rate for the re-establishment of littoral and submergent natives falls below a 50% success rate, then the WPD will replant natives and cage these plants to minimize herbivory. If listed species population monitoring shows declining numbers, the projects will be re-evaluated to determine potential cause.

Mitigation Measure B

If the replacement success rate falls below 50% for any of the replanting areas, the WPD will increase planting density and try alternate planting strategies. If the reason for failure is related to continuing public use of non-access areas, then more prohibitive plants will be used in these specific areas, such as agarita, yaupon holly, and tasajillo.

Mitigation Measure C

Critiques/surveys will be provided after each program to gather suggestions for continued improvement and information on the participants. If outreach efforts fall below set goal, they will be modified until public response improves, or replaced with more successful programs.

Mitigation Measure D

Critiques will be provided after each program to provide suggestions for continued improvement. If programs fail to reach the public, as determined by the comments given on the critiques, they will be modified until public response improves, or replaced with more successful programs. Numbers will also be tracked to determine whether or not a program should be continued.

Low Flow Protocol

Texas Parks and Wildlife found Texas wild-rice habitat began to be moderately impacted at flows around 100 cfs (TPWD August 2001). Therefore, this is the trigger discharge used in the SMRHCP to change project procedures. If the USFWS decides this trigger level needs to be amended, the SMRHCP will follow suit.

6.4 "NO SURPRISES" ASSURANCES

The covered species are adequately addressed under the SMRHCP and are, therefore, covered by the USFWS No Surprises policy assurances. In the event that it is demonstrated by the USFWS that Unforeseen Circumstances exist during the life of the Permit, and additional conservation and mitigation measures are deemed necessary to respond to Unforeseen Circumstances, the USFWS may require additional measures of the Permittee where the SMRHCP is being properly implemented, but only if such

measures are limited to modifications within the SMRHCP or related permit documents for covered species, and maintain the original terms of the SMRHCP to the maximum extent practicable. Notwithstanding the foregoing, the USFWS shall not:

i) Require the commitment of additional land, water, or financial compensation by the Applicants without the consent of the Applicants; or

ii) Impose additional restrictions on the use of land, water, or natural resources otherwise available for use by the Applicants under the original terms of the SMRHCP, including additional restrictions on covered actions that are permitted under the SMRHCP.

6.4.1 Effect of Unforeseen Circumstances on Permit

Except as provided above, notwithstanding the occurrence of Unforeseen Circumstances, as long as the Permittee continues to properly implement the provisions of the SMRHCP and any additional measures required by the Service in accordance with section 10, the Permit will remain in full force and effect.

6.4.2 Notice of Unforeseen Circumstances

The Service shall notify the Permittees in writing of any Unforeseen Circumstances of which the Service becomes aware that may affect the obligations of the Permittees under the Permit or the SMRHCP.

7.0 AMENDMENT PROCEDURE

It is necessary to establish a procedure to make changes to permitted activities or add activities under the Section 10(a)(1)(B) permit. However, approval of these changes and/or additions is dependent upon their impact. The cumulative effect of any amendments must not jeopardize endangered or threatened species, so the Service must evaluate amendments based on their effect on the habitat as a whole. The Service must be consulted on all proposed amendments to the SMRHCP projects that may affect any federally listed species. The types of proposed amendments and the applicable amendment procedures are as follows:

7.1 AMENDMENTS TO PROPOSED PROJECTS

The SMRHCP Implementation Team (comprised of City staff, Tx State personnel, and the USFWS) must be consulted on all proposed amendments to the proposed projects in the SMRHCP. The written request for any change or addition to the San Marcos River Habitat Conservation Plan will be submitted to the USFWS and co-applicants. This request will include an analysis of the cumulative effects of the amendments on listed species. The USFWS will review the request and consult with the applicants before approving or disapproving.

7.2 MINOR AMENDMENTS

Minor amendments involve routine administrative revisions to the management of the proposed projects and do not diminish the level or means of mitigation. Such minor amendments do not alter the terms of the Section 10(a)(1)(B) permit or increase the level of take.

Upon the written request of the City or Tx State, and after consultation with the WPD, USFWS is authorized to approve minor amendments to the SMRHCP. In addition, the changes/additions cannot conflict with the primary purpose of the SMRHCP as stated in Section 1.0 of this document.

7.3 ALL OTHER AMENDMENTS

All other amendments will be considered an amendment to the Section 10(a)(1)(B) permit, subject to any other procedural requirements of Federal law or regulation that may be applicable to amendment of such a permit.

8.0 PERMIT DURATION

The SMRHCP is written in anticipation of issuance of a 10(a)(1)(B) permit valid for a period of 20 years or until it has been incorporated into the Edwards Aquifer Authority HCP with an issuance of a 10(a)(1)(B) permit.

9.0 PUBLIC AND AGENCY COORDINATION

The following agencies, organizations, and individuals have been or will be consulted or coordinated with during the process of addressing listed species concerns for the San Marcos River:

Texas Parks and Wildlife Department
Edwards Aquifer Authority
Recovery Implementation Program Steering Committee
Environmental Review Committee for Aquarena Center
River Systems Institute
San Marcos River Foundation
San Marcos Greenbelt Alliance
River Pub and Grill
U.S. Fish and Wildlife Service, Austin, Texas
U.S. Fish and Wildlife Service, Albuquerque, New Mexico
Hays County
Lions Club
Canoe/Kayak liveries (TG Canoes & Kvanli's)

Public notification of the availability of the draft EA/HCP will be published in the federal register and a regional daily newspaper. All concerned agencies and entities will be provided a copy for review and comment. The public comment period is 60 days from the date of publication in the Federal Register.

10.0 OTHER CONDITIONS THAT MAY BE REQUIRED BY THE SERVICE

A. Upon locating a dead, injured, or sick listed species, the Permittee is required to contact the Service's law Enforcement Office in Austin, Texas at (512) 490-0948 or in San Antonio, Texas at (210) 681-8419 for care and disposition instructions. Extreme care should be taken in handling sick or injured individuals to ensure effective and proper treatment. Care should also be taken in handling

dead specimens to preserve biological materials in the best possible state for analysis of cause of death. In conjunction with the care of sick or injured listed species, or preservation of biological materials from a dead specimen, the Applicants have the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

B. If during the tenure of this permit the project procedures and/or extent of the habitat impact described in the SMRHCP is altered such that there may be an increase in the anticipated take, the Permittees are required to contact the Service and obtain authorization and/or amendment of the permit before commencing any construction or other activities which might result in take beyond that described in the EA/HCP.

C. The authorization granted by the permit will be subject to full and complete compliance with, and implementation of, the EA/HCP, and all specific conditions contained in the permit. The permit terms and conditions shall supersede and take precedence over any inconsistent provisions in the EA/HCP or other permit documents.

D. Acceptance of the permit serves as evidence that the Permittees understand and agree to abide by the terms of the permit and all applicable Sections of Title 50 Code of Federal Regulations Parts 13 and 17, pertinent to issued permits.

11.0 MITIGATION IMPLEMENTATION SCHEDULE

NOTE: Although “responsible party” is separated, the City and Tx State will be working together to implement the entire SMRHCP.

11.1 SMRHCP Implementation

The City and Tx State have jointly applied for a 20-year permit to allow incidental take in the San Marcos River. As potential permit holders, they will be jointly signing the

Implementing Agreement for the SMRHCP which will specify the responsibilities of each agency, the conservation and mitigation measures to be implemented, the monitoring and research procedures, and any other permit conditions that may be required. The SMRHCP participants will designate City and Tx State personnel to work together with the purpose of overseeing all aspects of conservation planning, coordination, and implementation, and monitoring of the permit conditions. The City and Tx State will coordinate implementation of the SMRHCP and administer required programs for the enhancement of endangered species habitat in order to assure the success of the Plan. The City and Tx State will report to the USFWS annually on January 31st regarding the status of the proposed projects and required mitigation described in the SMRHCP.

SMRHCP Mitigation Implementation Schedule

PROJECTS	HCP SECTION	MITIGATION/ AVOIDANCE	MITIGATION DURATION	RESPONSIBLE PARTY FOR MITIGATION	TAKE ANTICIPATED/ TYPE OF TAKE	COMMENTS
Management of Aquatic Vegetation in Spring Lake	6.4.1	Develop and implement a Recreation Master Plan (6.5.1)	Two years	WPD/Tx State (80/20%)	Harvester boatload = 12.5 cubic m; Take = one fountain darter per boatload (20 boatloads each month) Area of Impact = 165 m^2; Take = 15 San Marcos salamanders & 10 riffle beetles per month 100% killed	The recreation corridor begins at Spring Lake and continues to IH-35
		Replacement of non-natives in recreation corridor of Spring Lake and Sewell Park (6.5.2)	Ongoing	Tx State (100%)		

Sediment Removal in Spring Lake	6.4.2	Develop and implement a San Marcos River Watershed Plan (6.5.1)	Five years	WPD/Tx State (90/10%)	Area of Impact = 180 m^2 Take = 6 fountain darters, 1 salamander & 10 riffle beetles per month 100% killed	The recreation corridor begins at Spring Lake and continues to IH-35
		Removal of nutria from the Spring Lake area by Tx State (6.5.2)	Ongoing	Tx State (100%)		
Trail System	6.4.3				Area of Impact = 46,450 m^2; Take = 5 darters, 1 salamander per month 100% harassed	
SCUBA in Spring Lake	6.4.4	Development of Texas Rivers Center Master Plan (6.5.1)	Ongoing	Tx State (100%)	Area of Impact outside submarine theatre = 46,450 m^2; Take = 17 darters/month Area of Impact inside submarine theatre = 2,140 m^2; Take = 70 darters per month 30% harmed; 70% harassed	
		Public participation in aquatic plant mgt (6.5.4)				
Diversion of Water from Spring Lake	6.4.5	Diversion Pipe installation (6.5.6)	Ongoing	Tx State (100%)	Area of Impact = 2,250 m^2; Take = 35 darters per month 100% killed	
Management Practices for the Aquarena Golf Course and Grounds	6.4.6	Enhancement of riparian buffer (6.5.2) and development of an IPM plan	Ongoing	Tx State (100%)	Area of Impact = 83,600 m^2 Take = 112 darters, 83	

		(6.5.1)			salamanders & 1 riffle beetle each month 50% killed; 50% harmed	
Canoe classes in Spring Lake and Sewell Park	6.4.8	Texas River Center Educational Programs (6.5.3)	Ongoing	Tx State (100%)	Area of Impact = 2,250 m^2 Take = 2 darters per month 100% harassed	
Management of Aquatic Vegetation in Sewell Park	6.4.9	Texas River Center Educational Programs (6.5.3)	Two	Tx State (100%)	Area of Impact = 40 m^2per month; Take = 2 darters per month 30% harmed 70% harassed	The recreation corridor begins at Spring Lake and continues to IH-35
		Replacement of non-natives in portions of rec. corridor owned by Tx State (6.5.2)	Ongoing	Tx State (100%)		
Removal of Accumulated Plant Materials from Sewell Park	6.4.10	Replacement of non-natives in portions of recreation corridor owned by Tx State (6.5.2)	Ongoing	Tx State (100%)	Area of impact = 1400 m^2 Take = 5 fountain darters per quarter 100% harassed	
Sessom Creek Sand Bar Removal	6.4.11	Geomorph. Impact Analysis and TWR Restoration (6.5.5)	One	WPD/TxState (50/50%)	Area of Impact = 125 m^2; Take = 14 darters 100% killed	
Management of Aquatic Vegetation Below Sewell Park	6.4.12	Public participation in aquatic plant mgt (6.5.4)	Two	WPD (100%)	Area of Impact = 3050 m^2; Take = 20 darters per month	The recreation corridor begins at Spring Lake and continues to IH-35

		Replacement of non-natives in recreation corridor (6.5.2)	Ongoing	Tx State (Labor) WPD (On-site Supervision)	30% harmed 70% harassed	
Sediment Removal Below Sewell Park	6.4.13	Develop and implement a San Marcos River Watershed Plan (6.5.1)	Five years	WPD/Tx State (90/10%)	Area of Impact = 180 m^2per month; Take = 20 darters per month	The recreation corridor begins at Spring Lake and continues to IH-35
		Replacement of non-natives in recreation corridor (6.5.2)	Ongoing	Tx State (Labor) WPD (On-site Supervision))	100% killed	
Permanent Access Points/ Bank Stabilization	6.4.14	Replanting of eroding areas and desire trails (6.5.2) Educational programs -San Marcos Nature Center (6.5.3)	Ongoing	WPD (100%)	Area of Impact = 1,560 m^2; Take = 20 darters per project Area of Impact = 650 m^2; Take = 10 darters per project 100% killed	
TOTALS		**Impacted Area/year = 198,720 m^2** **Fountain darters taken per year = 3,966** **San Marcos salamanders taken per year = 1,200** **Riffle beetles taken per year = 252**				

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FIGURE 1

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

FIGURE 6

FIGURE 7

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 11

FIGURE 12

FIGURE 13

APPENDICES

Regarding the 20 acre permit, we can divert the water only if river flow exceeds 128 cfs.

Regarding the 60 acre permit, there are no restrictions on our ability to divert the water.

These two permits are from the same certificate of adjudication, 18-3866 and 18-3866A.

Do you need anything else.

Pat