Edwards Aquifer Habitat Conservation Plan

USFWS Permit No. TE63663A-0

2013 Annual Report

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

Prepared for
The U.S. Fish and Wildlife Service

On behalf of
The Edwards Aquifer Habitat Conservation Plan Permittees

Prepared by
SWCA Environmental Consultants

March 11, 2014

SWCA Project Number 27474-SAN

EDWARDS AQUIFER HABITAT CONSERVATION PLAN
2013 ANNUAL REPORT

On behalf of
THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN PERMITTEES

Prepared for

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

Ac-ft	Acre Feet
ASR	Aquifer Storage and Recovery
BIO-WEST	BIO-WEST, Inc.
BO	Biological Opinion
BMP	best management practice(s)
CEF	Critical Environmental Features
cfs	cubic feet per second
cm	centimeter(s)
DPS	Department of Public Safety
EAA	Edwards Aquifer Authority
EAHCP	Edwards Aquifer Habitat Conservation Plan
EARIP	Edwards Aquifer Recovery Implementation Program
ETJ	Extra-Territorial Jurisdiction
ERPA	Environmental Restoration and Protection Area
ESA	Endangered Species Act
FMA	Funding and Management Agreement
ft	feet/foot
ft^2	square feet
GBRA	Guadalupe-Blanco River Authority
HCP	Habitat Conservation Plan
HFM	Hydrogeologic Framework Model
HHW	Household Hazardous Waste
IH	Interstate Highway
IC	Intergovernmental Contract
IPMP	Integrated Pest Management Plan
ITP	Incidental Take Permit
lbs	pounds
LDC	Land Development Code
LID	Low impact development
m	meters
m^2	square meters
m^3	meters cubed
MCWE	Meadows Center for Water and the Environment
mg/L	milligram(s) per liter
MGD	Million Gallons per Day
MS4	municipal separate storm sewer system
msl	mean sea level
NAS	National Academy of Sciences
No.	Number
NOA	Notice of Availability
NRHM	Non-radioactive Hazardous Material
NTU	Nephelometric Turbidity Units

ACRONYMS AND ABBREVIATIONS - continued

O&M	Operations and Maintenance
PCL	Protective Concentration Levels
PEC	Probable Effect Concentration
PTR	Pristine Texas Rivers Inc.
RTI	Real-time Instrumentation
RWCP	Regional Water Conservation Program
SARA	San Antonio River Authority
SAWS	San Antonio Water System
SCUBA	Self Contained Underwater Breathing Apperatus
SMARC	San Marcos Aquatic Research Center
SMWI	San Marcos Watershed Initiative
SRP	Science Review Panel
SSA	State Scientific Area
STM	Stormwater Technical Manual
SWCA	SWCA Environmental Consultants
TCEQ	Texas Commission on Environmental Quality
TN	Total Nitrogen
TP	Total Phosphorus
TPWD	Texas Parks and Wildlife Department
TRRP	Texas Risk Reduction Program
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
UNT	University of North Texas
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UT	University of Texas
VISPO	Voluntary Irrigation Suspension Program Option
WQPP	Water Quality Protection Plan

EXECUTIVE SUMMARY

On February 05, 2013, the United States Fish and Wildlife Service (USFWS) issued an Incidental Take Permit (ITP) (No. TE-63663A-0) to five Permittees representing the collaborative efforts of the Edwards Aquifer Recovery Implementation Program (EARIP). The ITP became effective on March 18, 2013. These Permittees are the Edwards Aquifer Authority (EAA), the City of New Braunfels, the City of San Antonio acting by and through its San Antonio Water System (SAWS), the City of San Marcos, and Texas State University (collectively, the Permittees). This Annual Report is being submitted on behalf of the Permittees in compliance with ITP Sections T(2) and T(3) for the 2013 calendar year. This report was developed by SWCA Environmental Consultants (SWCA) with significant contributions from the Permittees, Stakeholders, and program staff.

As a condition of the ITP, the Permittees shall implement a Habitat Conservation Plan, specifically the Edwards Aquifer Habitat Conservation Plan (EAHCP). The ITP provides incidental take protection for eight federally listed species and three petitioned species. These species are included in Table ES-1.

Table ES-1. Covered Species under the EAHCP Incidental Take Permit

Common Name	Scientific Name	Federal Status
Fountain Darter	*Etheostoma fonticola*	Endangered
San Marcos Gambusia	*Gambusia georgei*	Endangered
Comal Springs Dryopid Beetle	*Stygoparnus comalensis*	Endangered
Comal Springs Riffle Beetle	*Heterelmis comalensis*	Endangered
Peck's Cave Amphipod	*Stygobromus pecki*	Endangered
Texas Wild Rice	*Zizania texana*	Endangered
Texas Blind Salamander	*Eurycea (+Typhlomolge) rathbuni*	Endangered
San Marcos Salamander	*Eurycea nana*	Threatened
Texas Cave Diving Beetle	*Haideoporus texanus*	Petitioned
Comal Springs Salamander	*Eurycea sp.*	Petitioned
Texas Troglobitic Water Slater	*Lirceolus smithii*	Petitioned

Biological goals for these species are located in Chapter Four of the EAHCP and are discussed by system and species. All long-term biological goals are accompanied by management and flow objectives necessary to achieve those goals.

Table ES-2. Biological Goals and Objectives – Comal Springs Ecosystem

Species	Population Objectives	Management Objectives	Flow Objectives
Fountain Darter	Maintain populations of fountain darters equal to or greater than historical population densities described over the last ten years.	Water quality shall not deviate more than 10% from historical (previous 10 years) water quality conditions.	Long-term average flows: 225 cubic feet per second (cfs) (over 50 years).
		Aquatic vegetation restoration in the study reaches should be mimicked in the entire river system; vegetation objectives are identified in Table 4-6 of the EAHCP.	
		Water temperatures less than 25 degrees Celsius will be maintained.	Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).
		Dissolved oxygen concentrations greater than 4.0 milligrams per liter (mg/L) will be maintained throughout habitat zones.	
Comal Springs Riffle Beetle	Maintain populations of riffle beetles equal to or greater than historical population densities described over the last six years.	Water quality shall not deviate more than 10% from historical water quality conditions.	Long-term average flows: 225 cfs (over 50 years).
		Maintain silt-free substrates along Spring Run 3 and the western shoreline in Landa Lake.	
		Restore the riparian areas along Spring Run 3 and the western shoreline to limit the amount of sedimentation resulting from rain events.	Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).
Comal Springs Dryopid Beetle and Peck's Cave Amphipod	Due to the subterranean nature of these species, population impacts are not expected and will be met through the management and flow objectives.	Edwards Aquifer water quality shall not deviate more than 10% from historical water quality conditions at the spring orifices.	Long-term average flows: 225 cfs (over 50 years).
			Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).

Table ES-3. Biological Goals and Objectives – San Marcos Springs Ecosystem

Species	Population Objectives				Management Objectives	Flow Objectives
Texas Wild-Rice	River Segment	Areal Coverage square meters (m^2)			Maintain minimum populations during all flow conditions (500 m^2 in Spring Lake, 2,490 m^2 from Spring Lake Dam to Rio Vista Dam, 390 m^2 from Rio Vista Dam to IH 35, and 120 m^2 downstream of IH-35).	Long-term average flows: 140 cfs (over 50 years).
	Spring Lake	1,000 - 1,500 m^2				
	Spring Lake to Rio Vista Dam	5,810 - 9,245 m^2			Increase public education and wild-rice protection when flows drop below 100 cfs.	
	Rio Vista Dam to IH-35	910 - 1,650 m^2				Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).
	Downstream of IH-35	280 - 3,055 m^2			Continued restoration of Texas wild-rice in high-quality habitat areas and development and implementation of a long-term extensive monitoring program.	
	Total	**8,000 - 15,450** m^2				
Fountain Darter	Maintain populations of fountain darters equal to or greater than historical population densities described over the last 10 years. Achieve and maintain population densities per vegetation type as described in Table 4-21 of the EAHCP.				Water quality shall not deviate more than 10% from historical water quality conditions.	Long-term average flows: 140 cfs (over 50 years).
					Aquatic vegetation restoration in the study reaches should be mimicked in the entire river system; vegetation objectives are identified in Table 4-21 of the EAHCP.	
					Water temperatures less than 25 degrees Celsius will be maintained.	Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).
					Dissolved oxygen concentrations greater than 4.0 mg/L will be maintained throughout habitat zones.	
San Marcos Salamander		Hotel Area (Spring Lake)	Riverbed Area (Spring Lake)	Eastern Spillway below Spring Lake Dam	Continue management of the aquatic vegetation within Spring Lake consistent with historic efforts implemented by Texas State University.	Long-term average flows: 140 cfs (over 50 years).
	Habitat	Silt-free gravel covering at least 90% within each study area			Manage recreation in the eastern spillway below Spring Lake Dam particularly when spring flow drops below 100 cfs	
	Population Density (salamanders per m^2)	At least 15	At least 10	At least 5		Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).
Texas Blind Salamander	Due to the subterranean nature of this species, population impacts are not expected and will be met through the management and flow objectives.				Edwards Aquifer water quality shall not deviate more than 10% from historical water quality conditions at the spring orifices.	Long-term average flows: 140 cfs (over 50 years).
						Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).

The ITP provides take coverage for four primary covered activities as described in the EAHCP:

- The regulation and use of the aquifer;
- Recreational activities in the Comal and San Marcos springs and river systems;
- Other activities in, and related to, the Comal and San Marcos springs and river ecosystems; and,
- Activities involved in and related to the implementation of the minimization and mitigation measures in those ecosystems.

Implementation of the EAHCP is managed by a set of Committees whose composition and responsibilities are described in detail in the Funding and Management Agreement (FMA) included as Appendix R to the EAHCP. Oversight of implementation is managed by the EAHCP staff residing at the EAA. For 2013, a budget of $20,416,847 was approved by the Permittees and only $5,413,544 was expended for program implementation. These funds were used to implement the Phase I restoration, monitoring, modeling, and research activities outlined in the EAHCP and shown in Table ES-2. Implementation of these activities in 2013 is in full compliance with the EAHCP and subsequent coordination with the USFWS throughout the year.

Table ES-4. Summary of Phase 1 EAHCP Mitigation and Minimization Measures

Type of Mitigation	Action
Flow Protection Measures	Stage V Critical Period Management
	Use of the SAWS ASR
	Regional Water Conservation Program
	Voluntary Irrigation Suspension Program Option (VISPO)
Habitat Protection Measures	Aquatic Habitat Restoration
	Bank Stabilization and Designated Access Points
	Gill Parasite Control (Comal River)
	Wild-rice Restoration and Maintenance (San Marcos River)
	Riparian Restoration
Supporting Measures	Applied Research
	LID/BMP Regional Measures
	Prohibition of Hazardous Materials Transport
	Ecological Modeling
	Biological Monitoring
	Water Quality Monitoring and Protection
	Refugia
	Household Hazardous Waste Programs

Based on in-field habitat evaluations and species surveys, BIO-WEST, Inc. determined incidental take and disturbance amounts for 2013. An overview of these results is included in Table ES-3.

Table ES-5. Incidental Take and Disturbance Summary

COVERED SPECIES PER SYSTEM	IMPACTED HABITAT (m^2)		HABITAT 2013 TOTAL (m^2)	INCIDENTAL TAKE		2013 INCIDENTAL TAKE TOTAL	ITP Permit Amount	ITP Permit Remaining
	EAHCP Mitigation / Restoration	EAHCP Measures / Drought		EAHCP Mitigation / Restoration	EAHCP Measures / Drought			
COMAL SYSTEM								
Fountain Darter	4,181	2,807	**6,988**	6,272	4,211	**10,482**	797,000	786,518
Comal Springs Riffle Beetle	0	103	**103**	0	681	**681**	11,179	10,498
Comal Springs Dryopid Beetle	0	134	**134**	0	13	**13**	1,543	1,530
Peck's Cave Amphipod	0	78	**78**	0	81	**81**	18,224	18,143
SAN MARCOS SYSTEM								
Fountain Darter	3,236	7,896	**11,132**	4,854	11,844	**16,698**	549,129	532,431
San Marcos Salamander	15	336	**351**	45	1,008	**1,053**	263,857	262,804
Texas Blind Salamander	0	0	**0**	0	0	**0**	10	10
Comal Springs Riffle Beetle	0	0	**0**	0	0	**0**	n/a	n/a

In 2013, no requests for adaptive management were submitted to the EAHCP Program Manager for consideration and review. The Permittees actively engaged the USFWS, EAHCP Stakeholders, and the EAHCP Science Committee throughout the year, as well as engaging in continuous efforts targeting community and public outreach and education initiatives.

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1.0 INTRODUCTION

On February 05, 2013, the United States Fish and Wildlife Service (USFWS) issued an Incidental Take Permit (ITP) (No. TE63663A-0) to five Permittees representing the collaborative efforts of the Edwards Aquifer Recovery Implementation Program (EARIP). The ITP became effective on March 18, 2013. These Permittees are the Edwards Aquifer Authority (EAA), the City of New Braunfels, the City of San Antonio acting by and through its San Antonio Water System Board of Directors (SAWS), the City of San Marcos, and Texas State University (collectively, the Permittees). The issuance of this ITP was a significant milestone regarding the most appropriate way to balance both the human and species needs of the Edwards Aquifer.

The Edwards Aquifer is a unique karst aquifer that is the primary source of municipal, industrial, and irrigation water for over two million people in south-central Texas. Additionally, this aquifer is essential to eight federally listed threatened and endangered species dependent upon water in or discharged from the aquifer at the Comal and San Marcos springs.

In the 1950s, a severe prolonged drought resulted in the cessation of springflow in the Comal system causing the extirpation of the fountain darter (*Etheostoma fonticola*) in that system. Years later, in 1991, the Sierra Club brought suit against USFWS for violating Sections 4 and 9 of the Endangered Species Act (ESA) by not taking sufficient measures to protect the federally listed species that are dependent on the Edwards Aquifer. The presiding judge, the Honorable Lucius Bunton, ruled in favor of the Sierra Club and, among other things, provided time for the State of Texas to consider the development of a state solution before the "blunt axes of federal intervention have to be dropped" (Sierra Club v. Babbit, Amended Findings).

In response, the Texas legislature passed the Edwards Aquifer Authority Act (EAA Act) (Senate Bill 1477) which created the EAA as a special regional groundwater conservation district responsible for managing withdrawals to, among other things, ensure continuous minimum springflows for the protection of endangered and threatened species to the extent required by federal law. Since becoming operational in 1996, the EAA has complied with its duties to implement the EAA Act. In the late 1990s and early 2000s, the EAA initiated actions to implement Section 1.14(h) of the EAA Act by the development of a springflow protection program, which included a habitat conservation plan as a component. Then in 2006, to further advance this process, the USFWS began to form a voluntary stakeholder initiative called a recovery implementation program, referred to as the Edwards Aquifer Recovery Implementation Program (EARIP). The Texas legislature responded by mandating that the EAA and four state agencies (the Texas Parks and Wildlife Department [TPWD], the Texas Department of Agriculture, the Texas Commission on Environmental Quality [TCEQ], and the Texas Water Development Board [TWDB]) participate in this process and set a deadline for completion of a consensus-based plan to be developed by December 31, 2012.

The EARIP was comprised of 26 members representing a diverse group of interests related to the Edwards Aquifer. All EARIP meetings were open and transparent public meetings attended by 50 to 80 regular participants. Meetings were held regularly over four years until November 7, 2011, when the Steering Committee recommended that the EAA, the City of New Braunfels, SAWS, the City of San Marcos, and Texas State University approve the two-phased, $18.6 million per year, fifteen-year Edwards Aquifer Habitat Conservation Plan (EAHCP).

The EAHCP and associated ITP application were submitted to the USFWS for consideration on January 6, 2012. On January 30, 2012, the Implementing Committee of the EAHCP met for the first time representing the five Permittees as voting members, along with the Guadalupe-Blanco River Authority

(GBRA) as a non-voting member. By January 1, 2013, the Permittees were prepared to begin implementation of the EAHCP. The ITP issued by the USFWS became effective on March 18, 2013.

On September 11, 2013 the EAA solicited several consulting firms for a bid to develop the 2013 EAHCP Annual Report. The EAA received three proposals and entered into a contract with SWCA Environmental Consulting on November 11, 2013, for completion of the report. SWCA prepared a report template which EAA distributed to the Permittees for the December 19, 2013, joint meeting of the Implementing, Stakeholder, and Science Committees for use in the preparation of individual Annual Report sections. First drafts of report language were submitted by December 22, 2013, and incorporated into the second draft of the report which was provided to the EAA on January 13, 2014, and distributed to the Implementing Committee with the January 16, 2014 meeting packet. Also provided was an excel sheet comment form to be used in providing comments to ensure consistency in the comment process. On January 22, 2014, EACHP Program Manager Nathan Pence distributed the draft Annual Report and comment matrix to the Implementing, Stakeholder, and Science Committee via email. Comments were accepted through January 31, 2014.

The EAA and SWCA reviewed and incorporated the comments received for the third draft of the Annual Report which was provided to the EAA on February 11, 2014, and to the Implementing Committee as part of the meeting packet for the February 20, 2014 meeting. Again, comments were solicited from all three Committees from February 20, 2014, through March 1, 2014. These comments were again incorporated into the Final Version of the EAHCP Annual Report submitted to the EAA on March 11, 2014. The Implementing Committee authorized the EAHCP Program Manager to submit the draft of the EAHCP to the USFWS on March 20, 2014.

The Annual Report discusses implementation activities of the EAHCP undertaken in 2013, and is formatted to include reporting requirements as they are outlined in the ITP.

1.1 EAHCP COVERED ACTIVITIES

The EAHCP outlines four categories of activities that have the potential to result in incidental take and are covered under the ITP: "(1) the regulation and use of the Aquifer; (2) recreational activities in the Comal and San Marcos springs and river ecosystems; (3) other activities in, and related to, the Comal and San Marcos springs and river ecosystems; and (4) activities involved in and related to the implementation of the minimization and mitigation measures in these ecosystems."

1.1.1 Regulation and Use of the Aquifer

The EAA is responsible for managing withdrawals from the Edwards Aquifer. The ITP take coverage allows the incidental take of species resulting from regulatory practices of the EAA, including issuance of initial regular permits, term permits, emergency permits, recharge recovery permits, and authorization of the use of exempt wells for the withdrawal of water from the aquifer. These otherwise lawful activities are required by state statute through the EAA Act. This coverage also includes protection for the administration of permits through transfers and amendments, conversion of Base Irrigation Groundwater, and critical period management.

1.1.2 Recreational Activities in the Comal and San Marcos Springs and River Ecosystems

The cities of San Marcos and New Braunfels and Texas State University have the authority to manage the spring and river ecosystems within their respective jurisdictions. Included for coverage in the ITP are

activities related to the management of public recreational use of the Comal and San Marcos spring and river ecosystems.

1.1.3 Other Activities in, and Related to, the Comal and San Marcos Springs and River Ecosystems

The ITP provides incidental take coverage for the following activities:

- The City of New Braunfels is covered for the management of water levels in the Comal River, the use of golf course diversions and general golf course management activities, surface water diversions related to the spring-fed pool and its operation, boat operations on the Comal River and Landa Lake, and maintenance and repair of city infrastructure that may impact the ecosystem.
- The City of San Marcos is covered for boat operations on the San Marcos River and maintenance and repair of city infrastructure that may impact the ecosystem.
- Texas State University is covered for existing vegetation management, existing research and diving programs, the use of a permitted surface water diversion from Spring Lake, management of the University golf course, and boating activities in Spring Lake.
- SAWS is covered for pumping its permitted Edwards groundwater from permits issued by the EAA, including water acquired from the EAA through leases and options of permitted Edwards rights from the Edwards Aquifer and the use and operation of the SAWS Aquifer Storage and Recovery Facility (ASR).
- TPWD is covered for the implementation and management of the State Scientific Areas discussed in the EAHCP.

1.1.4 Activities Related to the Implementation of the EAHCP

The ITP requires minimization and mitigation measures that are discussed in Section 3 of this report for each of the Permittees. Implementation of these measures pursuant with the EAHCP is included for coverage in the ITP.

1.2 INCIDENTAL TAKE PERMIT

On March 18, 2013, ITP No. TE63663A-0 issued to the five Permittees by the USFWS became effective. The ITP provides incidental take coverage for authorized activities within Bexar, Medina, Uvalde, Atascosa, Comal, Caldwell, Hays, and Guadalupe counties in the state of Texas. The ITP outlines covered activities and covered species afforded protection under the permit.

1.2.1 Permittees

As previously mentioned, five Permittees are covered under the EAHCP ITP. These are the EAA, the City of New Braunfels, SAWS, the City of San Marcos, and Texas State University.

1.2.2 Covered Species

The ITP authorizes the incidental take to ten animal species and one plant species. Species covered under the ITP are listed in Table 1-1.

Table 1-1. Covered Species under the EAHCP Incidental Take Permit

Common Name	Scientific Name	Federal Status
Fountain Darter	*Etheostoma fonticola*	Endangered
San Marcos Gambusia	*Gambusia georgei*	Endangered
Comal Springs Dryopid Beetle	*Stygoparnus comalensis*	Endangered
Comal Springs Riffle Beetle	*Heterelmis comalensis*	Endangered
Peck's Cave Amphipod	*Stygobromus pecki*	Endangered
Texas Wild Rice	*Zizania texana*	Endangered
Texas Blind Salamander	*Eurycea (+Typhlomolge) rathbuni*	Endangered
San Marcos Salamander	*Eurycea nana*	Threatened
Texas Cave Diving Beetle	*Haideoporus texanus*	Petitioned
Comal Springs Salamander	*Eurycea sp.*	Petitioned
Texas Troglobitic Water Slater	*Lirceolus smithii*	Petitioned

1.2.3 Authorized Incidental Take

Authorized take permitted for the 15-year term of the ITP is provided in Tables 1-2 and 1-3. In its Biological Opinion (BO), the USFWS recognizes the challenges associated with quantifying incidental take for the species covered in the ITP due to their biological nature. For the purpose of the ITP, the USFWS utilizes a habitat surrogate to represent the level of incidental take incurred. This habitat surrogate assumes that most impacts will occur in the form of harm and harassment through the direct loss of habitat and indirect effects of ITP issuance.

Table 1-2. Authorized Incidental Take -- Comal River System

Species	Permissible Take		Surrogate
Fountain Darter	Repeat of Drought of Record (BO, 116)	735,000	Flows dip below 30 cubic feet per second (cfs) for no more than 75 days during Phase I and 45 cfs for no more than 30 days in Phase II.
	Year of Average Conditions (BO, 117)	62,000 (7,750/year)	10% Surface Habitat impacted by EAHCP implementation activities.
	Total	**797,000**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions.
Comal Springs Salamander	"Incidental take of the Comal Springs Salamander will be provided for individuals of the species killed, harmed, or harassed by continuous spring flows as low as 27 cfs and/or up to 75 days below 30 cfs during EAHCP Phase I and by continuous spring flows up to 45 cfs and/or 30 days below 45 cfs during Phase II at Comal Springs" (BO, 136).		
Comal Springs Riffle Beetle	Repeat of Drought of Record (BO, 106)	10,739	Flows dip below 30 cfs for no more than 75 days during Phase I and 45 cfs no more than 30 days in Phase II.
	Year of Average Conditions (BO, 106)	440 (55/year)	5% surface habitat impacted by EAHCP implementation activities.
	Total	**11,179**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions.
Pecks Cave Amphipod	Repeat of Drought of Record (BO, 111)	17,360	Flows dip below 30 cfs for no more than 75 days during Phase I and 45 cfs no more than 30 days in Phase II.
	Year of Average Conditions (BO, 112)	864 (108/year)	5% surface habitat impacted by EAHCP implementation activities.
	Total	**18,224**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions.
Comal Springs Dryopid Beetle	Repeat of Drought of Record (BO, 100)	1,471	Flows are maintained at 27 cfs during EAHCP Phase I and 30 cfs during Phase II.
	Year of Average Conditions (BO, 102)	72 (9/year)	5% Surface Habitat impacted by EAHCP implementation activities.
	Total	**1,543**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions.

Table 1-3. Authorized Incidental Take -- San Marcos River System

Species	Permissible Take		Surrogate
Fountain Darter	Repeat of Drought of Record (BO, 116)	450,000	Flows dip below 50 cfs for no more than 30 days during Phase I and 15 days in Phase II.
	Year of Average Conditions (BO, 117)	99,128 (4,800/year San Marcos River; 7,591/year Spring Lake)	10% surface habitat in the San Marcos River and 2.5% surface Habitat (10,350 ft^2) impacted in Spring Lake by EAHCP implementation activities.
	Total	**549,128**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions.
San Marcos Salamander	Repeat of Drought of Record (BO, 122)	233,361	Drought of Record conditions not specified in this section of the BO.
	Year of Average Conditions (BO, 122)	30,496 (154/year San Marcos River; 3,658/year Spring Lake)	10% Surface Habitat in the San Marcos River (2,960 ft^2) and Spring Lake (33,250 ft^2) by EAHCP implementation activities.
	Total	**263,857**	Assumes 7 years of Drought of Record conditions and 8 years of average conditions
Texas Blind Salamander	EAHCP measures are "anticipated to maintain aquifer levels and spring flows generally supportive of the species' needs, though some drying of surface habitat near spring orifices that may affect the availability of food resources could occur during a repeat of Drought of Record-like conditions" (BO, 125).		
	Total	**10**	
Texas Cave Diving Beetle	"Incidental take of the Texas Cave diving beetle will be provided for individuals of the species killed, harmed, or harassed buy continuous spring flows as low at 50.5 cfs and/or up to 30 days below 50 cfs during EAHCP Phase I and by continuous spring flows to 51.2 cfs and/or up to 15 days below 50 cfs during Phase II at San Marcos Springs" (BO, 136).		
Texas Troglobitic Water Slater	"Incidental take of the Texas troglobitic water slater will be provided for individuals of the species killed, harmed, or harassed buy continuous spring flows as low at 50.5 cfs and/or up to 30 days below 50 cfs during EAHCP Phase I and by continuous spring flows to 51.2 cfs and/or up to 15 days below 50 cfs during Phase II at San Marcos Springs" (BO, 136).		
San Marcos Gambusia	"None of the measures proposed in the EAHCP or the effects of those measures are expected to destroy or modify habitat in any way that would prevent these areas from continuing to provide the elements required by the species" (BO, 120).		
Texas Wild-Rice	"The EAHCP established a goal of maintaining no less than 38,200 square feet (ft^2) of Texas wild-rice in Spring Lake and the San Marcos River during a repeat of Drought of Record-like conditions" (BO, 93).		

1.3 ANNUAL REPORTING COMPLIANCE

To comply with the ITP, the Permittees will submit an Annual Report to the Austin Ecological Services office of the USFWS and to the Habitat Conservation Plans and Research Permits office of the Albuquerque USFWS office by March 31 of each year. The purpose of the Annual Report is to outline the minimization and mitigation activities undertaken during the previous year and verify compliance with the terms and conditions of the ITP.

According to Section T(2) of the ITP, the Annual Report will include:

- EAA permitted withdrawals;
- Reference well levels;
- Springflows at Comal and San Marcos springs;
- Aquifer recharge;
- Aquifer discharge from wells and springflow;
- Critical period management reductions;
- Water quality data;
- Location of sampling sites;
- Methods for data collection and variables measured;
- Frequency, timing, and duration of sampling for these variables; and
- Description of the data analysis and who conducted the analysis.

Section T(3) of the ITP additionally requires that the Annual Report address management activities, including:

- Adaptive management undertaken during the year;
- Expenditures by the EAA on implementation activities;
- Proposed activities for the next year;
- Report on the status of implementation of minimization and mitigation measures and their effectiveness;
- Interim updates and final copies of any research, thesis or dissertation, or published studies accomplished in association with the EARIP or EAHCP;
- Description of species-specific research and management actions undertaken with specific reference to the biological goals and objectives identified for each species;
- Any changes to the biological goals and key management and flow-related objectives of the EAHCP and the reasons for such changes;
- Any changes to the objectives for the monitoring program;
- Effects on the covered species or permit area;
- Evaluation of progress towards achieving the biological goals and objectives; and
- Any recommendations regarding actions to be taken.

This document serves as the Annual Report for the calendar year 2013, and is in full compliance with the reporting requirements identified in the ITP.

1.4 HABITAT CONSERVATION PLAN MANAGEMENT

Management of the EAHCP is dictated by the FMA provided to USFWS with the initial ITP application. Day-to-day oversight is the responsibility of the Edwards Aquifer Authority which also holds the responsibility for funding program implementation. The program is funded through Program Aquifer Management Fees; user fees collected annually by the Authority from permitted aquifer pumpers.

Expenditures and EAHCP implementation strategies are approved by the Implementing Committee which includes the EAA, the remaining four Permittees, and any entity that contributes a minimum amount financially to the program annually represented as a non-voting member. The only entity that has currently made such a contribution is the Guadalupe-Blanco River Authority. For adaptive management decisions, the Implementing Committee must consult with the Stakeholder Committee which represents the interests included in the EARIP process, and the Science Committee.

Since the EAHCP is designed to accommodate the best available science, management decisions also involve communication and partnership with two scientific bodies; the Science Committee, providing local expertise, and a Science Review Panel, providing an objective third party review of EAHCP activities.

Designated EAHCP staff at the EAA is additionally responsible for coordinating with the USFWS on behalf of the Permittees throughout program implementation.

1.4.1 Edwards Aquifer Conditions/Management

In 2013, the effects of a persistent drought manifested themselves in declining aquifer levels across the region as a result of below-average recharge to the aquifer. These conditions prompted the EAA, under its Critical Period Management Plan, to require permitted users of the aquifer to curtail pumping from the aquifer by 41.8% in the Uvalde Pool and 28.9% in the San Antonio Pool for the calendar year 2013. More detailed information regarding Critical Period Management can be found in Section 3.1.4 of this Report. Spring flow, reference well, and permitted well data is included as Appendices D, C, and B, respectively.

A more detailed and comprehensive report of aquifer conditions for 2013 will be available in the 2013 Hydrological Report upon publication. The report will be provided in the EAHCP 2014 Annual Report as all available data is currently preliminary and pending review and analysis (the 2012 Hydrological Report is available as Appendix Q).

In 2013, the EAA continued to carry out its statutory mission of managing and protecting the Edwards Aquifer pursuant to its enabling statute the EAA Act. Of note, there were two significant management modifications implemented in 2013: one was a legislatively directed clarification of the process for determining exempt well status; and the other was an EAA board directive aimed at mitigating non-point source pollution impacts to the quality of water in the aquifer as it relates to the Comal and San Marcos springs ecosystems. These two changes are summarized as follows:

1) Wells with Limited Production Capabilities (SB 1241) -- In 2013, the EAA Board adopted new rules on *de minimis* use wells (called “limited production wells”) in order to implement the

provisions of Senate Bill (SB) 1241 passed in the 83rd Session of the Texas Legislature. The legislation was intended to add flexibility to the EAA's ability to more effectively administer its well permitting regulations under provisions of the EAA Act by creating an exception for existing groundwater users that can demonstrate minimal yearly pumping -- that is wells not capable of producing more than 1,250 gallons per day, or which are metered and do not produced more than 1.4 acre-feet of water in a calendar year -- regardless of type of use. Because this exception applies only to wells in existence prior to June 1, 2013, the impact of these *de minimis* uses on springflows and aquifer levels is recognized and accounted for in the EAHCP and in EAA groundwater planning within historic exempt use.

2) Coal Tar-Based Sealant Ban -- In November 2012, the EAA Board of Directors approved Final Rules prohibiting the use of coal tar-based pavement sealant products after December 31, 2012, in Comal and Hays counties within areas on the Edwards Aquifer Recharge Zone and on certain, defined portions of the Edwards Aquifer Contributing Zone. The prohibition is contained in Chapter 713, Subchapter H of the EAA rules. The prohibition adds an additional pollution prevention measure intended to reduce the potential for component chemicals of the sealants to enter the aquifer via precipitation runoff, and adversely affect water quality such that the habitats of federally protected species in the Comal and San Marcos springs ecosystems would be impacted.

1.4.2 2013 Financial Report

The 2013 adopted budget, as shown in the EAHCP Expense Report (Appendix E) is $20,416,847. This amount is the Annualized Implementation Costs adopted in the EAHCP. The EAHCP Expense Report also shows this adopted budget compared to the total approved 2013 Funding Application budget of $17,327,779 and the total 2013 Actual expenses of $5,413,544. The report also breaks down the Adopted budget, Funding Application budget and Actual expenses for Spring Flow Protection, San Marcos and Comal Springs projects, Modeling and Research projects and refugia expenses.

Approximately 73.5% of the 2013 adopted budget remained at the end of the December 2013, which was due primarily to balances related resulting from the SAWS ASR program and the VISPO program for appropriated expenditures that were not needed By the end of 2013, the reserve balance for the EAHCP was $24,130,786, which includes unspent budgeted amounts from both fiscal years 2012 and 2013.

The EAHCP Expense Report also shows the actual revenue for 2013 of $15,262,759 compared to the budgeted revenue of $15,110,386. Approximately 95% of the actual revenue comes from Aquifer Management Fees. It is anticipated that revenue acquired in 2014 will be similar to the revenue acquired in 2012 and 2013.

1.5 HABITAT CONSERVATION PLAN COMMITTEE ACTIVITIES

With issuance of the ITP, the EARIP was dissolved and replaced with six new committees, each filling a unique role in program implementation. Four of these entities were created by the FMA, with the other two being created by the EAHCP. These are the Implementing Committee, Adaptive Management Stakeholder Committee, Adaptive Management Science Committee, Science Review Panel, Regional Conservation Monitoring Committee, and the Aquifer Storage and Recovery Regional Advisory Committee. The composition and duties of these committees are outlined in detail in the FMA (EAHCP Appendix R).

1.5.1 Implementing Committee

The Implementing Committee is responsible for supervising the implementation of the EAHCP and ensuring compliance with the program documents including the ITP, FMA, and EAHCP. The Implementing Committee consists of representatives of the five Permittees as voting members and a representative of any entity that contributes at least $400,000 to the program as a nonvoting member. In 2013, only GBRA participated as a nonvoting member. The Implementing Committee met 15 times in 2013; the agendas and minutes from those meetings are provided in Appendix F.

Table 1-4. Representation on the Implementing Committee in 2013

Entity	Representative	Alternate
Edwards Aquifer Authority	Roland Ruiz	Rick Illgner
City of New Braunfels	Steve Ramsey	Robert Camareno
City of San Marcos	Tom Taggart*	Melani Howard
SAWS	Chuck Ahrens	Darren Thompson
Texas State University	Bill Nance (through September), then Andrew Sansom	Mike Abbott (through September), then Juan Guerra
GBRA	Todd Votteler	Charlie Hickman

*Chairman of the Committee

The Implementing Committee additionally convened a drought contingencies work group that met twice in 2013. The purpose of this work group was to assess the impacts of ongoing drought conditions on the activities occurring in the spring cities, and to respond to conditions outlined in the Incidental Take Permit relative to activities occurring during low flows. The minutes of these work group meetings can be found in Appendix F.

1.5.2 Adaptive Management Stakeholder Committee

According to the FMA the Stakeholder Committee will:

- Consult with, advise, and make recommendations to the Program Manager, any Permittee, or the Implementing Committee on routine adaptive management decisions as requested by the Program Manager or any Permittee;
- Consult with, advise, and make recommendations to the Implementing Committee on proposed Nonrouting AMP decisions;
- Consult with, advise, and make recommendations to the Implementing Committee on proposed strategic AMP decisions;
- Consult with, advise, and make recommendations to the Program Manager or the Implementing Committee on the design of studies related to the Biological Goals or the Biological Objectives;
- Consult with, advise, and make recommendations to the Program Manager or the Implementing Committee on any other matter at the request of the Program Manager or Implementing Committee, and;
- Make appointments of members to the Science Committee as provided in Section 7.9 of the FMA.

The Stakeholder Committee met twice in 2013; the agendas and minutes from those meetings are found as Appendix G.

Table 1-5. Representation on the Stakeholder Committee in 2013

FMA Entity	Representative	Alternate
TCEQ	Cary Betz	--
TPWD	Cindy Loeffler	Colette Barron-Bradsby
Texas Department of Agriculture	Kelley Faulk	--
TWDB	Declined to participate in 2013	
GBRA	Todd Votteler	Bill West
San Antonio River Authority (SARA)	Steve Raabe	--
South Texas Water Advisory Committee	Gary Middleton	Bob Keith
Bexar County	Renee Green	Kerim Jacaman
CPS Energy	Doris Cooksey	Louisa Eclarinal
A holder of an initial regular permit issued to a retail public utility located west of Bexar County	Bruce Alexander	Bob Lee
A holder of an initial regular permit issued by the EAA for industrial purposes	Buck Benson	Leigh Leshin
A holder of an industrial surface water right in the Guadalupe River Basin	Gena Leathers	--
A holder of a municipal surface water right in the Guadalupe River Basin	Jerry James	James Dodson
A retail public utility in whose service area the Comal Springs or San Marcos Springs is located	Roger Biggers	--
A holder of an initial regular permit issued by the EAA for irrigation	Rader Gilleland	Adam Yablonski
An agricultural producer from the Edwards Aquifer Region	Ray Joy Pfannstiel	--
Environmental Interest from the Texas Living Waters, National Wildlife Federation, or Sierra Club	Myron Hess	Tyson Broad
Recreational interest in the Guadalupe River Basin	Carl Adkins	--
A holder of an EAA initial regular permit issued to a small municipality located east of San Antonio	Jim Bower	--
Edwards Aquifer region municipal ratepayers/general public	Kirk Patterson	Carol Patterson
Guadalupe River Basin municipal ratepayers/general public	Gary Spence	--
A conservation organization	Dianne Wassenich	Annalisa Peace
Nueces River Authority	Con Mims*	Kirby Brown
City of San Marcos	Melani Howard	Tom Taggart
City of New Braunfels	Steven Ramsey	--
Edwards Aquifer Authority	Roland Ruiz	Rick Illgner
Texas State University	Mike Abbott	Andrew Sansom
SAWS	Patrick Shriver	Steven Bereyso

*Chairman of the Committee

1.5.3 Adaptive Management Science Committee

According to the FMA, the Science Committee will:

a. consult with, advise and make recommendations to the Program Manager, the Implementing Committee and the Stakeholder Committee on any AMP Decision upon request (see FMA § 7.9.2.a.);

b. provide independent and unbiased advice based on their best scientific judgment so that all AMP Decisions will be made consistent with the best scientific and commercial data available (see FMA §§ 7.9.2.b.; 7.11.5; 7.12.2; and 7.14.2);

c. participate in the meetings of the Science Review Panel and provide to the Panel such information as requested by that Panel or the Implementing Committee;

d. provide input to the Implementing Committee regarding the development and implementation of the monitoring program described in Section 6.2 of the EAHCP (see FMA § 7.5);

e. review and comment on the draft annual monitoring report for inclusion in the EAHCP annual report (see FMA § 7.5.3.b.);

f. provide input to the Edwards Aquifer Authority ("EAA") on the design and use of the ecological model described in Section 6.3.3 of the EAHCP (see FMA § 7.13.2.a.),

g. provide input to the EAA on the design of the applied research facility and other applied research studies described in Section 6.3.4 of the EAHCP (see FMA § 7.13.2.b.), including specifically providing comment and recommendations on plans related to the applied research activities described in the EAHCP, including, but not limited to, Subsections 6.3.4 (applied research facility), 6.3.5 (Texas wild-rice enhancement) and 6.3.6 (monitoring and reduction of gill parasites) (see FMA § 7.9.4.c.); and

h. review and comment on the results of the research and modeling required to develop the scientific record under Section 7.13 of the FMA (see FMA § 7.13.5).

The EAHCP Adaptive Management Science Committee is a group of subject experts with experience related to the various components of the EAHCP. This Committee serves as an independent and unbiased scientific body to advise, consult, and provide recommendations to the EAHCP Program Manager, Stakeholder, and Implementing Committees. The Science Committee is the local expertise on EAHCP program implementation and will assist the Science Review Panel with local-specific information as requested.

On November 15, 2012, the Stakeholder Committee recommended that the Implementing Committee increase membership on the Science Committee from nine to eleven members; this increase was approved by consensus of the Implementing Committee the same day.

Table 1-6. Representation on the Science Committee in 2013

Name	Affiliation	Expertise	Nominating Entity
Miguel Acevedo	UNT Denton	Geography Ecological Modeling	Implementing
Tom Arsuffi	Texas Tech	Aquatic Biology Stream Ecology	Implementing
Janis Bush	UT San Antonio	Plant Ecology Experimental Design	Stakeholder
Jacquelyn Duke	Baylor University	Stream Ecology Riparian Ecohydrology	Implementing
Charlie Kreitler	LBG-Guyton Associates	Hydrogeology Groundwater Science	Implementing
Glenn Longley	Texas State University	Biologist Edwards Aquifer Specialist	Stakeholder
Robert Mace	Texas Water Development Board	Hydrology Hydrogeology	Joint Nomination
Doyle Mosier*	Retired	Instream Flows Aquatic Habitats	Implementing
Chad Norris	Texas Parks and Wildlife Department	Aquatic Biology Aquatic Invertebrate Specialist	Stakeholder
Jackie Poole	Texas Parks and Wildlife Department	Botany/Taxonomy Texas Wild-rice Specialist	Stakeholder
Floyd Weckerly	Texas State University	Population Ecology Experimental Design	Stakeholder

*Chairman of the Committee

1.5.4 Science Review Panel

By December 31, 2013 the EAA must have entered into a contract with the National Academy of Sciences (NAS) or a comparable entity approved by the Implementing Committee for the creation of an independent Science Review Panel (SRP). This contract was entered into on December 18, 2013.

In 2013, the Implementing Committee considered NAS and potential alternatives to the NAS for the SRP. It was unanimously determined by the Implementing Committee that the NAS provided the most robust, scientifically defensible, and objective SRP possible. In late 2013, the EAA negotiated a contract with the NAS which includes three report deliverables between 2014 and 2018. The final contract is included as Appendix I.

The SRP did not meet in 2013; however, steps were taken to formally select the membership for the panel, and an initial meeting of the group is expected in February of 2014. NAS identified twelve provisional SRP members on January 8, 2014, that will be subject to a 20-day public comment period. Those identified are shown in Table 1-8.

Table 1-7. National Academy of Sciences Provisional Science Review Panel Membership as of January 8, 2014

Name	Affiliation	Area of Expertise
Danny Reible	Texas Tech University	Chemical Engineering
Jonathan Arthur	Florida Geological Survey	Hydrogeology and Hydrochemistry
M. Eric Benbow	Michigan State University	Entomology of Aquatic Ecosystems
Robin Craig	University of Utah	Water Law
David Hambright	University of Oklahoma	Biology and Water Quality
Timothy Kratz	University of Wisconsin—Madison	Aquatic Ecology
Andrew Long	U.S. Geological Survey	Hydrology
Laura Murray	University of Maryland—Cambridge	Wetlands Ecology
Jayantha Obeysekera	South Florida Water Management District	Hydrologic Modeling
Kenneth Rose	Louisiana State University	Population Modeling
Laura Toran	Temple University	Groundwater Monitoring and Modeling
Greg Woodside	Orange County Water District	Watershed Management and Planning

1.5.5 Regional Water Conservation Monitoring Committee

The Regional Water Conservation Monitoring Committee is established in Section 5.1.3.1 of the EAHCP and is responsible for:

- Ranking proposed activities related to the Regional Water Conservation Program in order of efficiency based on water savings and cost;
- Comment on the potential of each activity to achieve its goal for the term of the EAHCP;
- Make specific recommendations on adjustments that should be made to each proposed activity with the expected result; and
- Prepare periodic statements to demonstrate that program goals—20,000 acre-feet saved and 10,000 acre-feet committed to the Edwards Aquifer for 15 years—will be achieved by the 10th year of operation.

More information about the Regional Water Conservation Monitoring Committee and its 2013 activities can be found in Section 3.1.3 and Appendix O of this report.

1.5.6 Aquifer Storage and Recovery Regional Advisory Committee

A 12-person Regional Advisory Committee to advise SAWS on activities related to the ASR program is established in Section 5.5.1 of the EAHCP. This Committee and its 2013 activities are described in more detail in Section 3.5.1 and Appendix LL of this report.

1.5.7 Public Outreach and Education

For a comprehensive list of public outreach and education initiatives undertaken by the Permittees in 2013, *See* Appendix J.

2.0 BIOLOGICAL GOALS AND OBJECTIVES FOR COVERED SPECIES

USFWS requires that applicants for an ITP include target biological goals and objectives to direct the development of the minimization and mitigation measures. For the EAHCP, these goals and objectives are outlined in Chapter Four of the EAHCP and are discussed by system and species. All long-term biological goals are accompanied by management and flow objectives necessary to achieve those goals. Goals and objectives outlined in the EAHCP may not be changed except through the Adaptive Management Process outlined in the FMA.

2.1 COMAL SPRINGS SYSTEM

Table 2-1. Biological Goals and Objectives – Comal Springs Ecosystem

Species	Population Objectives	Management Objectives	Flow Objectives
Fountain Darter	Maintain populations of fountain darters equal to or greater than historical population densities described over the last ten years.	Water quality shall not deviate more than 10% from historical (previous 10 years) water quality conditions.	Long-term average flows: 225 cubic feet per second (cfs) (over 50 years).
		Aquatic vegetation restoration in the study reaches should be mimicked in the entire river system; vegetation objectives are identified in Table 4-6 of the EAHCP.	
		Water temperatures less than 25 degrees Celsius will be maintained.	Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).
		Dissolved oxygen concentrations greater than 4.0 milligrams per liter (mg/L) will be maintained throughout habitat zones.	
Comal Springs Riffle Beetle	Maintain populations of riffle beetles equal to or greater than historical population densities described over the last six years.	Water quality shall not deviate more than 10% from historical water quality conditions.	Long-term average flows: 225 cfs (over 50 years).
		Maintain silt-free substrates along Spring Run 3 and the western shoreline in Landa Lake.	
		Restore the riparian areas along Spring Run 3 and the western shoreline to limit the amount of sedimentation resulting from rain events.	Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).
Comal Springs Dryopid Beetle and Peck's Cave Amphipod	Due to the subterranean nature of these species, population impacts are not expected and will be met through the management and flow objectives.	Edwards Aquifer water quality shall not deviate more than 10% from historical water quality conditions at the spring orifices.	Long-term average flows: 225 cfs (over 50 years).
			Minimum average flows: 30 cfs (not to exceed 6 months in duration, and followed by 80 cfs for 3 months).

2.2 SAN MARCOS SYSTEM

Table 2-2. Biological Goals and Objectives – San Marcos Springs Ecosystem

Species	Population Objectives				Management Objectives	Flow Objectives
Texas Wild-Rice	River Segment	Areal Coverage square meters (m^2)			Maintain minimum populations during all flow conditions (500 m^2 in Spring Lake, 2,490 m^2 from Spring Lake Dam to Rio Vista Dam, 390 m^2 from Rio Vista Dam to IH 35, and 120 m^2 downstream of IH-35).	Long-term average flows: 140 cfs (over 50 years).
	Spring Lake	1,000 - 1,500 m^2				
	Spring Lake to Rio Vista Dam	5,810 - 9,245 m^2			Increase public education and wild-rice protection when flows drop below 100 cfs.	Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).
	Rio Vista Dam to IH-35	910 - 1,650 m^2				
	Downstream of IH-35	280 - 3,055 m^2			Continued restoration of Texas wild-rice in high-quality habitat areas and development and implementation of a long-term extensive monitoring program.	
	Total	**8,000 - 15,450** m^2				
Fountain Darter	Maintain populations of fountain darters equal to or greater than historical population densities described over the last 10 years. Achieve and maintain population densities per vegetation type as described in Table 4-21 of the EAHCP.				Water quality shall not deviate more than 10% from historical water quality conditions.	Long-term average flows: 140 cfs (over 50 years).
					Aquatic vegetation restoration in the study reaches should be mimicked in the entire river system; vegetation objectives are identified in Table 4-21 of the EAHCP.	
					Water temperatures less than 25 degrees Celsius will be maintained.	Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).
					Dissolved oxygen concentrations greater than 4.0 mg/L will be maintained throughout habitat zones.	
San Marcos Salamander		Hotel Area (Spring Lake)	Riverbed Area (Spring Lake)	Eastern Spillway below Spring Lake Dam	Continue management of the aquatic vegetation within Spring Lake consistent with historic efforts implemented by Texas State University.	Long-term average flows: 140 cfs (over 50 years).
	Habitat	Silt-free gravel covering at least 90% within each study area			Manage recreation in the eastern spillway below Spring Lake Dam particularly when spring flow drops below 100 cfs	
	Population Density (salamanders per m^2)	At least 15	At least 10	At least 5		Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).

Species	Population Objectives	Management Objectives	Flow Objectives
Texas Blind Salamander	Due to the subterranean nature of this species, population impacts are not expected and will be met through the management and flow objectives.	Edwards Aquifer water quality shall not deviate more than 10% from historical water quality conditions at the spring orifices.	Long-term average flows: 140 cfs (over 50 years). Minimum average flows: 45 cfs (not to exceed 6 months and followed by 80 cfs for 3 months).

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3.0 2013 STATEMENT OF COMPLIANCE AND INCIDENTAL TAKE PERMIT IMPLEMENTATION

The Permittees maintained open and transparent communications with the USFWS and EAHCP Stakeholders throughout 2013. Any compliance related items of interest were discussed up-front with the USFWS and Stakeholders throughout the year. As a result of this diligence, at the conclusion of 2013 there were no outstanding compliance matters related to the EAHCP and ITP.

Section 10(a)(2)(A) of the ESA requires that any application for an ITP be accompanied by a Habitat Conservation Plan (HCP). HCPs must include "measures the applicant will undertake to monitor, minimize, and mitigate such impacts [of the covered activities]" (USFWS HCP Planning Handbook, 3-10). This section discusses the progress achieved in 2013 towards meeting the minimization and mitigation measures outlined in the EAHCP.

A copy of the 2013 Work Plans outlining these activities in detail is included as Appendix K.

See Appendix L for 2014 Work Plans outlining in detail planned activities for 2014.

Table 3-1. Summary of Phase 1 EAHCP Mitigation and Minimization Measures

Type of Mitigation	Action
Flow Protection Measures	Stage V Critical Period Management
	Use of the SAWS ASR
	Regional Water Conservation Program
	Voluntary Irrigation Suspension Program Option (VISPO)
Habitat Protection Measures	Aquatic Habitat Restoration
	Bank Stabilization and Designated Access Points
	Gill Parasite Control (Comal River)
	Wild-rice Restoration and Maintenance (San Marcos River)
	Riparian Restoration
Supporting Measures	Applied Research
	LID/BMP Regional Measures
	Prohibition of Hazardous Materials Transport
	Ecological Modeling
	Biological Monitoring
	Water Quality Monitoring and Protection
	Refugia
	Household Hazardous Waste Programs

The subsequent sections of this report provide a detailed overview of activities implemented in 2013 pursuant with the ITP and its conditions.

3.1 EDWARDS AQUIFER AUTHORITY

The EAA is a special regional management district established by the 73rd Legislature in May 1993 with the passage of the EAA Act to preserve and protect the Edwards Aquifer. As established by the Legislature, the EAA is governed by a 17-member board of directors representing the various stakeholder interests across an eight-county jurisdiction, including Atascosa, Bexar, Caldwell, Comal, Guadalupe, Hays, Medina, and Uvalde counties, and the South Central Texas Water Advisory Committee. Geologists, hydro-geologists, environmental scientists, environmental technicians, educators, and administrative staff collaborate daily to fulfill the EAA's statutory mission of managing and protecting the Edwards Aquifer to the benefit of approximately two million South Texans who rely on the aquifer as their primary source of water.

3.1.1 Refugia (EAHCP §5.1.1)

Obligations:
Pursuant to Sections 5.1.1 and 6.3.4 of the EAHCP, the EAA will support and coordinate with the USFWS on the work relating to the San Marcos Aquatic Resource Center's (Fish Hatchery) operation and maintenance of a series of off-site refugia.

Permit Condition K of the ITP requires that "the support of the refugia will augment the existing financial and physical resources of these facilities, and provide supplementary resources for appropriate research activities, as necessary, to house and protect adequate populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques."

2013 Compliance Actions:
Beginning with the issuance of the EAHCP ITP in March 2013, the EAA began contract negotiations with the USFWS. Negotiations have continued over the remainder of 2013 and are ongoing.

Although contract negotiations are ongoing, the USFWS continues to provide research and refugia to a limited number of covered species. These activities have been historically provided by USFWS. USFWS has also begun salamander counts in both ecosystems and provides those data to the EAA on a regular basis (Appendix M).

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
It is expected the EAA will enter into a contract with the USFWS for the remaining term of the EAHCP ITP for the purpose of providing funds for the implementation of a series of refugia. There are three separate facilities that the USFWS will use to provide refugia: the San Marcos Aquatic Resource Center, the Uvalde and Inks Dam National Fish Hatcheries.

Consistent with the intent of Permit Condition K of the ITP, the EAA continues to undertake efforts to negotiate a refugia contract with the USFWS. The USFWS will use funding under the contract to increase personnel, enhance facilities, conduct life-cycle research, and provide refugia for the covered species identified in the EAHCP ITP.

3.1.2 Voluntary Irrigation Suspension Program Option (VISPO) (EAHCP §5.1.2)

The VISPO is a voluntary springflow protection program designed to compensate irrigation Permittees for not pumping from the Edwards Aquifer during certain drought conditions. Participants may enroll in a 5-year or 10-year option. Enrollment commits the Permittee to suspending all pumping activities for one calendar year if, on the previous October 1 trigger date, the aquifer level at the J-17 index well is at or below 635 feet (ft) mean sea level (msl). Participants are paid a stand-by fee for their involvement in the program annually, and compensated an additional, higher, payment in years where water suspension is mandated by the terms of the forbearance agreements.

Obligations:
Pursuant with Section 5.1.2 of the EAHCP, the EAA is responsible for administering the VISPO. The goal for this program is 40,000 acre-feet of enrolled EAA-issued irrigation permits. The target distribution for enrollment is 10,000 acre-feet/year in Atascosa, Bexar, Comal, and Hays counties and 15,000 acre-feet/year each in Medina and Uvalde counties. This program accepts both Base and Unrestricted Irrigation Groundwater.

2013 Compliance Actions:
Enrollment for the VISPO was open from December 2012 through October 1, 2013. Irrigators have two program options; a five-year program and a ten-year program; that provide the following payment schedules:

- Five-year program:
    - standby fee of $50/acre-foot that increases 1.5% per year;
    - suspension fee of $150/acre-foot that also increases 1.5% per year.
- Ten-year program:
    - standby fee of $57.50/acre-foot for years 1-5 and a step-up to $70.20/acre-foot for years 6-10;
    - suspension fee of $172.50/acre-foot for years 1-5 and a step-up to $210.60/acre-foot for years 6-10.

The EAA acquired 22,427 acre-feet of enrolled water in 2013 (Table 3-2).

Table 3-2. VISPO Enrollment 2013

County	Acre-Feet Enrolled	% of Goal
Atascosa	0	18.01% (of 10,000 ac-ft)
Bexar	1,678	
Comal	0	
Hays	123	
Medina	9,343	62.28% (of 15,000 ac-ft)
Uvalde	11,233	74.88% (of 15,000 ac-ft)
Total Enrollment	22,378	55.94% (of 40,000 ac-ft)

Modifications Due to Drought Conditions:
At this point, the perceived impact of drought does not warrant suggesting or making any changes to the operation or implementation of the VISPO. However, in the first year of enrollment, drought appears to have impacted VISPO enrollment in two very different ways.

First of all, the drought appeared to have had a dampening effect on the VISPO enrollment. 2013 began with Stage I drought restrictions (20%) in place. Aquifer levels declined slowly, but steadily and by mid-March Stage II restrictions (30%) were imposed. A heavy rainfall event around Memorial Day caused aquifer conditions to rebound briefly to Stage I conditions, before returning to Stage II around July 1 and then dropping to Stage III (35%) by August 1. It appears that the newness of the program and the persistent drought and lowering aquifer conditions caused potential participants to take a cautious approach during the middle of the year.

However, as the VISPO was better understood and with declining aquifer conditions and the very real possibility of triggering condition on October 1, there was a very significant spurt of enrollment at the end. A VISPO status report was prepared on September 11 for the September 19 Implementing Committee meeting showing a total enrollment of 12,191 acre-feet. Yet on October 1, only three weeks later, the final enrollment was 22,378 acre-feet, a 45% increase.

Aquifer conditions on October 1, 2013 were above 635 ft msl, so the VISPO did not trigger for the 2014 calendar year.

Proposed Activities for 2014:
In 2014, the EAA will continue to enroll voluntary participants into the VISPO. Since 2014 is not a trigger year, stand-by payments will be made in March to all participants who enrolled prior to October 1, 2013.

3.1.3 Regional Water Conservation Program (EAHCP §5.1.3)

The Regional Water Conservation Program (RWCP) was included in the EAHCP to provide an opportunity for Edwards Aquifer Permittees not currently engaged in conservation programs to be provided a mechanism for implementing water conservation to off-set their current levels of pumping. This program creates opportunities for municipal and industrial Permittees as well as exempt well owners.

Obligations:
Pursuant to Section 5.1.3 of the EAHCP, the goal of the RWCP is to conserve 20,000 acre-feet of permitted or exempt Edwards Aquifer water. Of this amount, 10,000 acre-feet will be held by the EAA in a groundwater trust where it will remain un-pumped for the term of the ITP to reduce stress on the aquifer. The other 10,000 acre-feet conserved will remain available for the participating entity. To show that this measure is reasonably certain to occur, the EAA is to obtain 'initial commitments' in the amount of 10,000 acre-feet/year starting in 2013, to be returned to the committing entity as additional conserved water is obtained from third-parties to off-set the initial commitment. At present SAWS, Texas State University, and San Marcos have made initial commitments in the amount of 8,400 acre-feet/year.

To achieve these goals, the RWCP will include the following programs:

- Lost Water and Leak Detection
- High-Efficiency Plumbing Fixtures and Toilet Distribution
- Commercial/Industrial Retrofit Rebate
- Water Reclamation

2013 Compliance Actions:
The goal for 2013 was to obtain initial commitments, and to fully develop and begin implementation of the four individual elements of the Regional Water Conservation Program: Lost Water and Leak Detection; High Efficiency Plumbing Fixtures and Toilet Distribution; Commercial Industrial Retrofit Rebate; and Water Reclamation for Efficient Water Use. The first year of the RWCP, which began January 1, 2013, was primarily dedicated to putting into place all program elements.

2013 Activities:

- The EAA entered into an Interlocal Cooperation Agreement with Texas AgriLife to manage and implement the RWCP (Appendix O).
- Texas AgriLife represented the EAA to assist Edwards Aquifer region water users in implementing the incentive programs described in the EAHCP.
- As part of the implementation of the RWCP, the EAA continued to meet the obligations described in the U.S. Bureau of Reclamation SMART Grant which is funded through September 2014 (Appendix O).
- The EAA entered into Initial Commitment Contracts with SAWS, the City of San Marcos, and Texas State University whereby these three Permittees "loaned" 8,400 acre-feet/year of conserved water to the RWCP to immediately establish the Groundwater Trust as prescribed in the EAHCP, until the loaned water can be off-set by new water savings.
- Texas AgriLife completed a priority matrix of communities in the Edwards Aquifer region identified for assessment (Appendix O).
- Texas AgriLife contacted communities from the matrix, identifying the first three municipalities willing to allow Texas AgriLife to conduct a water conservation assessment of their water system.
- Texas AgriLife completed assessments on three communities: Uvalde, Universal City, and Leon Valley (Appendix O).
- The EAA negotiated and entered into a contract with Moore Supply Company for the purchase of low-flow, high efficiency plumbing fixtures and delivery to water purveyors participating in the RWCP, taking advantage of volume pricing on the fixtures (Appendix O).
- The EAA negotiated and entered into an Interlocal Cooperation Contract with the City of Uvalde to implement identified water conservation projects in the City of Uvalde and Uvalde County (Appendix O).
- The EAA negotiated with the City of Universal City to contract for the implementation of identified water conservation projects in the City of Universal City. These negotiations are on-going.
- Texas AgriLife developed informational RWCP presentations, flyers, and articles, as well as installation certificates, forms, and procedures necessary for implementing the RWCP elements.
- Texas AgriLife assisted the City of Uvalde in beginning implementation of their water conservation measures.
- Texas AgriLife began contacting additional communities and scheduling assessments to be conducted in 2014.

- Texas AgriLife enlisted the support of the Texas AgriLife Extension Agents in Bexar, Comal, Hays, Medina, and Uvalde Counties in reaching out to Edwards Aquifer exempt well users and informing them about the available RWCP opportunities.
- Texas AgriLife conducted training on the EAHCP and the RWCP for Agriculture & Natural Resources and Family & Consumer Science Extension Agents at multiple AgriLife Extension events.
- Texas AgriLife presented information and provided flyers on the EAHCP and the RWCP to Edwards Aquifer exempt well users at "Water Day" in Medina and Uvalde Counties and at "Well Owner Training" in Hays and Uvalde Counties.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, activities directed at achieving the remaining 1,600 acre-feet/year needed to meet the goal of 10,000 acre-feet/year established by the initial commitments made by SAWS, the City of San Marcos, and Texas State University will continue as in 2013.

Specifically, EAA staff, and their contractor Texas AgriLife, will:

- Continue to work with the City of Uvalde to find additional opportunities for reducing the use of the Edwards Aquifer;
- Finalize a contract with the City of Universal City to implement a conservation program;
- Negotiate and finalize a contract with the San Antonio Zoo to replace aging infrastructure, capture air conditioner condensate, and harvest rainwater runoff;
- Contact large municipalities to discuss participating in a high efficiency, low-flow plumbing program;
- Continue to reach out to communities in the EAA jurisdictional area and determine their willingness to participate in the RWCP; and
- Identify other opportunities to place water in the Trust.

3.1.3.1 *Regional Water Conservation Plan Monitoring Committee*

The EAA is responsible for coordinating the RWCP Monitoring Committee. This committee was convened in 2012 to help assist in the development of the 2013 RWCP Annual Work Plan and the selection of a contractor to implement the RWCP. Representation on the Monitoring Committee includes one representative each from SAWS, the City of New Braunfels, the City of San Marcos, and a small water purveyor utilizing the Edwards Aquifer. It is the responsibility of this Committee to advise the EAA on the efficiency and significance of RWCP activities, to consider each activity in the context of achieving the overall EAHCP goal for the RWCP, to make specific recommendations regarding program implementation, and to develop periodic updates tracking the progress of the program.

The Regional Conservation Monitoring Committee, as prescribed in the EAHCP, met once in 2013; the agenda and minutes for this meeting is included as Appendix O. At this meeting, the Committee received presentations on the Interlocal Cooperation Agreement with Texas AgriLife, the 2014 RWCP Work Plan, the Community Prioritization Matrix, and the draft Universal City and Uvalde Assessment Reports and Proposed Implementation Plans. The Committee provided comments on the Work Plan and the Universal City and Uvalde Reports/Plans and recommended approval of the Prioritization Matrix and the

Assessment Reports/Implementation Plans. The Committee will meet again in early 2014 to receive a presentation on the Leon Valley Assessment Report and Proposed Implementation Plan and provide input.

3.1.4 Critical Period Management – Stage V (EAHCP §5.1.4)

Obligations:
By December 31, 2012, EAA will amend its Critical Period Management Program to add a new emergency Stage V reduction of 44 percent applicable in both the San Antonio and Uvalde pools. Stage V is designed to be triggered only when other measures have not proven sufficiently effective in maintaining springflow during drought conditions. For the San Antonio Pool, Stage V would be triggered by a combination of monthly average J-17 levels below 625 feet or springflows of either 45 cfs based on a ten-day rolling average at Comal Springs or 40 cfs based on a three-day rolling average. The Uvalde Pool would trigger Stage V using the Uvalde County Index Well (J-27) water level of 840 ft-msl.

2013 Compliance Actions:
On February 14, 2012, the Edwards Aquifer Authority Board of Directors approved the addition of Stage V emergency critical period reductions as provided in Tables 3-3 and 3-4 below. Stage V became effective on March 28, 2013, ten days following formal effectiveness of the ITP. On March 28, 2013, conditions warranted implementing Stage V reductions in the Uvalde pool.

Table 3-3. Critical Period Management Triggers, Stages, and Reductions for the San Antonio Pool of the Edwards Aquifer

Wells/Springs	Critical Period Stage I*	Critical Period Stage II*	Critical Period Stage III*	Critical Period Stage IV*	Critical Period Stage V**
Index Well J-17 Level (msl)	<660	<650	<640	<630	<625
San Marcos Springs Flow rate (cfs)	<96	<80	N/A	N/A	N/A
Comal Springs Flow rate)cfs)	<225	<200	<150	<100	<45** or <40**
Withdrawal Reduction	20%	30%	35%	40%	44%

* A change to a critical period stage with higher withdrawal reduction percentages, including initially into Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily Aquifer levels at the J-17 or J-27 Index Wells, as applicable, drop below the lowest number of any of the trigger levels for that stage. A change from any critical period stage to a critical period stage with a lower withdrawal reduction percentage, including existing from Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered only when the 10-day average of daily springflows at the Comal Springs and the San Marcos Springs and the 10-day average of daily Aquifer levels at the J-17 or J-27 Index Wells, as applicable, are all above the same stage trigger level.

** In order to enter into Critical Period Stage V, the applicable springflow trigger is either less than 45 cfs based on a ten-day rolling average or less than 40 cfs based on a three-day rolling average. Expiration of Critical Period Stage V is based on a ten-day rolling average of 45 cfs or greater."

Table 3-4. Critical Period Management Triggers, Stages, and Reductions for the Uvalde Pool of the Edwards Aquifer

Wells/Springs	Critical Period Stage I*	Critical Period Stage II*	Critical Period Stage III*	Critical Period Stage IV*	Critical Period Stage V*
Index Well J-27 Level (msl)	N/A	<850	<845	<842	<840
San Marcos Springs Flow rate (cfs)	N/A	N/A	N/A	N/A	N/A
Comal Springs Flow rate (cfs)	N/A	N/A	N/A	N/A	N/A
Withdrawal Reductions	N/A	5%	20%	35%	44%

* A change to a critical period stage with higher withdrawal reduction percentages, including initially into Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily Aquifer levels at the J-17 or J-27 Index Wells, as applicable, drop below the lowest number of any of the trigger levels for that stage. A change from any critical period stage to a critical period stage with a lower withdrawal reduction percentage, including existing from Stage I for the San Antonio Pool and Stage II for the Uvalde Pool, is triggered only when the 10-day average of daily springflows at the Comal Springs and the San Marcos Springs and the 10-day average of daily Aquifer levels at the J-17 or J-27 Index Wells, as applicable, are all above the same stage trigger level.

** In order to enter into Critical Period Stage V, the applicable springflow trigger is either less than 45 cfs based on a ten-day rolling average or less than 40 cfs based on a three-day rolling average. Expiration of Critical Period Stage V is based on a ten-day rolling average of 45 cfs or greater."

Modifications Due to Drought Conditions:
Due to the current drought in south central Texas, the EAA enforced critical period management cut-backs throughout most of 2013 in both pools of the Edwards Aquifer. Table 3-5 shows the number of days each pool spent in each stage of critical period cutbacks.

Table 3-5. 2013 Critical Period Management Enforced Reductions

CPM Stage	Total Days in Uvalde Pool	Total Days in San Antonio Pool
No CPM reduction	0	0
Stage I	0	96
Stage II	0	156
Stage III	3	113
Stage IV	83	0
Stage V	279	0
Total Reduction	41.8%	28.9%

Proposed Activities for 2014:
In 2014, the EAA will continue to enforce critical period management restrictions consistent with their Rules and as discussed in the EAHCP.

3.1.5 Expanded Water Quality Monitoring (EAHCP §5.7.2)

Obligations:
The EAA will continue its historical groundwater and surface water quality monitoring programs. In addition to historical monitoring, the EAA will add additional groundwater, surface water, and stormwater sampling in Landa Lake, the Comal River, Spring Lake, and the San Marcos River.

2013 Compliance Actions:
On January 1, 2013, the EAA's existing sampling program was expanded with the adoption of the EAHCP Section 5.7.2 to include collection of additional samples and sample types, in the immediate vicinity of Comal and San Marcos springs. The expanded water quality sampling program was developed in accordance with the directives of the EAHCP and provides a means for early detection of potential impairments to water quality within the Comal River and headwaters of the San Marcos River systems.

Modifications Due to Drought Conditions:
Sampling activities were minimally affected by the ongoing drought conditions in the area. No extreme low-flow sampling was initiated at wells (Sections 6.4.3.3 and 6.4.4.3 of the EAHCP) as flows at Comal Springs did not drop below 30 cfs, or below 50 cfs at San Marcos Springs. However, the ongoing drought made storm water sampling exceedingly difficult to perform. Rain events were generally scattered in nature and often too small in magnitude to result in sufficient runoff to sample.

Proposed Activities for 2014:
In 2014 the EAA will continue its historical water quality monitoring through the use of real-time stations. The EAA has contracted with SWCA Environmental Consultants (SWCA) to conduct the surface grab sampling, well sampling, stormwater sampling, and gore sampling in 2014. On April 3, 2013, the Science Committee reviewed the existing water quality program as conducted in 2013 and made recommendations for improvements in 2014. After discussion with EAA technical staff, some of these recommendations were incorporated into the 2014 Water Quality Program including the use of passive diffusion samplers and time restrictions for analyzing alkalinity samples to prevent degassing.

3.1.5.1 *Water Quality Data*

Water quality data are included in Appendix P – *Edwards Aquifer Habitat Conservation Plan Expanded Water Quality Monitoring Report December 2013*.

3.1.5.2 *Location of Sampling Sites*

Figure 3-1. Comal River water quality sampling sites.

Figure 3-2. San Marcos River water quality sampling sites.

3.1.5.3 *Methods for Data Collections and Variables Measured*

Surface Water

The preferred methods for obtaining a surface water sample are to either wade to the sample location and on the upstream side of the sampler (assuming stream is flowing), obtain field parameters (pH, specific conductivity, dissolved oxygen, and temperature) then insert the sample bottle directly into the water or utilize a sample bottle and pole assembly. In April 2013, EAA field staff utilized a retractable pole in order to obtain water quality samples from the Comal and San Marcos Springs complexes. Field parameters were collected first by inserting the appropriate probe into the surface water as close to the sample location as possible. Next, EAA field staff inserted a Teflon® beaker into the telescopic retractable pole and collected water samples. This process continued until all sample bottles were properly filled. However, during the October 2013 surface water sampling event, samples were collected in their respective containers directly from the surface water. Samples were collected in accordance with the criteria set forth in the *EAA Groundwater Quality Monitoring Plan.*

Sediment

Sediment samples were collected from the river bottom's surface to approximately 18 inches below the surface. Three to four samples were collected from each sample site by EAA staff in a sample tube using a Shelby sampler. Sediment samples from each site were individually homogenized at the contract laboratory prior to analysis. Sediment collection points included an area up to several feet in diameter, which varied based on the amount of available sediment at each location. The Shelby Sampler utilized one-inch diameter, 25-inch long plastic liners to contain the sediment collected within the probe. Laboratory analytical requirements dictated that a total of 48 linear inches of liner needed to be filled with sediment to have adequate volume for each sample. After extra head space was removed from the top the plastic liner, both ends were wrapped with laboratory film (Parafilm) before being capped with end pieces. Once 48 inches of sediments were collected, liners were individually labeled and bound together with Parafilm. Sediment samples were collected in accordance with the criteria set forth in the *EAA Groundwater Quality Monitoring Plan.*

Stormwater

Stormwater samples were collected across the storm-affected stream hydrograph at the rise, peak, and recession limb. In general, the turbidity and conductivity data from the real-time instrumentation (RTI) at each site were utilized as a surrogate for the stream hydrograph due to immediate availability of the data. Due to the inherently unsafe conditions associated with storm water flow, EAA field staff utilized a retractable pole when needed in order to safely obtain water samples during storm water sampling events. Field parameters were collected first by inserting the probe (from the YSI meters) as close to the sample location as possible (the probe was affixed in some instances to the retractable pole to insert the probe into the appropriate location). Next, EAA field staff utilized the telescopic retractable pole with a 500 mL Teflon® beaker attached to a stainless steel swivel at the end of the sampling pole to collect samples. After collecting each sample, water was transferred from the beaker into the appropriate sample bottle.

Real Time Instrumentation

The objective for implementing the use of RTI was to measure changes in basic water quality parameters in near real time. The RTIs record data at 15-minute intervals (or nearly continuous basis). As such, the instrumentation provides a mechanism for recording water quality changes related to season, time of day, weather, and various other influences. The instrumentation measures the following parameters.

- Dissolved oxygen (DO) in mg/L,
- pH (no units),
- Conductivity in micro-Siemens per centimeter (µS/cm),

- Turbidity in nephelometric turbidity units (NTU), and
- Temperature in degrees Celsius (°C).

The resulting data are stored locally on the instrument and also reported to and stored on a secure internet site. The data are subsequently downloaded monthly and permanently stored on the EAA computer network and can be accessed via the internet at: http://www.eahcp.org/index.php/supporting/water_quality_and_protection.

Table 3-6. Analytical Parameters by Sample Type

Analytical Parameter	Surface Water (Base Flow) Samples	Sediment Samples	Stormwater Samples
Volatile Organic Compounds (VOCs)	Yes	Yes	Yes
Semi-volatile Organic Compounds (SVOCs)	Yes	Yes	Yes
Organochlorine Pesticides	Yes	Yes	Yes
Polychlorinated Biphenyls (PCBs)	Yes	Yes	Yes
Herbicides	Yes	Yes	Yes
Metals (Al, Sb, As, Ba, Be, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, and Zn)	Yes	Yes	Yes
General Chemistry (GWQP) Total Alkalinity (as CaCO3), Bicarbonate Alkalinity (as CaCO3), Carbonate Alkalinity (as CaCO3); (Cl, Br, NO3, SO4, Fl, pH, TDS, TSS, Ca, Mg, Na, K, Si, Sr, CO3,)	Yes	No: TDS or TSS	Yes
Phosphorus (total)	Yes	Yes	Yes
Total Organic Carbon (TOC),	Yes	Yes	Yes
Dissolved Organic Carbon (DOC)	Yes	Yes	Yes
Total Kjeldahl Nitrogen (TKN)	Yes	No	Yes
Bacteria (E. Coli)	Yes	No	Yes
Field Parameters (DO, pH, Conductivity, Turbidity, Temperature)	Yes	No	Yes

3.1.5.4 *Frequency, Timing, and Duration of Sampling for the Variables*

Surface water quality grab samples were collected biannually from five sites throughout the Comal Springs complex and seven sites throughout the San Marcos Springs complexes. According to the EAHCP work plan, the sample dates were to be six months apart.

Sediment samples were collected once annually at five sites for the Comal Springs complex and seven sites for the San Marcos Springs complex. Locations were generally coincident with surface water samples at each of the spring complexes.

Stormwater samples were collected twice annually from each spring complex. Storm water samples were collected when rainfall amounts were adequate to initiate a significant rise at the respective USGS gauging locations for each spring complex.

3.1.5.5 *Description of the Data Analysis*

Samples were analyzed for parameters of interest by the contracted laboratory TestAmerica. EAA staff evaluated the results of the laboratory's analysis by sample type and applicable standards:

Surface Water
Regulatory standards for surface water quality vary dependent upon type of use. For this report, surface water results are compared to drinking water quality standards (30 TAC, Chapter 290, Subchapter F) for detected constituents of concern. These guidelines were selected for use since in general they provide the most stringent quality standards. For detections of interest that do not have an established maximum contaminant level (MCL) under 30 TAC 290, the Texas Risk Reduction Program (TRRP) from 30 TAC 350 was substituted. The TRRP standards used are the Tier I, residential standards and are referred to as protective concentration levels (PCL). Other guidelines may be more useful or appropriate for particular research; however, for the scope of this report these standards provide an appropriate and applicable guideline with regard to water quality.

Sediment
Analytical results for sediment samples are compared to the sediment quality guidelines published in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald et al. 2000). These guidelines are based on determination of probable sediment toxicity in freshwater ecosystems and provide a numerical sediment quality guideline for 28 chemicals of concern. The guidance provides two basic standards for comparison: 1) Threshold effect concentration (TEC), and; 2) Probable effect concentration (PEC). Analytical results with a concentration below the TEC are predicted to have no toxic effect on sediment dwelling organisms, while results with concentrations above the PEC have a higher probability of having a toxic effect on sediment dwelling organisms. Detected compounds with concentrations between the TEC and PEC are considered equally likely to be toxic or non-toxic. While numerous other guidelines for sediment quality exist, these guidelines provide a good reference for the scope of the current investigation. Future researchers may find other guidelines, more specific to particular concerns or interest, more applicable.

Stormwater
As previously mentioned, standards for surface water quality vary dependent upon type of use. For this report, storm water results are compared to drinking water quality standards (30 TAC, Chapter 290, Subchapter F) for detected chemicals of concern. These guidelines were selected for use since in general they provide the most stringent quality standards. For detections of interest that do not have an established MCL under 30 TAC 290, the TRRP from 30 TAC 350 was substituted. The TRRP standards used are the Tier I, residential standards and are referred to as PCLs. Other guidelines may be more useful or appropriate for particular research; however, for the scope of this report these standards provide an appropriate and applicable guideline with regard to water quality.

3.1.5.6 *2012 Hydrological Report*

The EAA 2012 Hydrological Data report is included as Appendix Q.

3.1.6 Biological Monitoring (EAHCP §6.3.1, §6.4.3, and §6.4.4)

The purpose of the biological monitoring program is to provide a means of monitoring changes to habitat availability and the population abundance of the Covered Species that may result from the covered activities included in the EAHCP.

Obligations:
Pursuant to Section 6.3.1 of the EAHCP, the EAA will continue its biological monitoring program (formerly known as the Variable Flow Study) initiated in 2000. In addition to the historical program, the following additional efforts will be added to comply with the EAHCP:

- Additional sampling efforts will be added during critical periods.
- Additional sampling for two new species, the Texas Cave diving beetle and the Texas troglobitic water slater.
- Additional nutrient testing will be conducted.
- Any additional changes as required by natural changes occurring in the system and determined appropriate through the Adaptive Management Process.

The biological monitoring program also includes the triggered monitoring activities outlined in Sections 6.4.3 and 6.4.4 of the EAHCP. Triggered monitoring, as outlined in these sections, requires additional sampling and vegetation mapping activities not originally anticipated in the Variable Flow critical period sampling program. Documents related to the implementation of the Biological Monitoring program can be found in Appendix R.

Modifications Due to Drought Conditions:
Critical Period monitoring in the Comal system was triggered by drought conditions in August of 2013, and critical period monitoring activities began on August 9, 2013. Springflow levels required continued critical period monitoring for 12 weeks from August through November, and one flood event report following heavy rainfall in late October. Copies of these reports can be found in Appendix R.

Proposed Activities for 2014:
In 2014, the EAA will continue to implement the biological monitoring program consistent with the requirements outlined in the EAHCP.

3.1.7 Groundwater Modeling (EAHCP §6.3.2)

Obligations:
By December 31, 2014, the EAA will (1) take appropriate steps to reduce the level of uncertainty in the MODFLOW model by filling in the data gaps to the extent practicable and by reducing the number of structural limitations in the model, and (2) create a new finite-element model to reduce uncertainty in the model results for use during the Adaptive Management Process and to provide assurance/confirmation that modeling results for the Aquifer and springflows are more reliable and defensible.

2013 Compliance Actions:

<u>MODFLOW Model</u>

Significant progress was made to update the MODFLOW model during 2013. The original model was calibrated using input data for years 1947 through 2000; it relied on a limited set of observation wells for water-level calibration targets; and pumping locations and rates had to be estimated because detailed pumping records were not available for most of the 64-year simulation period. While the 2004 MODFLOW model does a generally good job of predicting water levels at index well J-17 and spring flows at Comal and San Marcos springs, these limitations and data gaps add uncertainty to model predictions.

To reduce the level of uncertainty in accordance with the EAHCP, EAA staff completed several important tasks to reduce data gaps. First the staff conducted what it calls a MODFLOW Model Functionality Test. This test included the following steps:

- Additional water level data were compiled for wells within the model domain. The number of water-level measurement locations was increased from 286 wells in the original model to 1,540 locations for the period from 1947 to 2000.
- The model was then run without making any other changes to the input data and the model-predicted water levels were then compared to the measurements and the additional target water level locations.
- Areas of the model where computed water levels were significantly different from observations were identified so that model updates can focus on the specific areas of the model that are producing the greatest errors.

Following the MODFLOW Model Functionality Test, the EAA modeling team completed the MODFLOW Verification Test. The purpose of the Verification Test was to run the original model using input recharge and pumping data for years 2001 through 2009. Since the original model was calibrated using input pumping and recharge estimates for years 1947 through 2000, the model could then be "verified" by seeing how well the computed water levels and spring flows match observations for the subsequent nine years. Completion of the Verification Model proceeded as follows.

- Representation of pumping withdrawals was improved by individually specifying locations and monthly pumping rates at 4,851 individual well locations. This advancement significantly reduces the uncertainty related to groundwater pumping in the model.
- A monthly recharge input data set was developed using estimates obtained from the USGS and adjusted using the same methodology described for the 2004 model.
- Observations of water levels and springflows were compiled for 423 well and 7 spring locations for comparison to model-computed water levels and springflows. The number of continuously monitored well locations has increased significantly in the past decade
- The model was then set to begin with initial conditions determined from the last time step of the original model, which reflect the modeled conditions on December 31, 2000, and run using monthly time steps for the years 2001 through 2009.
- Results of the initial Verification Model run showed that model results are particularly sensitive to the initial conditions and the distribution of recharge in the model.
- Adjustment of model initial conditions and recharge resulted in some improvement to the model match to observations.
- Model results were evaluated for all water level and spring flow target locations and numerous sensitivity analyses were conducted.

Finite-Element Model

A three-year contract to develop a finite-element (FE) groundwater model was initiated with Southwest Research Institute in March 2012. An advantage of the FE method compared to the finite-difference method used in the MODFLOW model is that it permits an irregular grid that can be refined in areas of geologic complexity and element interfaces can be oriented in any direction.

Another significant change from the MODFLOW model approach is that the FE model domain will be significantly expanded to include the contributing zone. This expanded model domain will allow the testing of different conceptual models for recharge that may occur initially in the Trinity Aquifer to the north, but then flow laterally underground into the Edwards Aquifer.

The first major milestone of the FE model contract was to develop a three dimensional hydrogeologic framework model (HFM) to represent the hydrostratigraphy of the regional model. The HFM was completed in August 2013. The HFM will be used to define layer thicknesses and offsets along major faults, which will be incorporated into the numerical flow model.

Other major activities included reviewing all available literature and data, conducting field work, and performing technical analyses to support and update the overall conceptual model for the Edwards Aquifer. These reviews and analyses included:

- Review of tracer studies and analysis of groundwater geochemistry to improve understanding of potential groundwater flow directions and mixing of waters from different formations
- Evaluation of streamflow gain and loss studies and collection of new gain/loss data in selected streams within the contributing zone to better understand recharge to the Trinity Aquifer that eventually flows underground into the Edwards Aquifer.
- Analyses of the relationship between precipitation and distributed recharge in the contributing zone.
- Field studies and water balance analyses to evaluate the quantity of water that may leave the Edwards Aquifer via underground discharge into the Leona Gravel deposits, which is not accounted for in the current MODFLOW model.
- A study of geophysical and streamflow data to reevaluate the quantity of recharge that may be occurring from Medina Lake and Diversion Lake in the Medina River basin.
- Analysis of the connectivity of the Kinney Pool of the Edwards Aquifer with the Uvalde Pool.

These analyses resulted in development of an updated overall conceptual model for a water balance of flows into, out of, and between the Kinney, Uvalde, and San Antonio Pools of the Edwards Aquifer. This updated conceptual model will help to guide the development and calibration of the numerical finite-element model.

Development of a working finite-element numerical model is in its early stages at the end of 2013. An initial finite-element mesh was constructed and initial steady-state and transient model runs are ongoing.

Proposed Activities for 2014:
EAA staff is presently making revisions to the MODFLOW model based on the lessons learned from the Functionality Test and Verification model and improvements in knowledge about the underlying conceptual model that have been gained in the past decade. Model development progress is on track to be completed before the December 31, 2014 date specified in the EAHCP.

Further refinement of the finite-element numerical model and a transient calibration will be the main focus of activities for year 2014. Completion of the calibrated transient model is on schedule for completion by the December 31, 2014 date specified in the EAHCP.

3.1.8 Ecological Modeling (EAHCP §6.3.3)

Obligations:
The EAA will oversee the development of a predictive mechanistic ecological simulation model that will be used to predict the effectiveness of various mitigation and minimization activities and will inform the Adaptive Management Process. The model should be able to:

- simulate the dynamics of aquatic and terrestrial ecosystems, and model the inter-connectivity of the two systems;
- simulate the relationships between animals, plant, hydrological, climatic, and management variables;
- link to groundwater models to conduct simulations representing the integration of groundwater and surface water;
- be improved and modified without too much effort as more information becomes available and assumed functions and relationships are improved;
- be utilized by most commercially available computer systems with a user-friendly platform so that new staff and researchers involved in the process can easily be trained to run model simulations and interpret the results; and
- generate accurate results when verified against field studies.

2013 Compliance Actions:
After an extensive proposal review process, EAA entered into a contract with BIO-WEST, Inc. (BIO-WEST) in June 2013 to coordinate the initial development of predictive ecological models for the Comal and San Marcos Spring/River ecosystems. In addition to its own staff expertise, BIO-WEST assembled a team of experts that includes faculty and staff members from Texas A&M University, Texas State University, Baylor University, Watershed Systems Group, and the U.S. Army Corps of Engineers (USACE) Environmental Laboratory. The scope of work for the ecological modeling project identifies six tasks: (1) Literature Review, (2) Data Acquisition, (3) Modeling, (4) Recommendations for Future Work, (5) Draft and Final Reports, and (6) Meetings and Presentations.

Significant progress was made on the literature review for Task 1, which focused on reducing information deficiencies related to two key EAHCP issues: (1) fountain darter food source (aquatic macroinvertebrates) dynamics and response, and (2) Comal Springs riffle beetle response to extreme low flow conditions.

For the fountain darter food source, a variety of modeling approaches for aquatic macroinvertebrates was found that ranged from data intensive approaches employing Bayesian Belief Networks and Artificial Neural Networks to more mechanistically based models. Two mechanistically based modeling approaches were identified that are potentially adaptable to meet the EAHCP modeling requirements. The first approach, developed by Schuwirth and Reichert (2013), combines concepts of theoretical food web modeling, the metabolic theory of ecology, and ecological stoichiometry with the use of functional trait databases to predict the coexistence of invertebrate taxa in streams. It is a mechanistic model that describes growth, death, and respiration of different taxa dependent on various environmental influence factors to estimate survival or extinction. Parameter and input uncertainty are propagated to model results.

The second approach for modeling fountain darter food source, developed by Gertseva et al. (2004), is constructed based on functional feeding groups comprised of: shredders, scrapers, collectors and predators. Therefore, the model includes four blocks, each of which corresponds to a functional feeding group within the community.

No specific modeling approaches were identified in the literature for the Comal Springs riffle beetle or riffle beetles in general. However, important life history and general ecology information has been used to develop influence diagrams that might form the basis of a modeling approach.

These existing influence diagrams can provide a basis for developing either a Bayesian Belief Network or a Fuzzy Logic model as a mathematical framework within which probabilistic reasoning based on uncertain and varying data can be utilized to infer potential system responses to physical, chemical, or biological conditions. This approach may be ideally suited for the initial modeling of the Comal Springs riffle beetle given the lack of existing models and the ability to formulate the probabilities based on expert judgment. A final decision on the specific modeling approach to be taken is anticipated towards the end of year 2014.

Tasks 2 and 3 of the ecological modeling contract involve gathering of data and development of models. The modeling task and associated data gathering, represents the majority of work to be done under the contract. Four separate modeling tasks are identified.

- Task 3.1, modification of existing aquatic vegetation models developed by the USACE Aquatic Plant Control Research Program.
- Task 3.2, review available input data and potentially update the existing fountain darter response/dynamics model.
- Task 3.3, simulate the characteristics of Texas wild rice using the modified models identified in Task 3.1.
- Task 3.4, develop model structure and associated model parameters to evaluate the response/dynamics of gill parasites and non-native host snails to projected flow conditions.

These modeling activities are still in the stages of data mining and reviews to ensure all available information sources are considered prior to final model development and implementation.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
The current contract and activities related to Ecological Modeling in 2013 will extend into 2014. Once all current ongoing tasks are completed, the EAA will work with the Implementing and Science Committees to develop a new scope of work to identify specific deliverables for 2014. According the Technical Memorandum developed by BIO-WEST and Watershed Systems Group, Inc. President Dr. Thom Hardy on December 14, 2012, 2014 activities will likely include a combination of model development, calibration, and validation for the assorted issue specific models.

3.1.9 Applied Research (EAHCP §6.3.4)

The applied research program of the EAHCP is designed to expand the understanding of how the covered species interact with their environments given varied flow conditions. The applied research program is designed to provide data to support the development of the ecological model.

Obligations:
The EAA is responsible for support and coordination of the development of an applied research facility at the San Marcos Aquatic Research Center that includes experimental channels for use during research

activities. The EAA will enter into contracts for the completion of applied research at this facility. The EAHCP identifies three tiers of targeted research for this program, summarized in Table 3-7.

Table 3-7. Applied Research as Outlined in §6.3.4.2 and §6.3.4.3 of the EAHCP

Tier	Research Activity
Tier A – Fountain Darter Habitat and Food Supply and Comal Springs Riffle Beetle Habitat Associations and Movement	Low-Flow Effects on Native Aquatic Vegetation
	Low-Flow Effects on Macro Invertebrates
	Effects of Low-Flows on Comal Springs Riffle Beetle Movement
	Extended Low-Flow Period Effects on Comal Springs Riffle Beetle
	Test Spring Run Connectivity
Tier B – Direct Impacts to Covered Species	Low-Flow Effects on Fountain Darter Movement, Survival, and Reproduction
	Low-Flow Effects on Comal Springs Riffle Beetle Survival and Reproduction
Tier C – Testing Repeat Occurrences of Low-Flows or a Combination of Effects	System Memory
	Ecological Model Validation
Additional Studies	Aquatic Vegetation and Restoration and Non-Native Plant Removal • Evaluate transplant methodologies for various types of native aquatic vegetation • Evaluate the success of transplants over extended time periods • Evaluate methodologies for removal of non-native plants • Track maintenance required to keep non-native species from re-establishing
	Old Channel ERPA • Evaluate the need for channel manipulation for the enhancement of fountain darter habitat in the Old Channel (§5.2.2.1 of the EAHCP)

The Permittees shall consult with the Science Committee in the development of methodologies and anytime unforeseen conditions or challenges arise during experimentation for all applied research activities. Additional applied research activities may be conducted as deemed necessary and appropriate through the Adaptive Management Process.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the following applied research projects will be conducted:

- Tier A (Extended Low-Flow Effects on Comal Springs Riffle Beetle): Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low Flow Study
- Tier A (Extended Low-Flow Effects on Comal Springs Riffle Beetle): Extended low-flow period effects on Comal Springs Riffle Beetles Study
- Tier A (Test Spring Run Connectivity and Baseline Study): Study to Establish Comal Springs Riffle Beetle Baseline Population Distribution and Refine Riffle Beetle Collection Methods
- Tier B (Low-Flow Effects on Fountain Darter Movement, Survival and Reproduction): Effects of Low Flow on Fountain Darter Fecundity Study
- Tier B (Low-Flow Effects on Fountain Darter Movement, Survival and Reproduction): Effects of Predation on Fountain Darter Population Size at Various Flow Rates Study

- Tier B (Low-Flow Effects on Fountain Darter Movement, Survival and Reproduction): Effects of Vegetation Decay and Water Quality Deterioration on Fountain Darter Movement Study

3.1.10 Program Management (Funding and Management Agreement)

Per Section 2.2 of the FMA, the EAA "has responsibility for the general management and oversight of the program, subject to the duties and responsibilities held solely or jointly by the other [Permittees], in accordance with the terms of the Program Documents;"); and §5.6.5 of the FMA allows for use of EAHCP funds to fund EAA administrative costs and employee salaries, so long as all incurred costs and salaries are 100% related to "general management and oversight" of the EAHCP.

Part of this responsibility includes facilitating the employment of the Program Manager. The Program Manager is immediately responsible for managing the EAHCP program and ensuring compliance with all relevant program documents. Through early August 2013, Robert L. Gulley served as the Program Manager; following his retirement, Nathan Pence was appointed as the interim Program Manager until September when he was officially promoted by the EAA to that position. On October 17, 2013, the Implementing Committee voted unanimously in support of Resolution and Order No. 10-13-001 indicating their support of the selection of Nathan Pence as the Program Manager.

Select Program Management activities that were completed in 2013 include:

- The EAHCP staff successfully facilitated the budgeting process and financial duties as assigned by the FMA. Upon issuance of the ITP in March of 2013, staff established the EAHCP Budget and provided guidance and forms to the Permittees to be able to expend against the EAHCP budget. Staff tracked the budget throughout 2013, providing monthly updates to the Implementing Committee and timely reimbursement to the Permittees. This process included managing and tracking 30+ contracts.
- Staff successfully coordinated the 2014 budget process, including the timely approval of: 1) 2014 work plans from all Permittees, 2) funding applications from EAA, City of New Braunfels, City of San Marcos, and Texas State University, 3) and Interlocal Funding Contracts for reimbursement with City of New Braunfels, City of San Marcos, and Texas State University. Additionally, staff assisted EAA staff with getting all necessary budget items approved by the EAA Board of Directors.
- Staff successfully facilitated meetings and activities of the Science Committee during 2013.
- Staff coordinated the City of New Braunfels, the City of San Marcos, and Texas State University acquisition of secondary permits: including: United States Army Corp of Engineers Nationwide 27 Permits, Texas Parks and Wildlife Public Stocking, Exotic Species, and Sand & Gravel permits, and Texas Historical Commission (THC) permits.
- Staff successfully facilitated negotiations between the National Academy of Sciences and the EAA for the development of the SRP.
- In early 2013, the EAHCP staff contracted with Wyatt McSpadden to conduct a series of baseline photographs in San Marcos and New Braunfels. EAHCP staff will continue to photograph the progress of the restoration activities in the cities including annual baseline photos for future years.

3.2 CITY OF NEW BRAUNFELS

The City of New Braunfels has authority over the ecosystems of Comal Springs, Landa Lake, and the Comal River within its geographical boundaries. These ecosystems are used for recreational and surface

water diversions that are authorized by the State. A summary of covered activity categories for the City of New Braunfels under this EAHCP include 1) recreational activities within the City's jurisdiction, 2) the management of the ecosystems of the Comal Springs, Landa Lake, and Comal River, 3) the diversion of water from the Comal River, and 4) the minimization and mitigation measures that the City will either implement or have responsibility for implementation. This section specifically addresses the City's minimization and mitigation measures by describing A) the City's obligations; B) physical actions and activities conducted in 2013; C) any modifications that may have occurred relative to the 2013 drought; D) challenges encountered and implemented solutions; and E) whether 2013 activities were in compliance with the EAHCP and ITP, and; E) planned activities for 2014.

3.2.1 Flow-Split Management in the Old and New Channel (EAHCP §5.2.1)

Obligations:
The City of New Braunfels will control the flows entering the old and new channels of the Comal River using the culverts and valves between Landa Lake and the Comal River. The purpose of this activity is to maintain optimal habitat conditions for the listed species under varying total flow conditions in the system per the flow-split management plan. The optimal target flow rate is between 40 and 80 cfs to the Old Channel. Table 5-3 of the EAHCP describes in detail the flow-split goals for the Comal River.

2013 Compliance Actions:
As described in the EAHCP, the first charge under this measure is for the City of New Braunfels to replace and repair existing gates and control mechanisms to restore the operability of water paths to the Old Channel from Landa Lake. This repair will allow for the manipulation of water flow per the flow split strategy in Table 3-8 and the prevention of sustained high flows in the Old Channel that result in scouring.

In 2013, the City, through their engineering contractor, completed an assessment of all existing structures as well as design services necessary to facilitate a construction bid. A full set of plans was developed and submitted for bid in fall 2013. Based on that bid package, a contractor was hired in late 2013 to conduct the necessary repairs starting in early 2014. For complete documentation on the 2013 activities and results, refer to the Comal River Flow Split Management Pre-Design Memorandum included in Appendix V.

Figure 3-3. Locations of culverts for flow-split management (HDR 2013).

Table 3-8. Old Channel Flow Targets (Table 5.3, EAHCP 2011)

FLOW-SPLIT MANAGEMENT FOR OLD AND NEW CHANNELS				
Total Comal Springflow (cfs)	Old Channel (cfs)		New Channel (cfs)	
	Fall, Winter	Spring, Summer	Fall, Winter	Spring, Summer
350+	80	60	270+	290+
300	80	60	220	240
250	80	60	170	190
200	70	60	130	140
150	60		90	
100	60		40	
80	50		30	
70	50		20	
60	40		20	
50	40		10	
40	30		10	
30	20		10	

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will complete repairs on the culverts between Landa Lake and the New and Old channels, making them operational to manage flows.

3.2.2 Native Aquatic Vegetation Restoration and Maintenance (EAHCP §5.2.2)

Obligations:
The City of New Braunfels will implement native aquatic vegetation restoration in the Comal River. This will be done by systematically removing invasive vegetation from the stream bed and replacing it with native vegetation suitable for fountain darter habitat. The City will additionally undertake small channel modifications to improve habitat, including the removal of a sediment island in the Old Channel downstream from Landa Lake. These activities will be targeted in the Old Channel Environmental Restoration and Protection Area (Old Channel ERPA).

The City of New Braunfels will determine areas with potential to support fountain darters between the Last Tubers Exit and the confluence of the Guadalupe River. This will involve designation of permanent access points, improved aquatic vegetation, and ongoing monitoring of restored and existing habitat zones.

It is expected that activities related to native aquatic vegetation restoration will require continued annual maintenance to achieve the most successful program possible. The City of New Braunfels will regularly monitor and enhance new and existing habitat areas within the Comal River. Fountain darter habitat goals as outlined in Table 4-6 of the EAHCP are summarized in Table 3-9.

Table 3-9. Fountain Darter Habitat Goals (area in m^2)

Study Reach	Bryophytes	Hygrophila	Ludwigia	Cabomba	Sagittaria	Filamentous Algae	Vallisneria
Upper Spring Run	1,850	650	150		600		
Landa Lake	4,000	250	900	500	1,250		13,500
Old Channel	150	200	1,500			300	
New Channel	150	1,350		350			
Total	**6,150**	**2,450**	**2,550**	**850**	**1,850**	**300**	**13,500**

2013 Compliance Actions:
In 2013, the City of New Braunfels utilized a contractor to develop and implement an aquatic vegetation restoration plan for Landa Lake and the Old Channel of the Comal River. The plan established a framework for conducting native aquatic vegetation restoration within key, sustainable reaches of the Comal River by planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal. The goal of this restoration program is to improve and increase habitat of the federally listed endangered fountain darter.

Once the restoration plan was in place, restoration efforts including native vegetation propagation and restoration planting in the Landa Lake and Old Channel Project Areas (Figure 3-2) were implemented in 2013 to replace *Hygrophila* stands and promote the growth of native aquatic vegetation, thus restoring quality fountain darter habitat and enhancing existing habitat in the Comal system.

An updated map of aquatic vegetation within the entire Comal system was completed in February 2013 (Figure 3-4). Through the mapping effort, historical comparisons, and an assessment of fountain darter density within the Comal system, it was determined that initial native vegetation restoration efforts in the Landa Lake Project Area should be focused on re-establishing *Ludwigia repens* (*Ludwigia*) in the Three Islands area, as well as re-establishing *Cabomba caroliniana* (*Cabomba*) along the eastern shoreline of the lake. Similarly, initial habitat restoration efforts in the Old Channel involved the removal of *Hygrophila* and re-establishment of native aquatic vegetation within the middle of the Old Channel Project Area. As part of the restoration projects, a concentrated effort was made to locally and cost-effectively produce a large number of healthy, native plant specimens of *Cabomba*, *Ludwigia* and *Sagittaria platyphylla* (*Sagittaria*) necessary to complete the proposed restoration plantings. Using a combination of nursery pond and in situ field propagation nursery sites, a large stock of 600-1,200 native plants was produced every 3-4 weeks from April through December.

Figure 3-4. General location of the native aquatic vegetation restoration project areas (red boxes) in Landa Lake (top) and Old Channel Reach (bottom) (BIO-WEST 2013a).

Following the removal of *Hygrophila* and planting of native plant specimens, native stands were monitored for growth as well as *Hygrophila* re-emergence. Overall, the Comal system flow conditions in 2013 were very amenable to aquatic vegetation restoration activities. Water levels were slightly lower than average, which made planting somewhat easier. Additionally, current velocities in restored habitat areas were slightly slower than average, which was likely beneficial for initial plant plug survival and root establishment. However, as was anticipated, not every restored site produced similar results, even with the employment of similar methods of *Hygrophila* removal and native plantings. Plantings in areas with coarser substrate were not as successful, and shallower areas that enabled the most thorough hand removal of *Hygrophila* experienced the least amount of *Hygrophila* re-emergence.

Over the course of 2013 (April-December), a total of 10,526 plants covering over 2,000 m^2 were planted in restoration plots in the Landa Lake (Figure 3-3) and Old Channel Reach (Figure 3-4) Project Areas. Tables 3-10 and 3-11 show the plot labels, native plant species and numbers, and % Cover by native plants near the end of 2013. Approximately 8,300 of these plants were propagated in the field, with the remaining being propagated in the nursery pond or were direct transplants. As shown in Tables 3-10 and 3-11, overall, the restoration plantings did very well with many of the restoration plots planted earlier in the year (April-June) reaching at least 90% coverage by native plants at the end of 2013. Restoration plots planted later in the year (October-December) had less time to grow, and as they experienced shorter daylight hours in the winter months, there was lower native plant coverage than in the 'older' plots at the conclusion of 2013 (Tables 3-10 and 3-11).

Table 3-10. Planting Dates and Number of Native Specimens Planted within Each Old Channel Reach Restoration Plot, and End-of-Growing Season Cover by Native Plants in Each Plot

Plot	*Cabomba* Planted	*Ludwigia* Planted	*Sagittaria* Planted	Cover of Native Plants (%)	Area of Plot (m^2)	Month Planted
A	144	96	45	90	19.60	April and June
B	-	205	-	90	26.75	April
C	-	221	54	90	22.01	
D	-	177	-	80	32.16	
E	80	-	-	90	23.97	June
F	-	144	-	95	30.98	June
G	160	112	102	40	24.97	June and September
H	-	735	-	85	99.57	June
I	-	175	-	45	27.74	June
J	-	210	-	20	27.03	July
K	-	240	-	50	44.38	July
L	284	1,056	-	80	195.82	August, September, and October
M	-	118	-	40	22.96	September and October
N	15	735	22	60	284.56	October
O	-	1,200	-	10	213.40	December
P	215	-	-	10	44.56	November
S.I.	84	679	328	65	287.78	April and October
Total	**982**	**6,103**	**551**	**-**	**1,428.24**	**Total 2013**

Table 3-11. Planting Dates and Number of Native Specimens Planted within Each Landa Lake Restoration Plot

Plot	*Cabomba* Planted	*Ludwigia* Planted	Cover of Native Plants (%)	Area of Plot (m^2)	Month Planted
A	-	192	40	35.17	April
B	96	-	90	4.54	
C1	-	5	0	0.44	May
C2	-	6	0	0.42	
C3	-	7	0	0.18	
C4	-	7	0	0.18	
C5	-	7	0	0.10	
C6	-	80	40	35.07	
C7	-	80	30	14.32	
D	-	96	95	115.57	
E	150	-	10	53.41	
F	-	192	100	36.50	May and July
G	-	144	100	43.15	May
H	-	144	100	23.23	
I	280	-	20	24.07	June and July
J	-	240	70	53.40	June
K	144	-	50	14.50	June
L	48	-	100	6.23	June
M	-	500	80	125.99	July
N	-	316	80	23.03	July
O	151	5	90	10.68	
Total	**869**	**2,021**	**-**	**620.18**	**Total 2013**

In the Old Channel Reach project area, seventeen restoration plots totaling 1,428.24 m^2 of planted area were planted with a total of 7,636 native plant specimens in 2013. In the Landa Lake project area, twenty-one restoration plots totaling 620.18 m^2 of restored habitat area were planted with a total of 2,890 native plant specimens in 2013. *Hygrophila* areal coverage was reduced by 60% in the Landa Lake project area, with *Cabomba* increasing 5% and *Ludwigia* increasing 66%. Impressively, *Hygrophila* coverage in the Old Channel project area was reduced by 40%, with an increase of *Ludwigia* by 660%, an increase of *Cabomba* by 182%, and an increase of *Sagittaria* by 18%.

Figure 3-5. Restoration plots in the Landa Lake project area planted in 2013 (BIO-WEST 2013a).

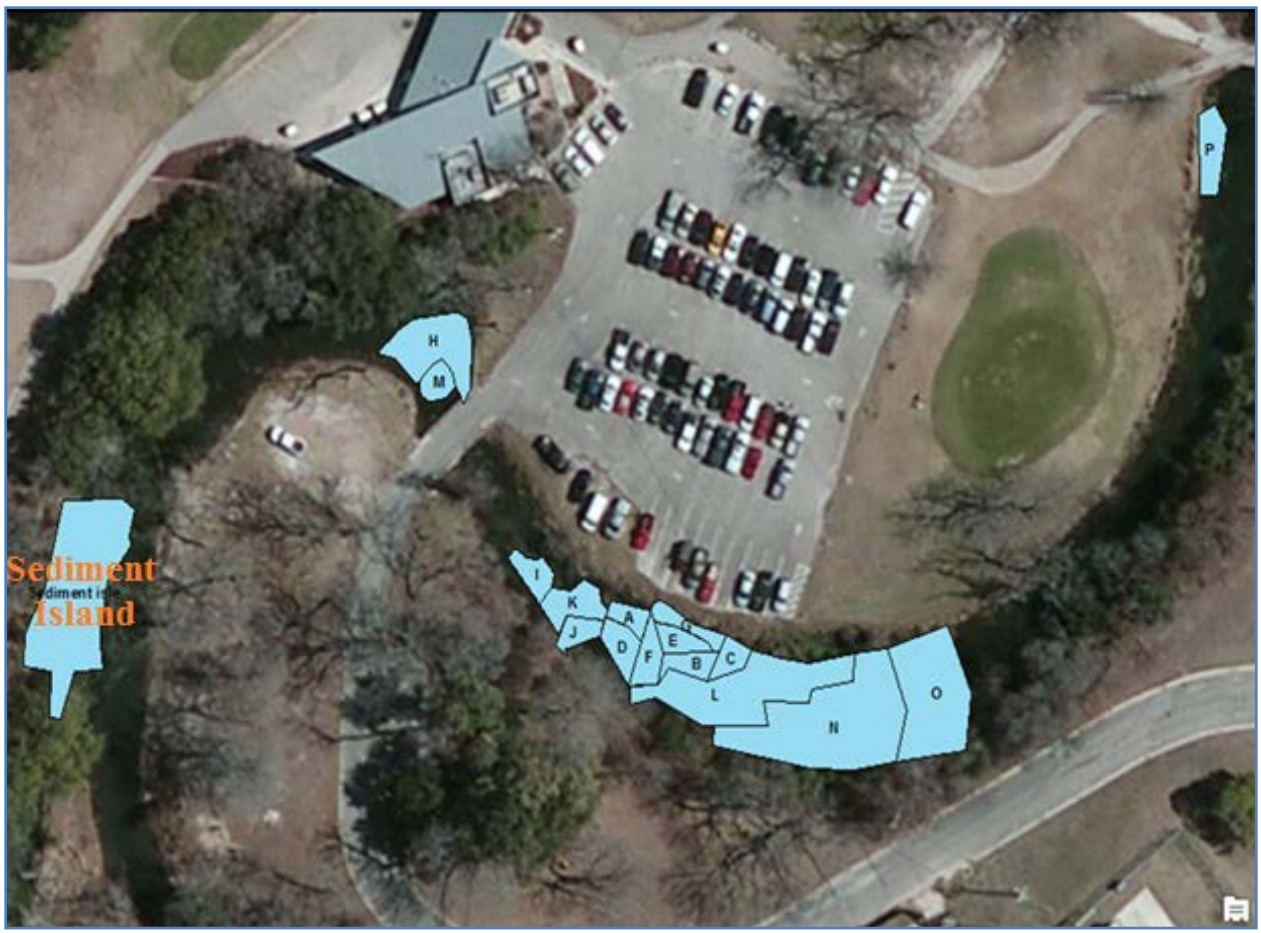

Figure 3-6. Restoration plots in the Old Channel Reach project area planted in 2013 (BIO-WEST 2013a).

Consistent gardening and maintenance, such as the removal of snags and vegetation mats, was a key contributor to the success of this restoration process to date. It is unlikely that *Hygrophila* will be completely eliminated from the Comal system, but these two habitat restoration projects have shown that the plant can be managed and controlled, and native aquatic plants can be successfully established within the system on a large scale.

Finally, a specific area targeted for sediment removal in 2013 was a small island (Figure 3-7) that formed just behind the spring-fed pool and just downstream of Landa Lake. This sediment island was continuing to expand, had established destructive non-native cane, and had displaced/destroyed fountain darter habitat. The sediment island was successfully removed in spring 2013 (Figure 3-7). Following removal, native aquatic vegetation was restored in the immediate footprint and adjacent areas.

For complete documentation of the 2013 activities and results, refer to the 2013 Aquatic Vegetation Restoration in Landa Lake and Old Channel Reach Final Report included in Appendix W.

Figure 3-7. Photographs of the sediment island pre- and post-removal (top left – fall 2012; top right – April 2013; bottom left – April 2013 – initial replanting; bottom right – August 2013) (BIO-WEST 2013a).

Modifications Due to Drought Conditions:
Throughout 2013, the biological conditions observed within the Old Channel did not warrant any suspension of aquatic vegetation restoration activities. Additionally, there were no major changes in flow or water level in the Old Channel during 2013. However, when flow declined below 130 cfs, the water level in Landa Lake did decrease several inches. Although biological conditions remained strong, the City took the conservative approach and suspended any non-native vegetation removal or replanting of native vegetation in Landa Lake during that late summer/early fall period when flows were less than 130 cfs.

Proposed Activities for 2014:
The City of New Braunfels will remove approximately 1,000 m^2 of non-native aquatic vegetation to be restored with native vegetation. Additional restoration will occur within the study reaches. Each restoration area will be regularly monitored with additional monitoring occurring after natural or anthropogenic disturbances.

3.2.3 Management of Public Recreational Use of Comal Springs and River Ecosystems (EAHCP §5.2.3)

Obligations:
The City of New Braunfels will continue to enforce recreation restrictions that were in place at the time of the EAHCP development on the Comal River through the duration of the permit. This specifically applies to regulations limiting recreation on Landa Lake, the Spring Runs in Landa Park, and the Old Channel of the Comal River. The City of New Braunfels will additionally extend its take protection to commercial outfitting businesses that are willing to meet the conditions of such protection through a Certificate of Inclusion Program to be developed by the City of New Braunfels.

2013 Compliance Actions:
The City of New Braunfels has begun an educational program to encourage Certificate of Inclusion (COI) participation for local businesses involved in recreation within the Comal River system. Many local businesses are educated on the EAHCP program regarding the endangered species. The long-term goal is to continue education activities and have all interested businesses sign up for the COI willing to meet conditions consistent with the EAHCP.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will continue to educate private outfitters about the Certificate of Inclusion program and enrollment into the program will continue. The 2014 goal is to engage most of the outfitters using the river in the program by the end of the year.

3.2.4 Decaying Vegetation Removal and Dissolved Oxygen Management (EAHCP §5.2.4)

Obligations:
The City of New Braunfels will develop a dissolved oxygen management program for Landa Lake. When springflow drops below 80 cfs, this program will be implemented. The goal will be to maintain sufficient dissolved oxygen levels to sustain the ecosystem of Landa Lake.

2013 Compliance Actions:
The first task to undertaking the dissolved oxygen management program was to get the necessary equipment in place early in 2013. For effective and continuous monitoring of dissolved oxygen and other water quality parameters in Landa Lake, the City of New Braunfels, through their contractor, installed and maintained water quality monitoring equipment within Landa Lake. Additionally, the contractor installed an aeration system within Landa Lake to provide response capabilities in the event that practicable steps to mitigate for depressed dissolved oxygen were necessary. The location of the aerators and water quality monitoring equipment are shown in Figure 3-8.

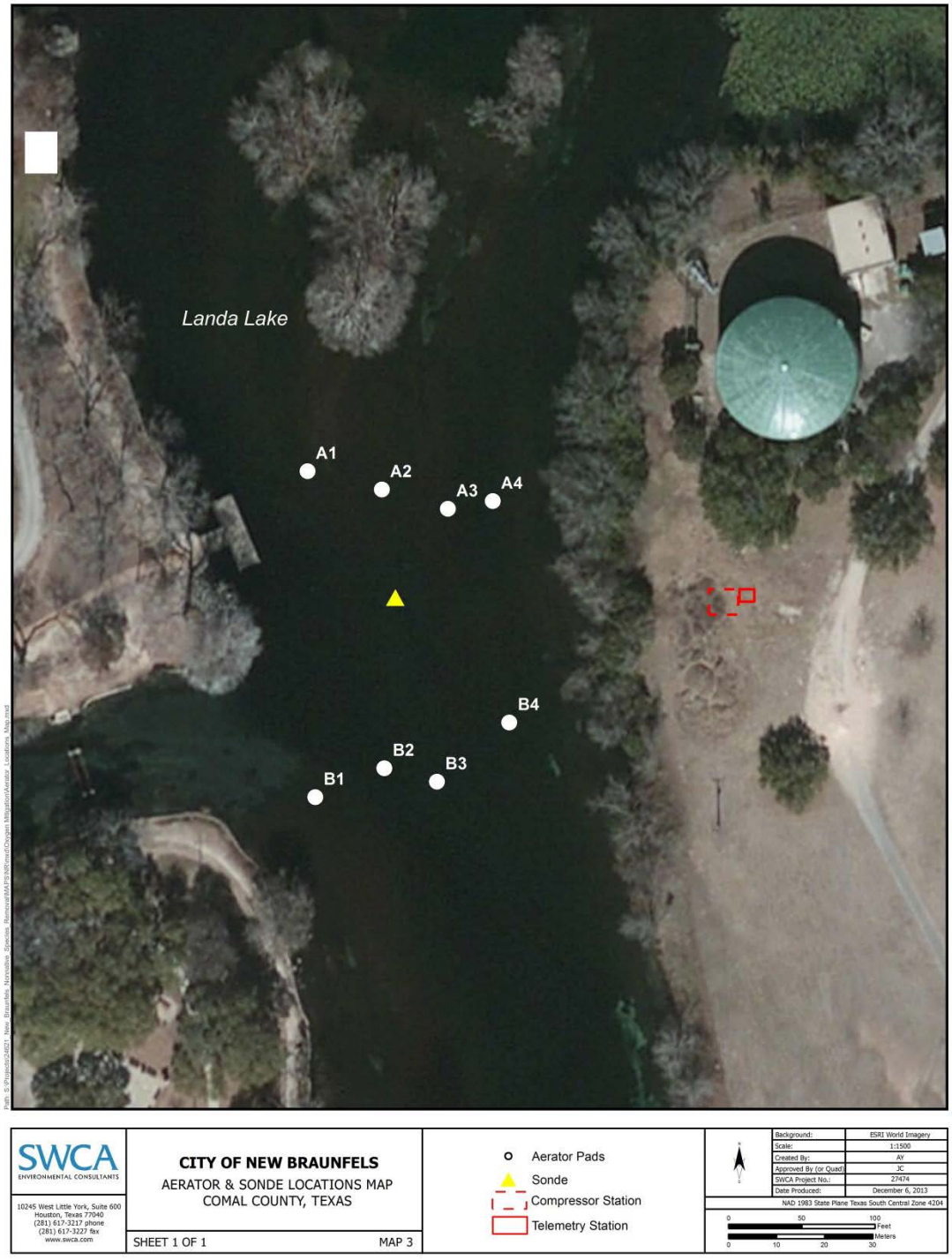

Figure 3-8. Aerator and water quality sonde locations in Landa Lake (SWCA 2013a).

In particular, a water quality monitoring station consisting of a Eureka Environmental Engineering's Manta 2 multiparameter sonde that transmits data to remote stations using the Eagle Eye telemetry system was installed in Landa Lake. The sonde and telemetry system are solar powered with the telemetry system directly transmitting sonde readings to data tables that are accessible from the internet. The telemetry unit is co-located with the aerators and is attached to the sonde in the middle of Landa Lake immediately downstream of the pier near Gazebo Circle (Figure 3-8). Although diel water chemistry patterns are often measured just beneath the surface, at mid-depth, or throughout the water column, a stainless steel and concrete submerged harness was installed with the probes oriented downstream such that the probes are positioned just above the sediments in the lake bed. This provides data indicative of the benthic water chemistry that is pertinent to the fountain darter and provides the added benefits of reducing the structures on which floating vegetation mats may potentially collect and maintaining the aesthetics of Landa Lake. The sonde itself is equipped with probes for measuring dissolved oxygen, temperature, pH, conductivity, and turbidity on a continual basis, with discrete measurements collected every 30 minutes. These data provide guidance for management decisions related to maintaining adequate dissolved oxygen concentrations to support endangered species populations under periods of stress.

In order to have a response tool should conditions warrant, two Keeton Industries Solaer® Model SB-4B solar powered aeration systems were also installed. Each system consists of two 3.3 x 5.5 foot solar panels, a heavy duty plastic cabinet, compressors, batteries, and diffusers with their requisite weighted tubing (Figure 3-9). When actuated, each compressor draws ambient air through a filter and pressurizes the air flowing into the manifold. The air flow is split by the manifold and pushed through weighted tubing to the aerator pads associated with each compressor. Each of the pads consists of tubing and a diffuser membrane that is held in place within a heavy plastic housing by concrete. The manifold valves have been adjusted to produce similar air output from each of the diffusers. The diffusers are anchored at roughly even intervals across the lake bed (Figure 3-9). After installing the aerators in May 2013, the contractor verified operability of the system by performing basic operations checks on the system.

The second response component to the management program is the removal of floating vegetation mats when water quality conditions show reason for concern. The extent of the mats of decaying vegetation appears to be linked to grazing by the exotic species (e.g., giant ramshorn snails [*Marisa cornuarietis*]) throughout Landa Lake as well as upstream recreational activities. As such, manually removing the decaying vegetation provides only temporary benefits to the lake. If the exotic species are the main contributor to the accumulation of decaying vegetation, this problem will continue until these species are effectively suppressed or controlled. Although the removal of decaying vegetation certainly benefits the aesthetics of Landa Lake, the current water quality data are insufficient to draw inferences regarding the water chemistry benefits of these actions.

Daily water quality data were collected every 30 minutes following installation of the system in early May 2013. The data were regularly reviewed on ienvironet.com by the contractor to evaluate current and recent water quality trends. Additionally, ienvironet.com allows the user to set pre-defined alert criteria based on measured values. Based on initially collected dissolved oxygen values, it was determined that email alerts would be sent if dissolved oxygen concentrations were below 2.0 mg/L. To date, this alert has only been triggered four times; two of those alerts were an anomalous event that was apparently related to an electronics problem. During the monitoring period, the measured water quality parameters remained relatively stable with dissolved oxygen, pH, and water temperature fluctuating on daily patterns, as expected. Turbidity and specific conductivity did not demonstrate any discernible patterns over the same period. The duration of the monitoring is too brief to allow for the elucidation of any annual patterns for the water quality parameters.

Throughout the monitoring period, measurements of overnight dissolved oxygen values were rarely observed below the established limit of 2.0 mg/L. More importantly, depressed dissolved oxygen measurements were not associated with long-term cycles and were not prolonged, but rather temporary lows that were not confirmed by a similar measure in the next interval. As such, the low measures were most likely associated with chance events. The most commonly measured dissolved oxygen concentrations were between 3 and 5 mg/L and represent measurements collected during peak respiration hours. More importantly, depressed dissolved oxygen measurements were not associated with long-term cycles and were not prolonged, but rather temporary lows. It is possible that dissolved oxygen is influenced in the areas immediately surrounding the vegetation mats; however, the lack of trends in dissolved oxygen measurements throughout the monitoring period at the monitoring station suggest that Landa Lake was not influenced by decaying vegetation at a broad scale in 2013. The lack of triggering events led the contractor to carry out vegetation removal activities based on observations made during calibration visits and verbal notification from concurrent projects.

During removal efforts, there was a noticeable (though unmeasured) high water temperature immediately beneath the vegetation on clear, sunny days. This was assumed to be caused by a combination of effects. Firstly, the decaying matter slows water velocity within the vegetation causing these areas to have much more sluggish water movement. These backwater areas are exposed to more ambient solar radiation over time and therefore heat faster than more turbulent, high-velocity areas. Secondly, floating vegetation absorbs a great deal of solar radiation, which is converted to heat. As a result, the vegetation warms the underlying water. Although labor-intensive, use of the floating booms proved effective in displacing the majority of the floating mats of decaying vegetation. Based on the data currently available, the removal of decaying vegetation had a largely aesthetic benefit to Landa Lake, although there may have also been some benefits to water quality. No marked improvements in water quality were detected during the monitoring period; however, the removal of surficial decaying vegetation will certainly improve light penetration and photosynthesis within the water column.

For complete documentation of the 2013 activities and results, refer to the 2013 *Decaying Vegetation Removal and Dissolved Oxygen Final Report* included in Appendix X.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will regularly monitor real time water gauges, maintain the aerators installed at Landa Lake, and provide additional dissolved oxygen as required by flow conditions.

Figure 3-9. Aerator and water quality study equipment (top – aerator systems, telemetry unit, and their solar panels; bottom – submerged view of aerator diffusers in operation) (SWCA 2013a).

3.2.5 Control of Harmful Non-Native Animal Species (EAHCP §5.2.5)

Obligations:
The City of New Braunfels will implement an aggressive non-native species control program that targets the suckermouth catfish (*Pterygoplichthys disjunctivus*), tilapia (*Oreochromis aureus*), nutria (*Myocastor coypus*), and giant ramshorn snail (*Marisa cornuarietis*). The City will conduct annual monitoring and maintenance activities to ensure continued control of the invasive population within the Comal system.

2013 Compliance Actions:
Invasive fish species were removed by using four fyke nets during each trapping session (Figure 3-10). Fyke nets are passive traps that have 50-foot leads that guide fish into a 12-foot long by 3-foot wide hoop net. Targeted fish are caught live and non-target fish are released alive (only five largemouth bass were caught during the entire removal effort). In addition, biologists snorkeled early in the morning and late in the afternoon (high times of fish activity) in areas of high fish density and speared all non-native fish possible. Once removed from the water, all invasive fish were eviscerated, in accordance with state laws. The carcasses were measured, weighed to the nearest kilogram, and a total biomass was calculated. Total length was also taken to determine if, over time, the removal of adults affects target population demographics. Specimens of the vermiculated sailfin armored catfish were given to the Texas Parks and Wildlife Department for necropsy studies including gender, reproductive, and age analysis.

Over 22 field days of invasive species removal, 393 vermiculated sailfin catfish, 2,248 tilapia, 40 nutria, and 995 giant ramshorn snails were lethally removed from Landa Lake. This resulted in over 6,000 lbs. of biomass removed from Landa Lake, with over 80% of that being comprised of tilapia. Invasive species removal efforts typically take years to accomplish a goal of severe population depletion or entire eradication. Typically, invasive species eradication is not feasible due to the open nature of the target system (areas of immigration and emigration available). Landa Lake does not fit an open system model. There is no direct overland flow into the lake nor is there likelihood of the various spillways within the lake flooding enough on a regular basis to allow for invasive species within the river to repopulate the lake area. It is the contractor's professional opinion that with very high removal effort, over a long period of time, eradication of three of the four (tilapia, armored catfish, and nutria) major invasive species in the lake is possible.

For complete documentation of the 2013 activities and results, refer to the final report for the invasive species removal project for the City of New Braunfels included in Appendix Y.

Modifications Due to Drought Conditions:
No modifications to this measure were necessary in 2013 as a result of drought conditions.

Proposed Activities for 2014:
In 2014, the City will continue to monitor non-native species populations and refine removal techniques specifically targeting sucker-mouth catfish, tilapia, and nutria.

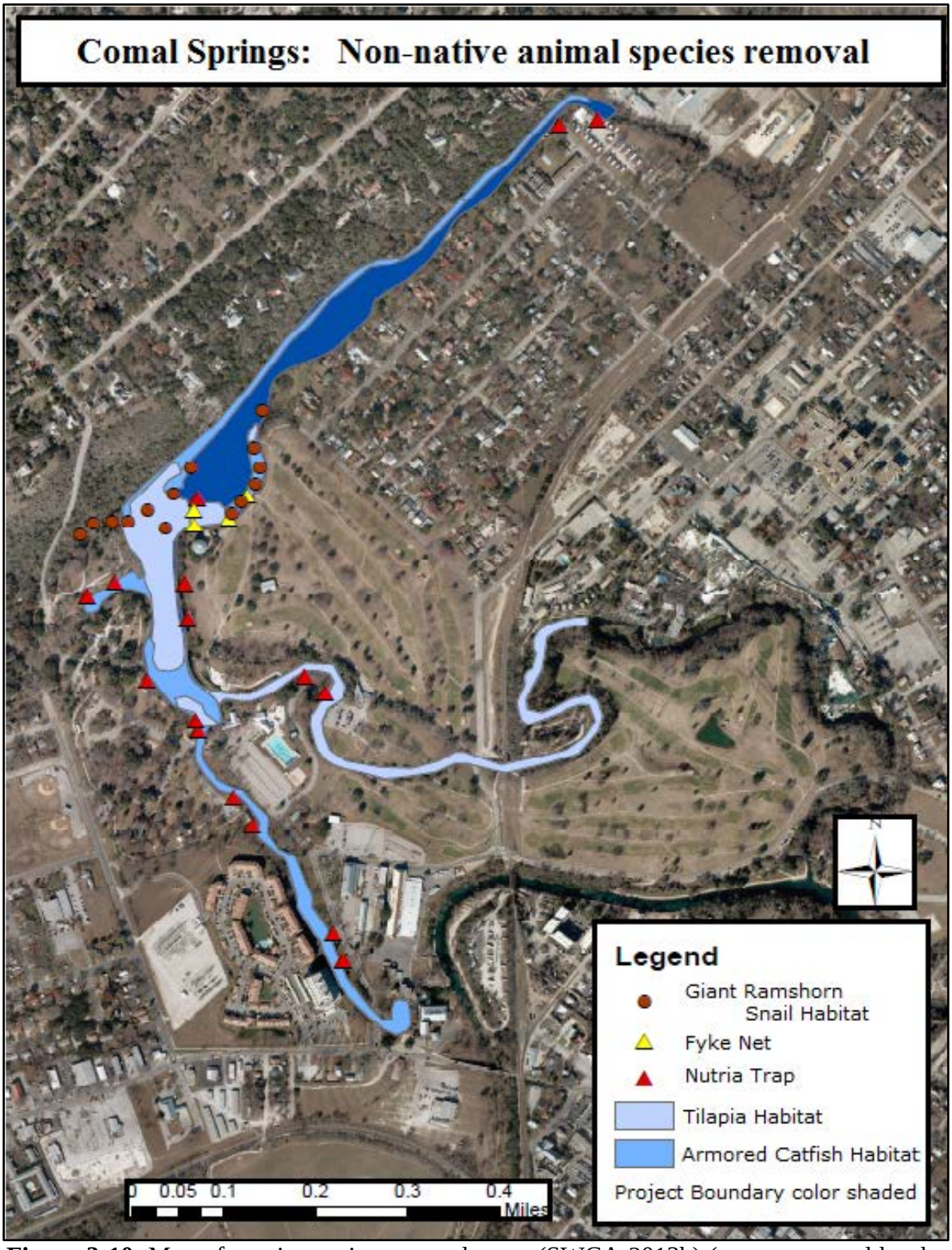

Figure 3-10. Map of exotic species removal areas (SWCA 2013b) (map re-created by the City of New Braunfels).

Figure 3-11. Exotic species removal activities (SWCA 2013b).

3.2.6 Monitoring and Reduction of Gill Parasites (EAHCP §5.2.6)

Obligations:
The City of New Braunfels will develop and maintain a gill parasite monitoring and reduction program that will target the removal of red-rimmed melania (*Melanoides tuberculatus*) snails in the Comal River. Additional research will be conducted through the Adaptive Management Process to determine the most appropriate strategy for gill parasite control in the system.

2013 Compliance Actions:
In 2013, the City of New Braunfels retained contractors to further investigate the gill parasite, and to explore potential management techniques aimed at minimizing and mitigating for the impact of this parasite under low flows. Much of the effort in early 2013 was aimed at describing the distribution and density of both species throughout the system. A system-wide snail survey was conducted to document the distribution of *M. tuberculatus* throughout the Comal River system (Figure 3-12). Results from this survey showed the snail to be extremely abundant in areas of Landa Lake, the New Channel above the old power plant, and parts of the Upper Spring Run near Spring Island. However, few snails were found downstream of the power plant in the New Channel or in the Old Channel. Based on the results of this initial snail survey, density sampling was conducted in select areas to quantify the density of *M. tuberculatus*. Average densities of *M. tuberculatus* in these areas ranged from 179/m^2 to over 1,000/m^2, with the highest densities being observed in the New Channel between Landa Lake and the power plant. A subset of the snails collected during density sampling was then retained for quantification of *C. formosanus* infection prevalence. Results from these studies, as well as similar follow-up studies, demonstrated low infection rates of less than 1% in most locations.

Throughout 2013, various methods for removing/controlling *M. tuberculatus* were explored. After extensive experimentation and communication with other exotic snail researchers, a bait formulation was found that would successfully attract large numbers of *M. tuberculatus*. Additionally, a trap design was developed that would successfully trap the snails. In areas with high densities of *M. tuberculatus*, baited snail traps resulted in an average capture rate of 18 snails/trap/24-hour period with nearly 200 snails per night when using a series of ten traps.

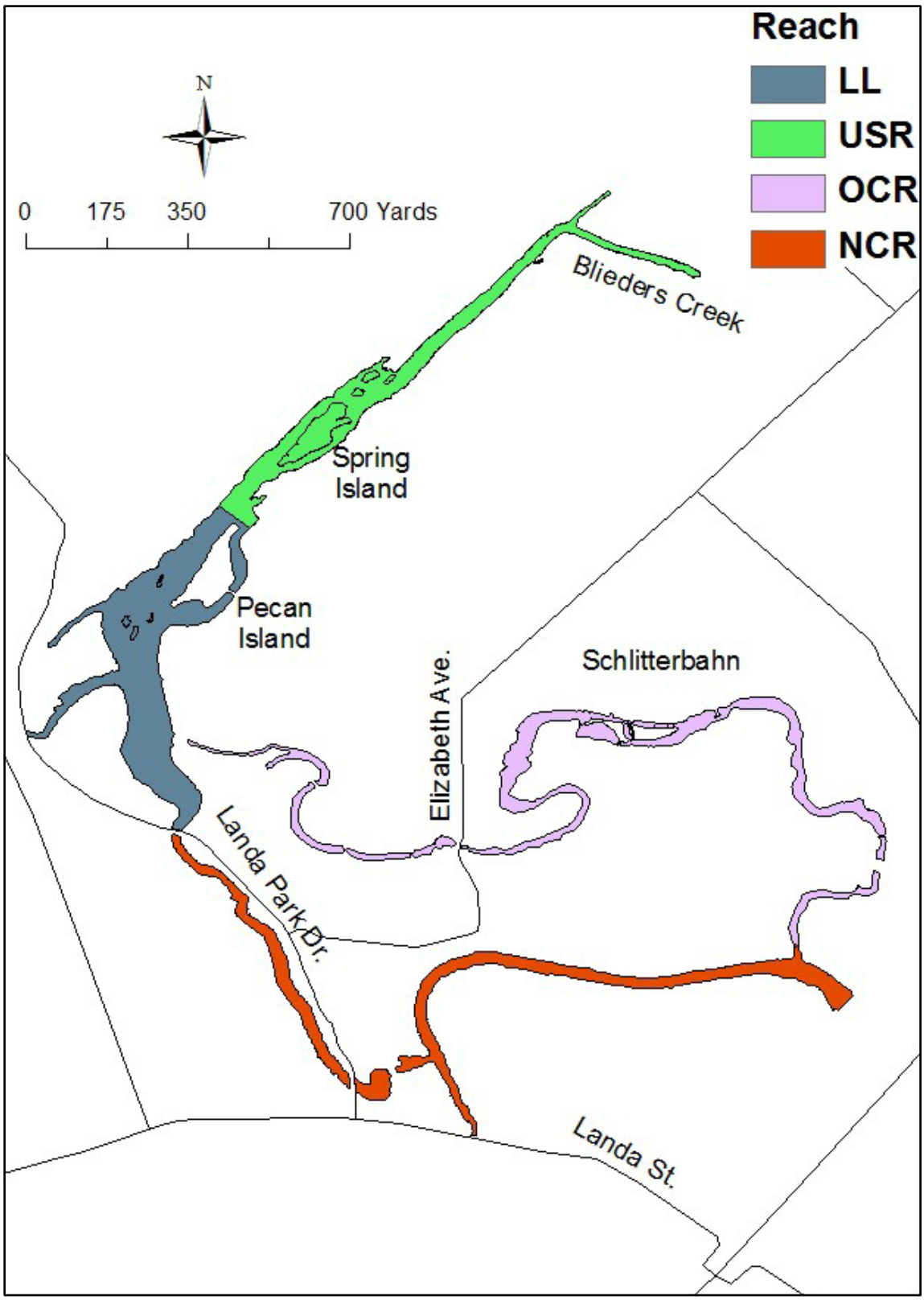

Figure 3-12. Map of the study area showing the four snail sampling reaches - Upper Spring Run (USR), Landa Lake (LL), Old Channel Reach (OCR), and New Channel Reach (NCR).

Surveys were also conducted to gather data on the distribution and abundance of *C. formosanus* cercariae in the Comal River (Figure 3-13). Results from cercariae density studies showed relatively few cercariae at the upstream end of the system in the Upper Spring Run near Houston Street. However, cercariae concentrations progressively increased in a downstream direction, getting higher near Spring Island, then higher again near Landa Lake, and finally showing the highest median concentrations near Landa RV Park in the New Channel immediately below the power plant. Interestingly, cercariae concentrations in the Old Channel and at the Confluence site (below confluence of Old Channel and New Channel) were relatively low. However, this is not surprising given the low numbers of *M. tuberculatus* observed in the Old Channel.

With the aid of newly acquired distribution and density data for both *M. tuberculatus* and *C. formosanus* cercariae, a Snail Removal Pilot Study was initiated in June 2013 to assess the feasibility of large-scale snail removal on impacting cercariae concentrations. Intensive *M. tuberculatus* snail removal was implemented in a short segment of the New Channel, with *C. formosanus* concentrations measured both upstream and downstream of the site prior to and for several weeks after snail removal. During the removal effort, over 250 person-hours were spent to remove an estimated 86,262 *M. tuberculatus* from the study area. Despite this intensive effort, no significant before and after difference in snail density was detected in the study reach, and significant effects to cercariae concentrations were not observed. With *M. tuberculatus* densities of over 1,000/m^2 in some areas and an average infection prevalence of less than 1%, the number of snails that must be removed to exert an influence on water column cercariae concentrations makes widespread snail removal difficult at this time. However, if aggregations of highly infected snails are located, removal in these more localized areas may be beneficial.

For complete documentation of the 2013 activities and results related to the gill parasite, refer to the 2013 *Comprehensive Final Report for Gill Parasite (Centrocestus formosanus) Activities in the Comal River* which is included in Appendix Z.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will continue distribution and density estimates and further refine snail removal techniques in an effort to expand the 2014 gill parasite monitoring and removal program.

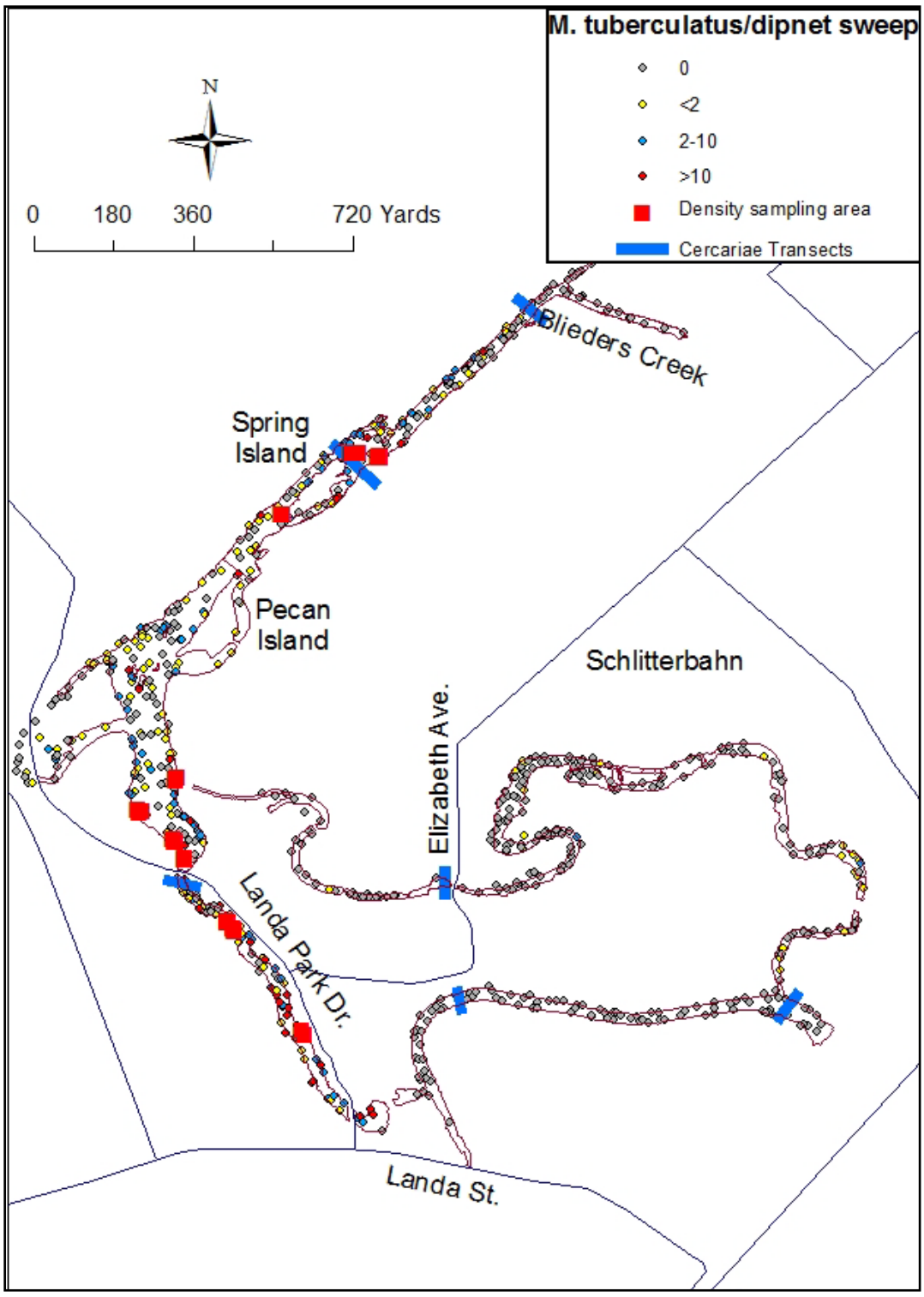

Figure 3-13. Map of the study area showing results of initial snail survey, locations of snail density sampling areas, and locations of parasite monitoring transects (BIO-WEST 2013b).

3.2.7 Prohibition of Hazardous Materials Transport across the Comal River and its Tributaries (EAHCP §5.2.7)

Obligations:
The City of New Braunfels will coordinate with the Texas Department of Transportation (TxDOT) to prohibit the transportation of hazardous materials over the Comal River and its tributaries.

2013 Compliance Actions:
Discussions have been started by City of New Braunfels and TxDOT on trying to establish new adjacent routes above the Comal Springs/Landa Lake. These smaller routes will establish where signage needs to be installed so that Hazardous Materials Transport vehicles will not utilize those routes when traveling through the area (based on potential accidents/leaks into storm sewers above the Comal Springs).

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will focus on identifying small and alternative roadways that cross the Comal River to further inform the existing Hazardous Materials prohibition transport plan.

3.2.8 Native Riparian Habitat Restoration (EAHCP §5.2.8 and §5.7.1)

Obligations:
To improve riffle beetle habitat, the City of New Braunfels will remove non-native vegetation along Spring Run 3 and the western shoreline and re-vegetate with native species. Restoration will target plants and trees with extensive root systems to provide the greatest opportunity for riffle beetle habitat. The City will additionally remove fine sediments currently covering small springs along the shoreline.

2013 Compliance Actions:
Comal Springs riffle beetle restoration project
For this activity, the net benefit the species is derived from a reduction in sedimentation accumulation arising from upgradient riparian areas. Watering was used to help the plantings establish. As a result of the enhanced riparian areas promote erosion control. Because of the reduced survivability of up gradient plantings over the course of the project, focus shifted to mechanical traps and down gradient sedges following removal of non-native elephant ear. Future efforts will focus on traps and on planting sedges and/or grass near and at the water's edge.

The most effective restoration activity in 2013 was construction of shoreline erosion control measures. This is based on the fact that in areas where erosion control measures captured sediment, a typical estimate would be that over 75% of the sediment entering the trap was retained in the trap. Across the entire site area, no estimate is available of the total sediment volume entering lake waters or of sediment volume affecting specific riffle beetle habitats. Sedimet traps were installed in areas most likely to convey sediment into the lake. Preliminary monitoring data, collected by BIO-WEST in 2013, of spring openings has suggested a reduction in riffle beetle numbers following a large precipitation event where fine sediment accumulation was revealed on the riffle beetle sampling rags. Monitoring will continue and this trend will be further analyzed.

Vegetation efforts attempted in this riparian area were different than for aquatic vegetation efforts elsewhere. For this project the riparian (up gradient) species plantings proved to be less successful. However, for this project the shoreline edge vegetation (sedges) planting efforts were successful, which is consistent with other projects that focused on aquatic vegetation.

The erosion control sediment traps captured multiple cubic yards of sediment before sediment could enter Spring Run 3 or Landa Lake. Non-native elephant ear was successfully reduced along the shoreline by cutting and repeat herbicide application. Treated areas were replanted with native sedge species that are having significant success. Non-native ligustrum trees were removed which allowed for more sunlight to penetrate some areas of the shoreline. Cut ligustrum log and brush material was utilized on-site for construction of erosion control sediment traps. Shoreline planting of native ground cover and tree species was less successful because of the rocky terrain, shallow soils, heavy canopy cover, wildlife grazing and foot traffic. Accumulated fine sediment was removed from the lake bottom by suction dredging. Following dredging activities in areas without previously documented springs, a localized increase was observed in the spatial extent and frequency of springs degassing activity.

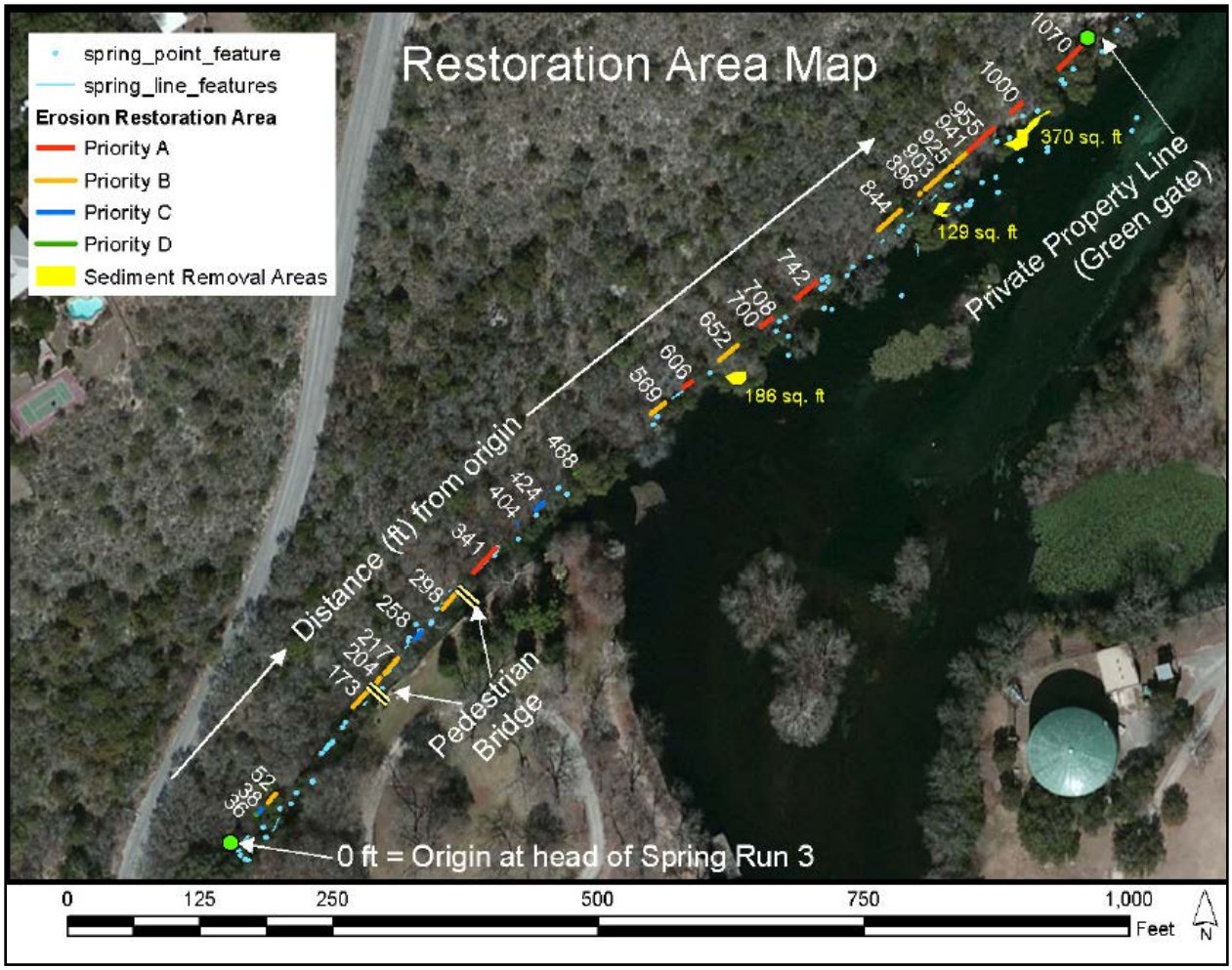

Figure 3-14. Map of priority riparian shoreline areas and sediment removal areas (RPS 2013).

Old Channel bank stabilization project

A specific area where aquatic vegetation restoration occurred in 2013 was in the Old Channel Reach along a priority riparian shoreline where a sediment island was removed (Figure 3-7). Sediments were thought to be deposited in the channel due to the instability of the adjacent river bank. To protect areas where sediments have been removed and revegetation has been established to enrich habitat, the program includes bank stabilization to prevent materials from sloughing from the bank into the river channel.

As part of the bank stabilization project both a geomorphic assessment and riparian vegetation evaluation were completed in 2013. The study reach for these assessments extends from the downstream face of the culverts on the east side of Landa Lake to the upstream face of the culverts under Golf Course Road (Figure 3-15).

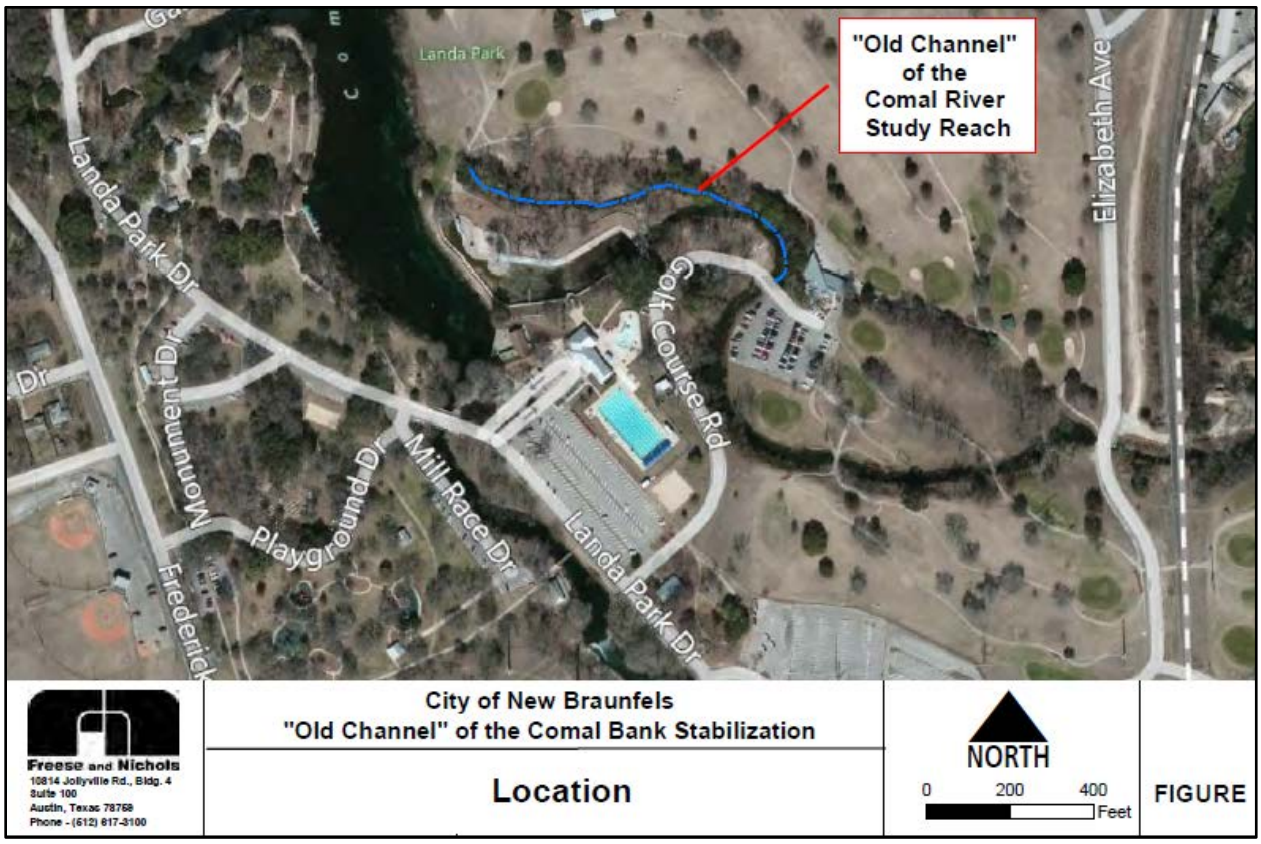

Figure 3-15. Native riparian and bank stabilization study area (Freese and Nichols 2013a).

The geomorphic site assessment defined the morphology of the reach and provided valuable information pertinent to bank stabilization and riparian vegetation species. In March 2013, a field visit was performed on approximately 1,000 feet of the Old Channel. The objective was to document the existing condition of the channel and provide a bank stabilization evaluation based on sediment incipient motion, shear stress, and bend scour analysis. The results from this assessment were used to inform the bank stabilization design. Subsequently, a riparian vegetation site visit to the upper section of the Old Channel was also conducted. The term riparian refers to the land along the bank of the river and not within the water itself. This distinction is important so that this effort is not confused with native aquatic vegetation work simultaneously being conducted in the Old Channel under a separate project.

Based on field observations, portions along the banks of the Comal River are covered with invasive riparian vegetation. Recommendations were made for the removal and/or replacement of invasive vegetation with native riparian vegetation where appropriate. The native vegetation recommended is expected to grow well in riparian areas and have good root structures to help with erosion control. The native trees and vegetation proposed to be kept along the banks will offer beneficial canopy and ground cover along the banks. With their deep roots already in place, they will continue to help stabilize the bank. Areas along the bank were determined where vegetation can remain in its present condition and where

invasive vegetation could be removed or replaced by native riparian vegetation. Riparian vegetation recommendations were selected to protect the bank and look aesthetically pleasing in areas not receiving structural improvements.

Finally, structural concepts are currently being developed where vegetation stabilization will not be sufficient enough due to bank steepness. Preliminary designs were presented to the EAHCP Science Committee and Implementing Committee in 2013. Based on recommendations received from those reviews, the contractor has made modifications to the proposed design and has a complete design ready for final review by both committees in early 2014.

In summary, the fluvial geomorphological conditions of the river were evaluated for current and possible bank failures including erosion and incising. The native and invasive vegetation was catalogued for purposes of developing a remediation plan for this stretch of the river. Based on guidance from the geomorphic assessment and riparian vegetation evaluation, structural concepts and designs were completed in 2013. All efforts of this study will come together to help provide a more stable bank along this upper stretch of Old Channel of the Comal River.

For complete documentation on the 2013 activities and results for both components of this measure, refer to *2013 Final Report for Riffle Beetle Habitat Restoration Spring Run 3 and Landa Lake Shoreline* (Appendix AA), *Old Channel of the Comal River Geomorphic Site Assessment* (Appendix BB), and the *Old Channel of the Comal River Riparian Vegetation Plan* (Appendix CC).

Modifications Due to Drought Conditions:
Although it did not modify the components of the study or time sequencing of events, the extended drought experienced in 2013 did cause challenges to the native riparian restoration planting success along the hillside adjacent to the western shoreline of Landa Lake. Although the installation of a temporary watering system to assist with planting success was a project component, water restrictions caused by the drought influenced the timing and amount of water that could be used for this activity.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will complete the bank stabilization project in the Old Channel near where the sediment island was removed in 2013. As bank stabilization is conducted, riparian restoration will likely occur simultaneously, but may be delayed to later in the year by construction activities.

3.2.9 Reduction of Non-Native Species Introduction and Live Bait Prohibition (EAHCP §5.2.9)

Obligations:
The City of New Braunfels will act to stop or limit through city ordinance the amount of non-native species being introduced into the rivers system from aquariums, and will undertake measures to prohibit the use of live bait species for local fishing.

2013 Compliance Actions:
The City of New Braunfels has begun to educate local businesses on the EAHCP and endangered species and the effects of non-native species in Landa Lake and Comal River. All local Bait shops and Aquarium stores have been approached and educated on potential hazards of non-native species and aquarium dumping into the local lakes and streams. Based on a small amount of bait and aquarium shops, the City of New Braunfels has extended its reach into nearby cities (Canyon Lake, Seguin, Garden Ridge, Schertz, Selma, San Marcos, Austin) to educate shops that sell bait and aquariums.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will expand their education and enforcement programs related to enforcing existing state regulations regarding the introduction of exotic species. The City of New Braunfels may partner with TPWD for education initiatives.

3.2.10 Litter Collection and Floating Vegetation Management (EAHCP §5.2.10)

Obligations:
The City of New Braunfels will remove litter and floating debris from the Comal Springs, Landa Lake, and the Comal River. Additionally, floating vegetation mats will be cleaned of litter and dislodged to allow them to move freely downstream.

2013 Compliance Actions:
The City of New Braunfels has instituted a weekly removal/dislodging of floating vegetation mats and also litter collection in the Comal River (underwater cleanup).

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will continue to remove litter and floating vegetation mats consistent with pre-existing protocols.

3.2.11 Management of Golf Course Diversions and Operations (EAHCP §5.2.11)

Obligations:
The City of New Braunfels will develop and implement a Golf Course Management Plan that will include an Integrated Pest Management Plan targeting techniques for protecting water quality and limited potential effects on the covered species.

2013 Compliance Actions:
The City of New Braunfels has done an extensive evaluation of their entire Golf Course and has created a new Integrated Pest Management Plan (IPMP) (Appendix DD). Based on multiple reviews from internal staff and outside agencies (Edwards Aquifer Authority, San Antonio Water System, Texas State University and City of San Marcos, EAHCP Science Committee), minor upgrades were made in Fall 2013 for a completed product by December 2013. City of New Braunfels Golf Course is currently closed (October 2013) for renovation and will reopen in October 2014. During renovation, the City of New Braunfels will incorporate features consistent with the EAHCP, including water's edge vegetative buffer areas and drainage controls to enhance runoff water quality that may enter Landa Lake and the Old River Channel.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will implement the Integrated Pest Management Plan developed in 2013.

3.2.12 Management of Household Hazardous Wastes (EAHCP §5.7.5)

Obligations:
The City of New Braunfels will enhance its Household Hazardous Waste (HHW) program. Currently the program includes one annual opportunity for the community to dispose of HHW. HHW materials include chemical products that are toxic, reactive, ignitable or corrosive. The goal of the program is to expand it to four collection events a year.

2013 Compliance Actions:
There were two HHW disposal events in 2013. At each event approximately 15 tons of materials were collected as delivered by approximately 250 participants. The events were publicized though the local media. Education outreach included materials offered to the local newspaper, radio and city access TV channel. Handouts and other materials were distributed to local elementary and middle schools.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will increase its public outreach and education initiatives for HHW, including additional scheduled drop-off days, working toward the goal of four events per year.

Figure 3-16. Collection days at HHW Center.

3.2.13 Impervious Cover and Water Quality Protection (EAHCP §5.7.6)

Obligations:
The City of New Braunfels will identify target impervious cover limits and will provide incentives to public and private landowners who are willing to convert existing impervious cover to pervious cover. Target programs will be identified consistent with the recommendations of the Low Impact Development (LID)/Water Quality Work Group Report developed during the EARIP and included as Appendix Q to the EAHCP.

2013 Compliance Actions:
A report was developed to provide a guide to implementing Low Impact Development (LID) Best Management Practices (BMPs) (Appendix EE) that will protect and preserve the habitat of four endangered species identified within the study area. This study focuses on the watersheds of the Comal River and Blieders Creek that contribute drainage to the Comal Springs and Landa Lake areas.

This report seeks to identify LID BMPs that can be adopted on a watershed basis to enhance runoff water quality draining to endangered species habitat areas.

In order to identify and recommend LID practices that can be implemented locally on a volunteer basis, , this report relies heavily on stakeholder input. Local insights, opinions and thoughts regarding LID BMPs were gathered through a public process involving New Braunfels residents in order to better understand the public's perception of LID BMPs, as well as their likelihood of success.

Two community input events provided opportunities to both educate business and property owners in the study area about the threats to Landa Lake and the endangered species as well as Low Impact Development techniques. The first was an information booth at one of the Concerts in the Park events at Landa Lake. Participants were able to peruse exhibits that illustrated low impact development products. An online survey followed up the outreach to receive feedback from a broader audience on potential rebate programs and to gauge the knowledge of best management practices.
The second event was a special meeting of Friends for the Preservation of Historic Landa Park where dedicated guardians of the park were given recommendations on actions they could take in their homes to protect the park that they love so much.

The LID BMP implementation strategies included in this report have been chosen specifically for their potential benefits to the identified endangered species.
The BMPs were prioritized according to seven key goals of the project:

1) fiscal benefit
2) reduction of impervious cover
3) reduction in stream runoff sediments and pollutants
4) increase of groundwater recharge
5) reduction of groundwater pollution
6) easily understandable and implementable
7) aesthetically pleasing.

BMPs meeting the most goals are recommended for early implementation. Public information and education were key recommendations in the report. The first year of implementation will focus on education through public events and distribution of general information. The development of a rebate program for LID BMPs like rain barrels, rain gardens, native plant landscaping, and permeable pavements is proposed. Finally, the implementation of pilot programs such as integrating LID BMPs into public projects are recommended to enhance community education. With actual LID BMPs in place, business and property owners interested in such features, have reference projects in the community to model their improvements by.

The implementation strategy in this report illustrates how these key recommendations are to be launched and sustained over the next six years. The first year is focused heavily on education and outreach while preparing for the launch of a rebate program and implementation of pilot projects. In following years, the pilot projects will be installed and public awareness of the rebate program will grow, requiring less and less public outreach. More funds in later years can be spent on the actual implementation of low impact BMPs.

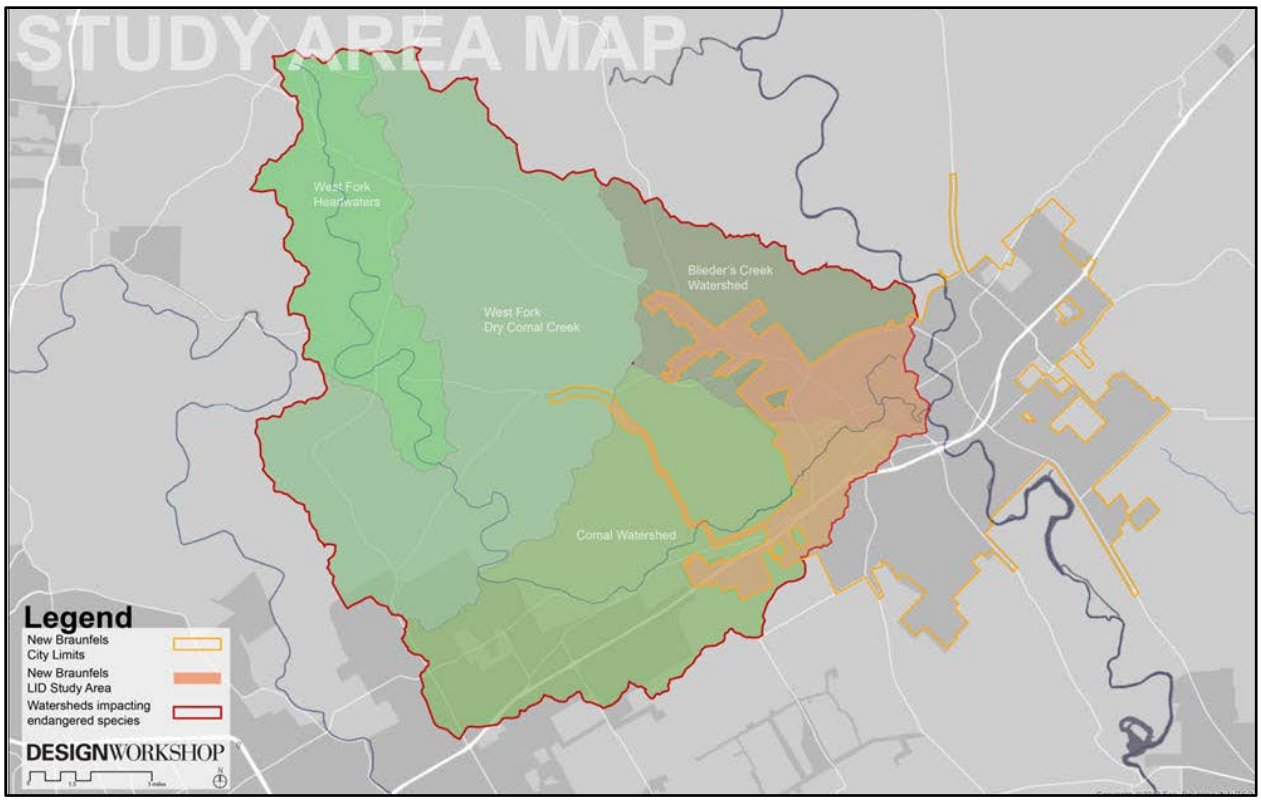

Figure 3-17. LID study area map (City of New Braunfels – multiple watersheds).

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of New Braunfels will implement identified strategies for the LID/BMP program in conjunction with the municipal separate storm sewer system (MS4) process taking place in the City. BMPs developed for the EAHCP will be above and beyond the requirements of the MS4 program.

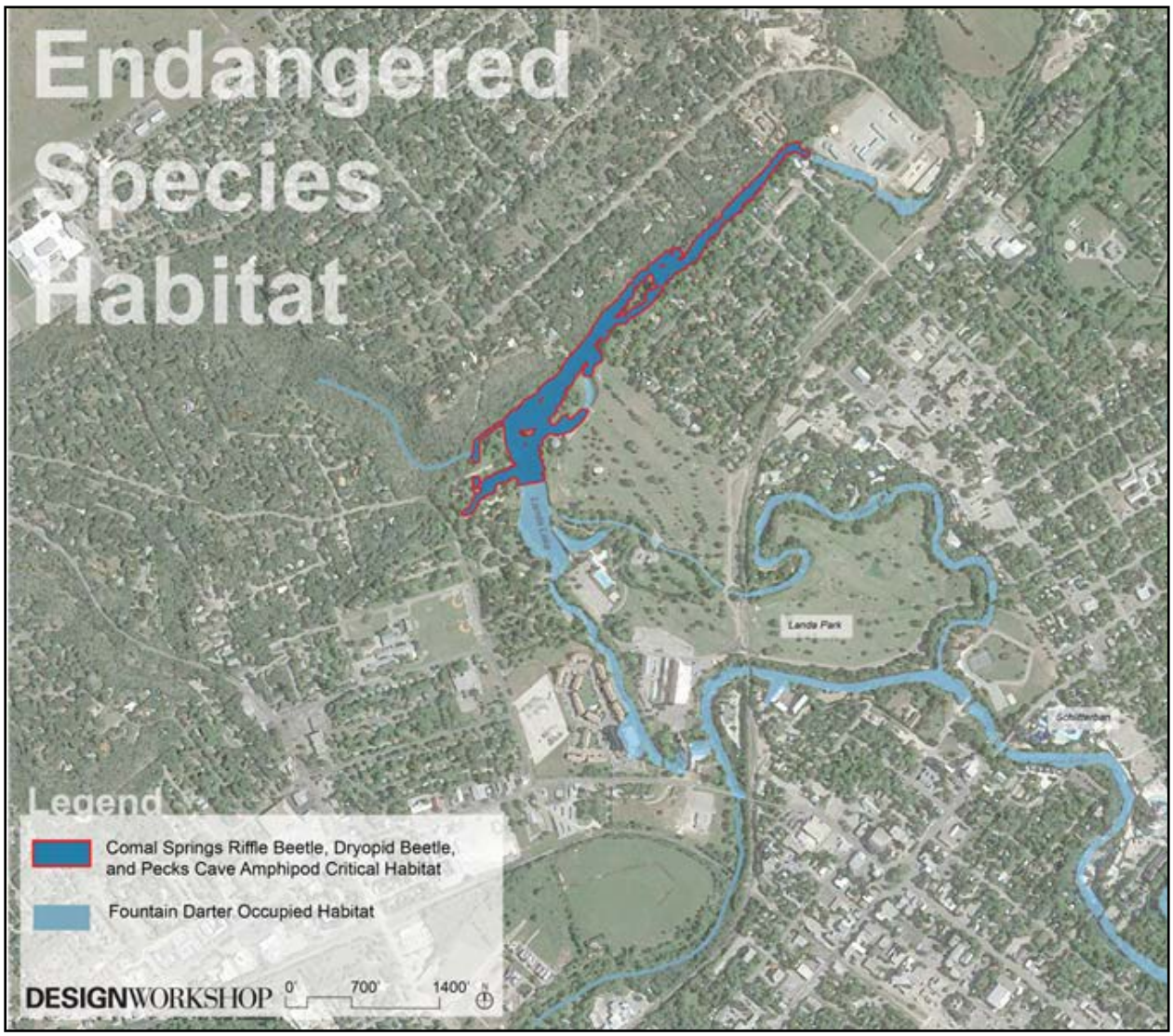

Figure 3-18. LID study area – endangered species regions.

3.2.14 Challenges Observed and Identified Solutions

In 2013, the City of New Braunfels experienced the following challenges:

- Regarding Certificate of Inclusion (COI) activities, City staff experience difficulty in making contact with local recreational outfitters due to new staff unfamiliarity with these businesses and scheduling conflicts. As new staff becomes familiar with the COI aspect of the EAHCP program, outfitter contacts will be established to discuss COI opportunities. In regards to riparian restoration along Spring Run 3, although signage was posted to deter human activities, disturbance via foot traffic and tampering was still evident. The solution for human disturbance was the additional placement of signs and boundary flagging to protect immediate revegetated areas. This proved moderately successful in 2013, but may require additional attention and public education in 2014.
- Herbivory from local fauna posed additional challenges to the success of the project. An effective solution for herbivory was to enclose the native vegetation in fenced areas.
- Where riparian restoration was being conducted, the extensive canopy and limited soil depth along the steep embankment constrained the success of native riparian vegetation establishment on the hillside. The solution was to focus on native vegetation planting activities nearer to the shoreline of Landa Lake in more gentle sloping areas with greater sediment depth for root establishment.

3.3 CITY OF SAN MARCOS

The City of San Marcos is responsible for the following measures under the EAHCP:

- Texas Wild-Rice Enhancement and Restoration (EAHCP §5.3.1 and §6.3.5)
- Management of Recreation in Key Areas (EAHCP §5.3.2)
- Management of Aquatic Vegetation and Litter below Sewell Park (EAHCP §5.3.3)
- Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (EAHCP §5.3.4)
- Reduction of Non-Native Species Introduction (EAHCP §5.3.5)
- Sediment Removal Below Sewell Park (EAHCP §5.3.5)
- Designation of Permanent Access Points and Bank Stabilization (EAHCP §5.3.7)
- Control of Non-Native Plant Species (EAHCP §5.3.8)
- Control of Harmful Non-Native and Predator Species (EAHCP §5.3.9)
- Native Riparian Habitat Restoration (EAHCP §5.7.1)
- Septic System Registration and Permitting Program (EAHCP §5.7.3)
- Minimizing Impacts of Contaminated Runoff (EAHCP §5.7.4)
- Management of Household Hazardous Wastes (EAHCP §5.7.5)
- Impervious Cover and Water Quality Protection (EAHCP §5.7.6)

EAHCP measures have been implemented according to the reviewed and approved 2013 Work Plan. Implementation of these measures has been accomplished in partnership with Texas State University and

the Texas Parks and Wildlife Department as specified in the EAHCP. All measures are in compliance with the EAHCP and ITP.

3.3.1 Texas Wild-Rice Enhancement and Restoration (EAHCP §5.3.1 and §6.3.5)

Obligations:
The City of San Marcos, in partnership with Texas State University, will identify optimal habitat areas for Texas wild-rice and target those areas for restoration. Restoration will involve the removal of non-native plant species, propagation of new wild-rice plants, and continued monitoring of the new stands. The City will use modeling results from Texas State to determine appropriate sites for restoration to ensure the best possible success rate.

2013 Compliance Actions:
Non-native aquatic vegetation was removed in areas suggested as optimal Texas wild-rice habitat based on modeling results from Hardy et al. 2010 (Appendix GG). Non-native vegetation was also removed in mixed stands of Texas wild-rice and the original Texas wild-rice stand monitored for expansion. Similarly, for Texas wild-rice stands occupying optimal areas with adjacent non-native vegetation, the non-native vegetation was removed and the Texas wild-rice monitored for expansion. Non-native vegetation was fanned to displace fountain darters prior to uprooting the vegetation. After removal, all non-native vegetation was sorted and any fountain darters (or other native species) were salvaged and returned to the river. The non-native vegetation was disposed at the City of San Marcos composting facility or the Spring Lake composting facility. Denuded areas were planted with Texas wild-rice obtained from the San Marcos Aquatic Research Center (SMARC) or from raceways located at the Freeman Aquatic Building, Texas State University campus.

After removing the non-native vegetation, a 0.25 m^2 grid was used to monitor Texas wild-rice expansion. Known locations were established and used pieces of rebar embedded into the substrate to locate grid positions. At each location, the grid was used to quantify the area of expansion (i.e., growth) of the Texas wild-rice on a monthly basis. At each grid, habitat characteristics (e.g., water depth, canopy cover, current velocity) were recorded for each vegetation growth assessment. A total of 48 grids were placed in the San Marcos River to monitor the expansion of Texas wild-rice patches following the removal of *Hydrilla verticillata* and *Hygrophila polysperma* (Figure 3-19). Grids were located within a range of depths (0.22 m – 0.68 m), current velocities (0.02 m/s – 0.41 m/s), and substrates (i.e., silt, sand, clay, gravel, and cobble).

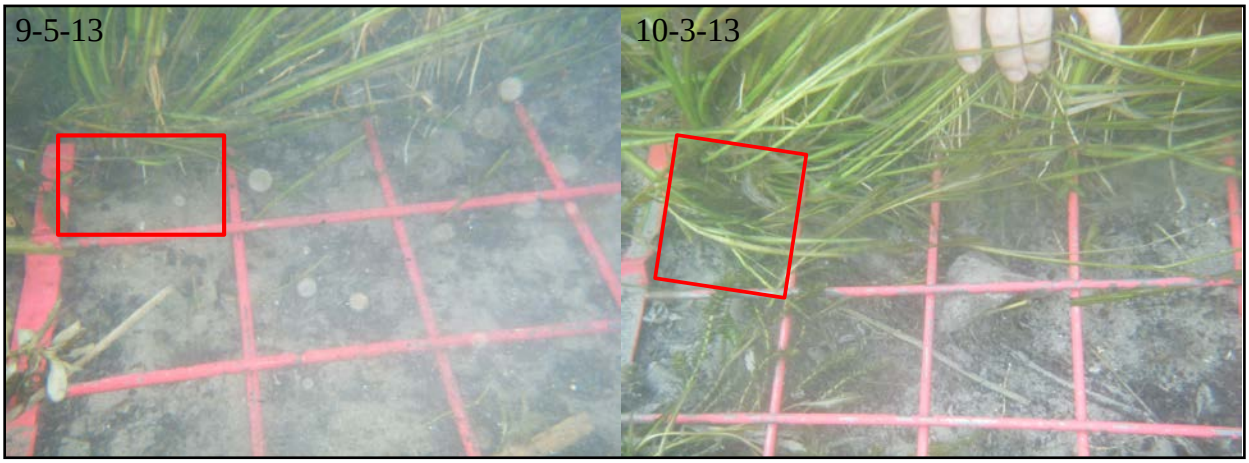

Figure 3-19. Example of Texas wild-rice growth (red polygons) observed in one month after non-native aquatic vegetation removal.

Texas wild-rice was planted in areas denuded of non-native aquatic vegetation in the San Marcos River downstream of Sewell Park (Figures 3-20 and 3-21). An estimated total number of Texas wild-rice planted throughout the San Marcos River in 2013 was 3,068 individuals (59% obtained from SMARC and 41% from the Freeman Aquatic Building) that covered 20-50% of the denuded area (Table 3-10). Net gain of Texas wild-rice area was 383 m^2 within the areas denuded of non-native vegetation followed with Texas wild-rice planting throughout all areas planted. A majority of Texas wild-rice area increase was observed downstream of Sewell Park (203 m^2).

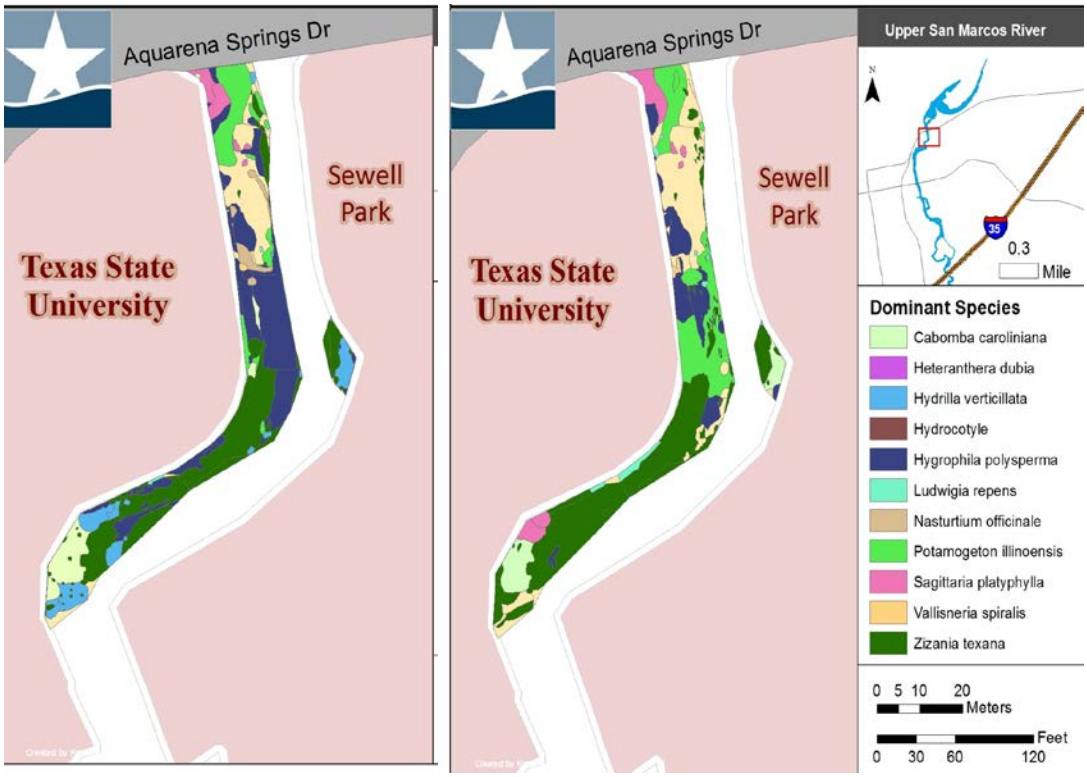

Figure 3-20. Spring 2013 and fall 2013 vegetation maps showing extent of non-native plant removal and Texas wild-rice enhancement.

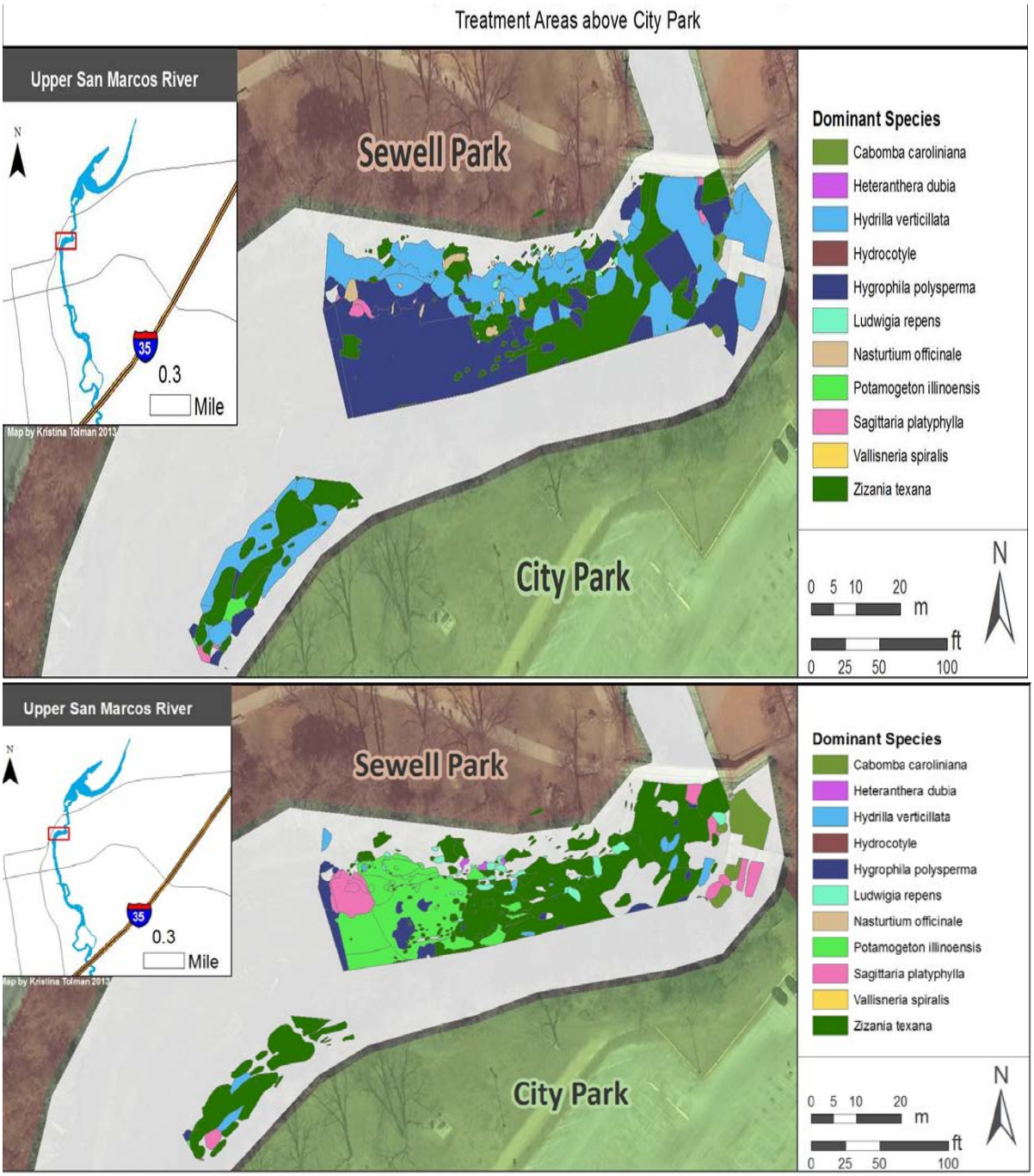

Figure 3-21. Spring and fall 2013 vegetation transects exhibit non-native removal and native/Texas wild-rice plant stand increases.

Table 3-12. Number of Each Native Vegetation Species Planted Monthly in the San Marcos River Downstream of Sewell Park (2013). *Zizania texana* individuals were not tracked to differentiate between City and University so the total was split in half.

	Month					
	June	July	August	September	October	**Total**
Zizania texana	521	487	49	84	393	1,534
Ludwig repens	154	152	38	191	447	982
Sagittaria platyphylla	157	38	72	44	978	1,290
Heteranthera dubia	23	-	-	5	125	153
Hydrocotyle umbellate	-	-	-	-	15	15

Among the grids, 95% tiller growth and plant expansion was observed with growth observed in as little as a month (Figure 3-19). Texas wild-rice expansion was generally observed laterally to an existing patch or on the downstream portion of the patch among all ranges of depths and current velocities measured. No growth was observed at the upstream side of a Texas wild-rice patch.

Modifications Due to Drought Conditions:
Texas wild-rice plantings were shifted to areas of greater depth to prevent the stand from becoming emergent with any further decrease in flow.

Proposed Activities for 2014:
In 2014, the City of San Marcos will continue to maintain existing Texas wild-rice stands and plant stands in areas where new habitat has been created through sediment removal and aquatic vegetation restoration. The 2014 goal is to add 1,100 m^2 of additional Texas wild-rice to the system.

3.3.2 Management of Recreation in Key Areas (EAHCP §5.3.2)

Obligations:
The City of San Marcos will implement recreation mitigation measures approved by the San Marcos City Council on February 1, 2011. These include, but are not limited to, trespassing enforcement on private riverfront property, implementation of buffer zones around designated recreation areas, a robust river education program, removal of silt to restore the river to more natural conditions, increasing enforcement measures for violators of river-related recreation management restrictions, and the issuance of Certificates of Inclusion to river outfitters to extend the protections of the ITP to those entities.

2013 Compliance Actions:
Several strategies were used by the City to manage recreation in key areas:

- Access control: A strategy was developed using hardened access points with a dense riparian buffer between all access points was implemented in 2013. These objectives are discussed in detail as part of two other EAHCP measures (Sections 1.2.10 and 1.2.13).
- Fencing: As part of the riparian restoration measure (Section 1.2.13), the City constructed fence on the upland edge of the plantings to protect them from trampling. This fence will be in place for multiple years to allow time for the plants to mature, which offers an effective opportunity for public outreach.

- Signage. Using the EAHCP sign template created by the EAA, the City produced ten signs discussing each EAHCP project, listed species and the uniqueness of the San Marcos River, and placed them at each of the fence sites. A sign was also produced discussing cultural history and will be placed at Ramon Lucio Park – the site of the bank stabilization/access point located furthest downstream. Three kiosks were constructed to display signs produced by the TPWD – two located in Sewell Park and one in Bicentennial Park.
- Conservation Crew. This work team was developed to educate the public about the EAHCP, but their primary focus was on Texas wild-rice stands in high recreation areas. The team was composed of nine university students. They began work May 27th with an orientation at the San Marcos Aquatic Resource Center (SMARC). On June 5th, the Conservation Crew began working Wednesday-Sunday, and worked through the Labor Day weekend. Four crewmembers worked in teams of two each day from 11:00 AM – 7:00 PM with two crew members kayaking the river and two crewmembers walking the banks in an effort to maximize river user contact. Duties performed by the crew included interacting with people using the river and riverside parks to help increase public knowledge about Texas wild-rice, clearing vegetation mats from surface of Texas wild-rice stands, emptying litter boats during the recreation season, monitoring , and picking up litter along and in the river.
- Establishment of a recreational baseline. Meadows Center for Water and the Environment (MCWE) took video at hourly intervals at four locations along the river from Sewell Park to Rio Vista Falls to obtain a baseline of recreational use. These data are being analyzed and correlated with turbidity and water quality data from these reaches.
- Assisted TPWD with public outreach regarding the State Scientific Areas by providing barriers, signage, and informational kiosks as seen in Figure 3-22.

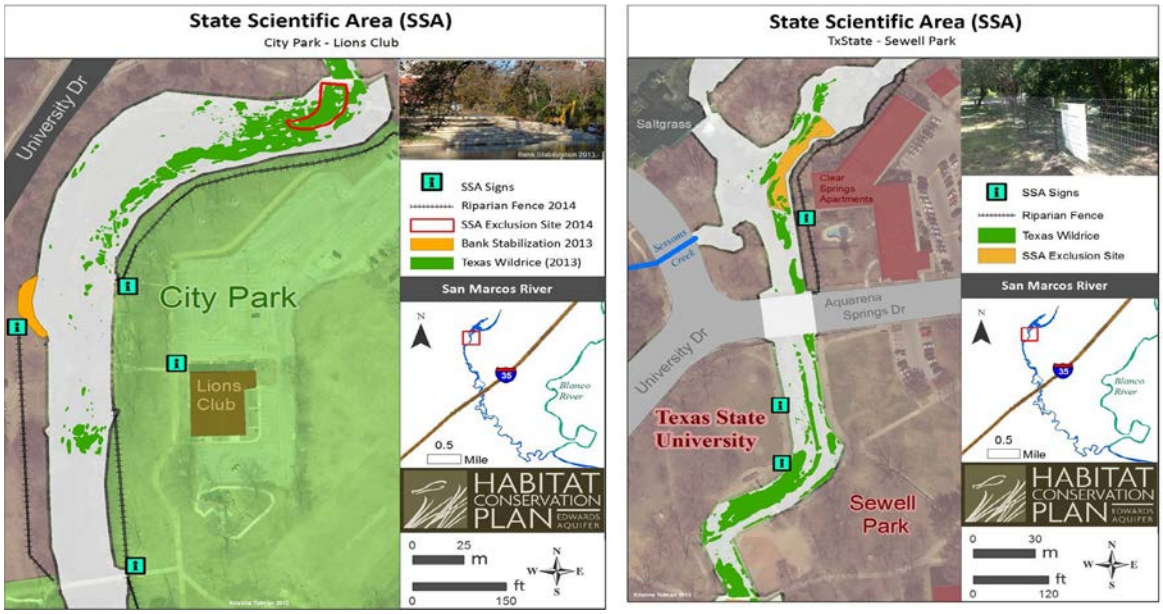

Figure 3-22. Location of SSAs, kiosks and signage along the San Marcos River.

Action has been taken on the following tasks:

- Buffer Zones. Rio Vista Falls has a 100-foot buffer zone on the east side of the river that excludes picnic tables, pop-up tents, shelters and portable grills. The riparian restoration measure is setting up multiple buffers from upper Sewell Park to IH 35.
- Education.
    - Signage. Kiosks and fence signs have been posted by Clear Springs Apartments, Sewell Park, and Bicentennial Park. TPWD and City/University are working on Spanish translations of their signs. The EAA sign template is used as the background for most of the signs.
    - Overall Interpretation Plan. A master plan is under development for location and type of all park signage to ensure an aesthetic and effective effort.
    - Stencil on rented tubes. Applied stencils rubbed off over time so this action was eliminated. The video loop at City Park and signage while tube renters are queuing will replace this action.
- Reduce turbidity through watershed management strategies. This action is fully covered as discussed in Section 1.2.17.
- Partnership between the City and University. The Conservation Crew monitors both City and University property and is supported by City Park Rangers and University Police. A pre-recreation season meeting is held with University and City law enforcement to ensure a cohesive approach to recreation management. Additionally, the Habitat Conservation Plan Manager is funded equally by University and City to ensure a unified approach.

Modifications Due to Drought Conditions:
The drought caused lower flow rates in the San Marcos River which resulted in increased accumulation of floating vegetation on Texas wild-rice stands and litter on the substrate. Therefore, removal of vegetation mats from Texas wild-rice stands as well as litter removal frequency increased as flows decreased to minimize potential impacts.

Proposed Activities for 2014:
The City of San Marcos in 2014 will continue to implement education programs targeting river users about sustainable river use and the listed species. Texas State University will gather information on recreational use of the river and potential impacts of those activities on the ecosystem. The Conservation Crew, a paid group of individuals responsible for educating the public, informing authorities of destructive behavior, and conducting miscellaneous clean-up of the system will be present from Memorial Day to Labor Day.

3.3.3 Management of Aquatic Vegetation and Litter below Sewell Park (EAHCP §5.3.3)

Obligations:
The City of San Marcos will dislodge floating vegetation mats on the river's surface to facilitate their movement downstream. The City will additionally remove inorganic litter regularly during the recreation season.

2013 Compliance Actions:
Pristine Texas Rivers Inc. (PTR) removes inorganic litter from the surface of Spring Lake to City Park, and uses SCUBA equipment in those same locations to remove underwater litter (Figures 3-23 through 3-27). PTR has identified litter "hot spots" and tracks them throughout the year (Figure 3-24). They also walk the four San Marcos River tributaries (Figure 3-25) and collect litter in mesh bags. The monthly totals of litter removed exhibit the importance of focusing on areas downstream of IH-35 and the tributaries (Figures 3-26 and 3-27). Due to the low amounts of litter collected in Spring Lake, this activity will be accomplished by the University as needed under the Spring Lake Management Plan.
PTR collected large debris consistently, primarily from the tributaries. The large debris included tires, road cones, PVC, and metal building materials. PTR found that the heavy rains in May and October deposited increased amounts of litter so during those two months PTR focused on the section below IH-35 and accessible areas behind the flood control dams on Sink and Purgatory Creeks. By July, PTR had reduced recent depositions of litter in the river, and older deposits were becoming visible – mostly below Rio Vista Falls. They are uncovering more old debris with every pass. PTR also noticed a reduction in new litter when the City implemented the No Alcohol and No Styrofoam ordinances this summer

Modifications Due to Drought Conditions:
PTR increased time spent removing floating mats, particularly from Texas wild-rice stands because floating mats accumulated more quickly on plant stands as flows decreased. Similarly, litter removal increased because low flow facilitated litter collection.

Due to increased accumulation of vegetation mats on stands of Texas wild-rice, both the Conservation Crew and MCWE personnel spent time removing mats from the system.

Proposed Activities for 2014:
In 2014, the City of San Marcos will continue to implement floating vegetation mat and litter removal consistent with protocols established in the EAHCP and in the 2013 program.

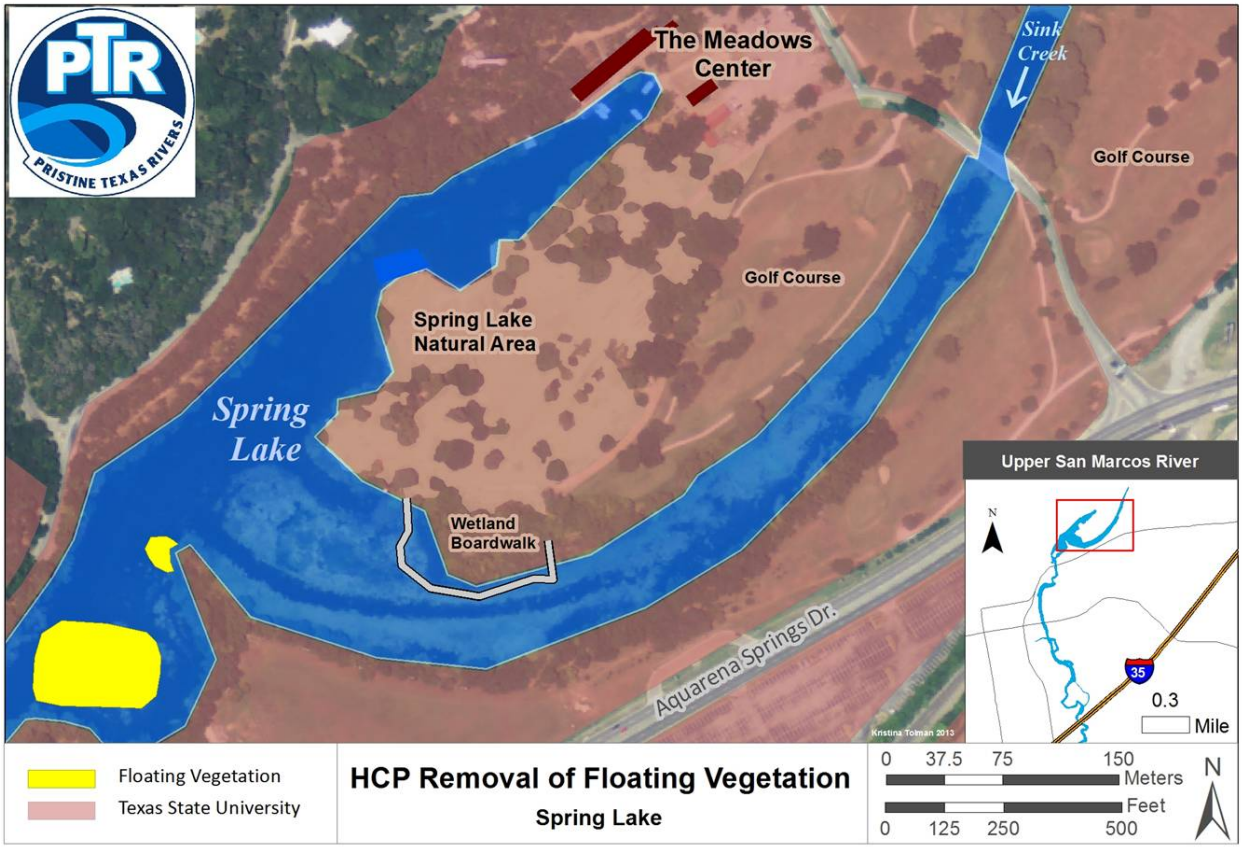

Figure 3-23. Location of floating vegetation and litter removal in Spring Lake.

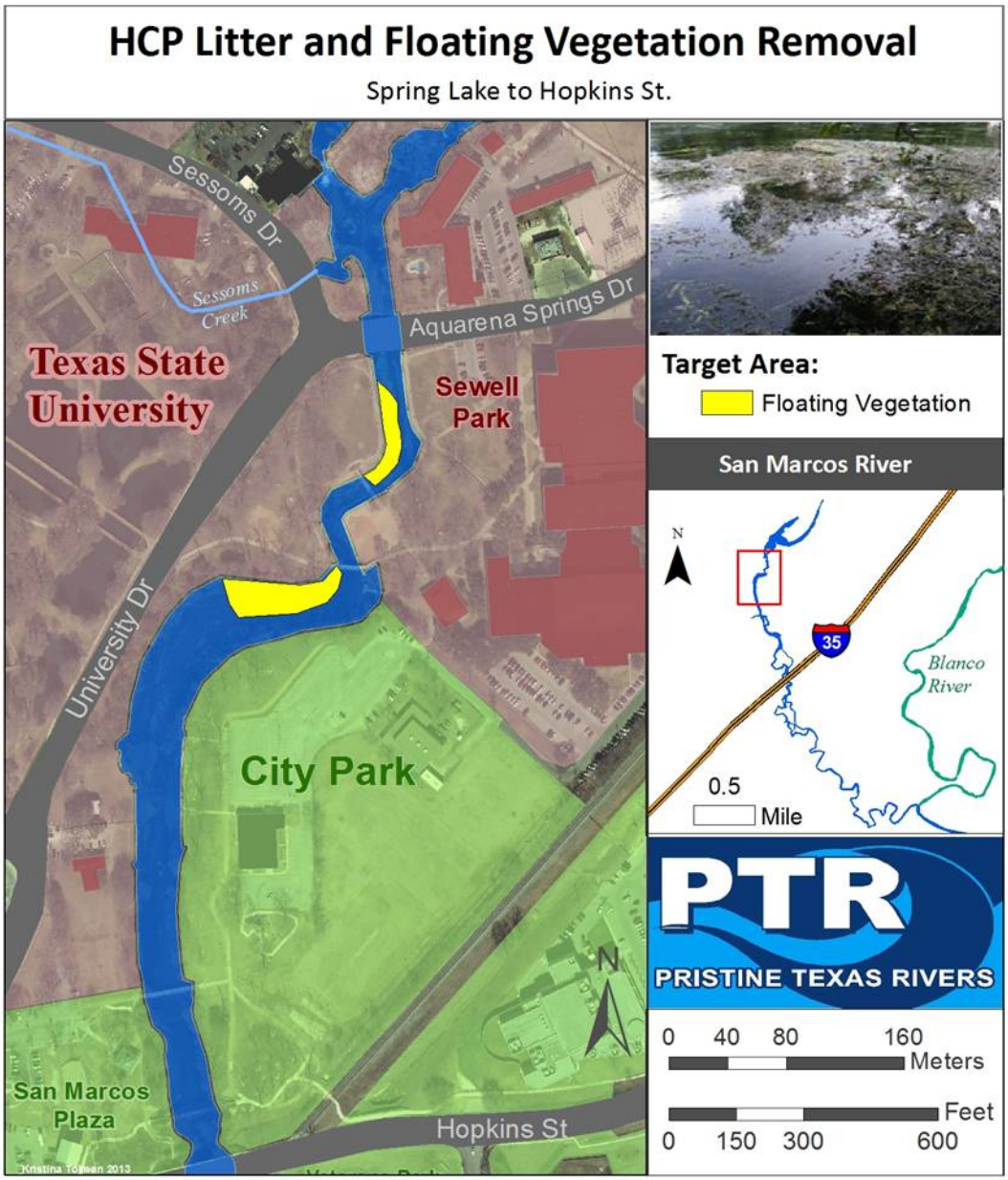

Figure 3-24. Location of litter removal in Sewell and City Parks.

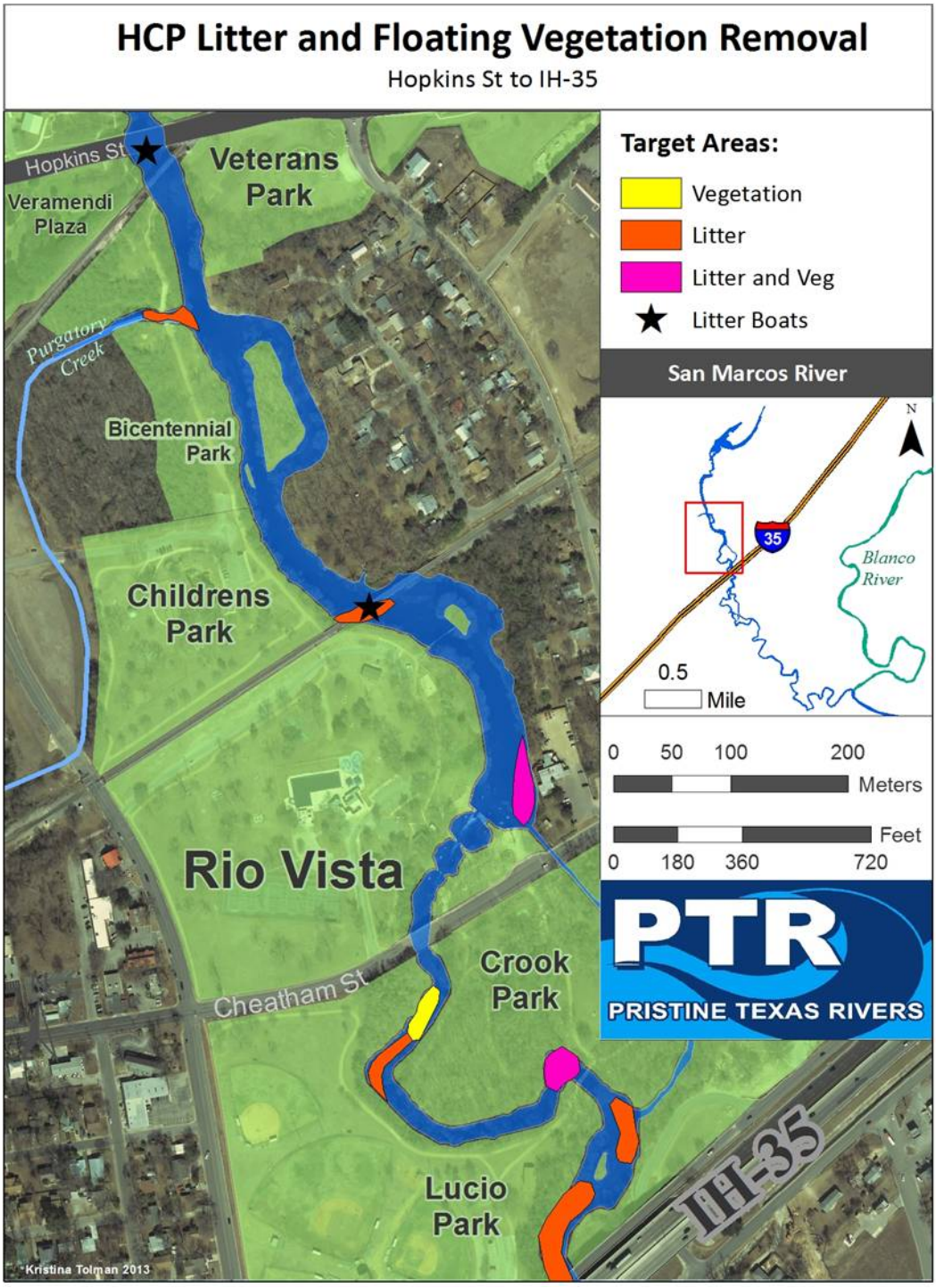

Figure 3-25. Location of litter and floating vegetation removal along with litter boat station.

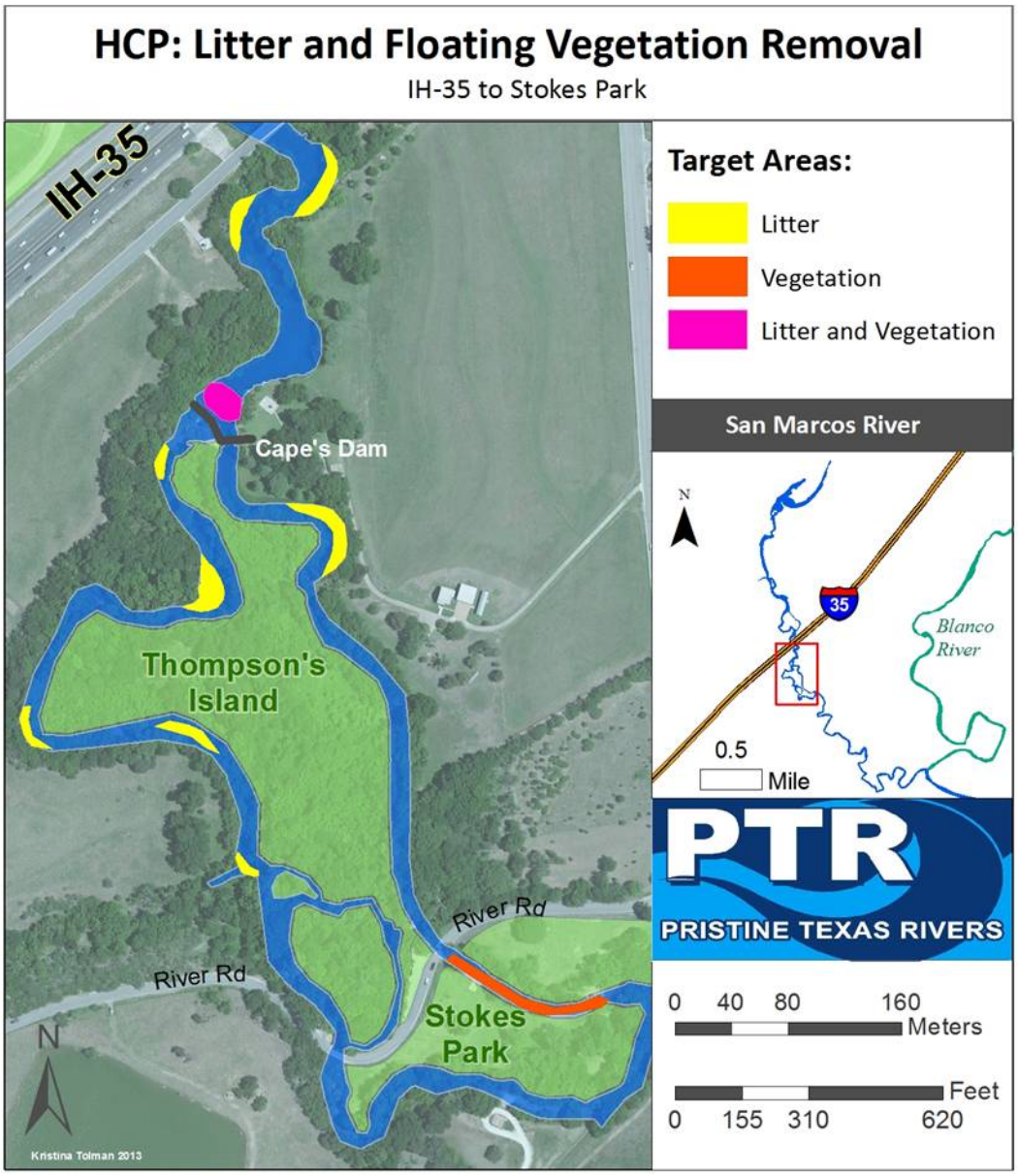

Figure 3-26. Removal of litter and floating vegetation below IH-35.

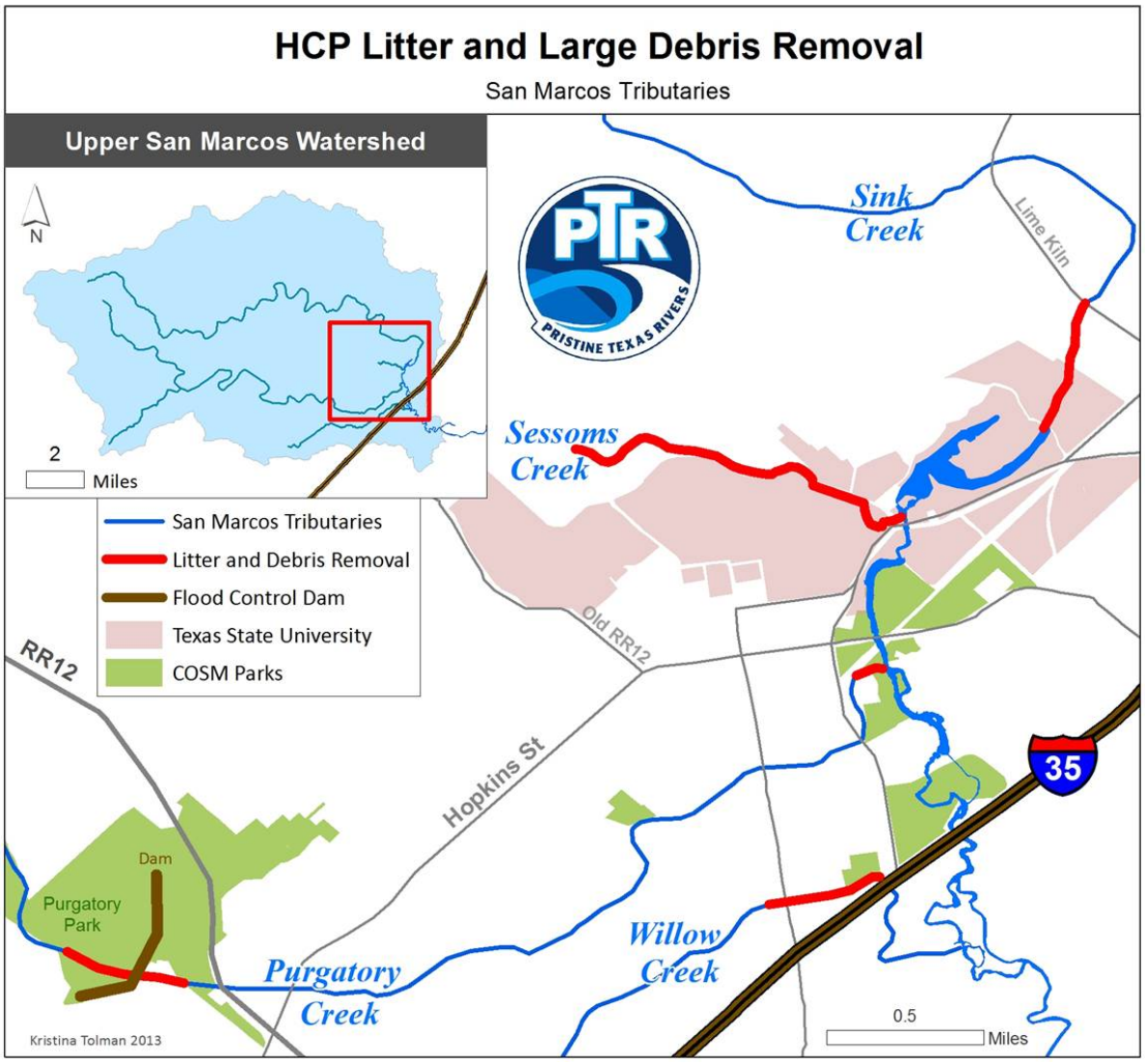

Figure 3-27. Areas of the San Marcos River tributaries cleaned by PTR.

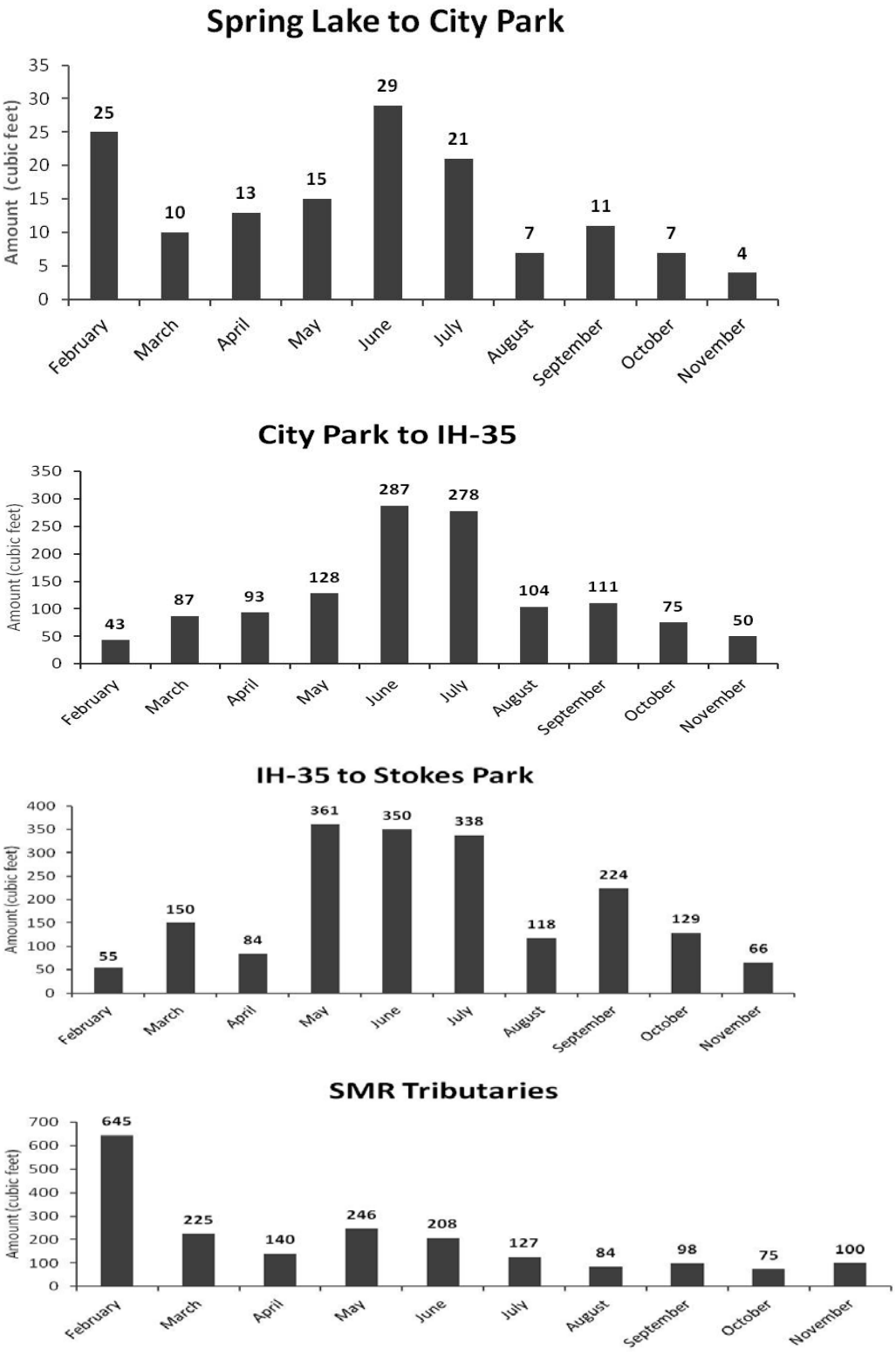

Figure 3-28. Amount of litter collected through 2013 by river segment.

3.3.4 Prohibition of Hazardous Materials Transport across the San Marcos River and its Tributaries (EAHCP §5.3.4)

Obligations:
The City of San Marcos will coordinate with TxDOT to designate routes for the transportation of hazardous materials that will minimize the potential for impacts to the San Marcos River and its tributaries.

2013 Compliance Actions:
The City has initiated the below TxDOT process to designate Wonder World Drive from IH-35 to RR12 as a HAZMAT Route (Figure 3-29). This process is based on the document titled *Traffic Operations Manual*, Chapter 5 Regulatory Signs, Section 7 Non-Radioactive Hazardous Materials Routing. The City is working with Ben Englehardt from TxDOT.

Figure 3-29. Proposed HAZMAT route.

Authority

Rules for Non-radioactive Hazardous Material (NRHM) routing are contained in the Texas Administrative Code under Title 43, Sections 25.101–25.104. These rules authorize a political subdivision of a state to establish NRHM route designations consistent with the federal regulations (Title 49, Code of Federal Regulations, Part 397, Subpart C). As the state routing agency, TxDOT is required to approve all new NRHM routing designations or revisions to existing routing designations. A city or political subdivision cannot simply pass an ordinance to establish an NRHM route. In establishing or revising an NRHM route, a political subdivision must comply with both federal and state regulations for NRHM routing (49 CFR, Part 397, Subpart C, and 43 TAC, Sections 25.101–25.104).

Financial Responsibility

The City is responsible for all costs of NRHM route development, including proposal preparation, public hearings, signs, sign supports, sign installation, and sign maintenance. The TxDOT local district office should obtain or amend any agreements as appropriate.

The following steps outline the process of establishing or revising an NRHM route.

Step 1: Initial Contact (*Accomplished – Ben Engelhardt*)

A political subdivision considering the establishment of an NRHM route must contact the local TXDOT district office and any other political subdivisions within a 25 mile radius of any point along the proposed route. The political subdivision must consult with the district office and other affected political subdivisions during the process of determining the best NRHM route. Coordination with the Texas Department of Public Safety (DPS) and the local emergency planning council or committee is encouraged. The district office is encouraged to contact TRF for assistance with the procedures.

Step 2: Route Analysis and Proposal (*Accomplished – Wonder World Drive from Hunter Road to RR12*)

The political subdivision must develop a route proposal. The written proposal must address all of the federal standards and factors listed in 49 CFR Section 397.71(b). The political subdivision must use the most current version of the United States Department of Transportation publication entitled Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials or an equivalent routing analysis tool to develop the route proposal. If an equivalent routing analysis tool is used, the political subdivision must include in its route proposal a written explanation of how the tool is equivalent to the United States Department of Transportation standards.

Step 3: Local Public Hearing

The political subdivision must hold at least one public hearing on the proposed NRHM routing designation. Public hearings may take the form of a city council or commissioner's court meeting and must conform to all applicable state laws governing public meetings, including the Texas Open Meetings Act, Government Code, Chapter 551. Public notification of the hearing must comply with the following criteria:

- The public must be given 30 days prior notice of the hearing through publication in at least two newspapers of general circulation in the affected area, one of which is a newspaper with statewide circulation.
- The notice must contain a complete description of the proposed route, including the location, route name, highway number if the route is on the state highway system, and beginning and ending points of the route. The notice must also provide the date, time, and location of the public hearing.

- The notice must initiate a 30-day public comment period and inform the public where to send written comments.

Step 4: Proposal Submission
After performing the analysis and conducting a local public hearing, the political subdivision must submit eight copies of the NRHM route designation proposal and one original color map of the proposed NRHM route to TRF for approval.

Step 5: Proposal Review
TxDOT Public Hearing. TRF will provide the public with notice through publication in the Texas Register and a 30-day period in which to comment. TRF will also conduct a public hearing to receive additional comments on the proposed NRHM routing designation. TRF will publish a notice satisfying the criteria described in Step 3 above. The notice must be published in two newspapers of general circulation in the affected area. The public hearing must be held in Austin, Texas. The public hearing must be conducted before the executive director or the designee of the executive director.

Step 6: Authorization and Approval
If TxDOT determines that a route has met all of the criteria for approval, TRF will submit the proposed NRHM routing designation to the TXDOT executive director for approval. Upon approval by the TxDOT executive director, TRF will notify the political subdivision in writing that the proposed routing designation is authorized, and will issue appropriate notice to the Federal Highway Administration and the Texas DPS.

Step 7: Route Designation and Signing Designation
Upon receipt of a letter of approval from TxDOT, the political subdivision must designate the NRHM route by ordinance, resolution, rule, regulation, or other official order. The political subdivision must forward a copy of the order to TRF within 30 days of receipt of the letter of approval.

Step 8. Signing
After passage of the order, the political subdivision must submit the proposed sign and installation locations of the NRHM route designation to the local TxDOT district office for approval. All signs must conform to the latest version of the Texas Manual on Uniform Traffic Control Devices (see "Route Signing Guidelines" below). The local TxDOT district office should submit the proposed signing schematic to TRF for review. The political subdivision must coordinate sign installations with the local TxDOT district office prior to placement.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
The City of San Marcos, in 2014 will coordinate with TxDOT to implement hazardous material route restrictions and develop appropriate signage.

3.3.5 Reduction of Non-Native Species Introduction (EAHCP §5.3.5)

Obligations:
The City of San Marcos will partner with Texas State University and other groups to establish an education campaign targeted at reducing the introduction of non-native species into the river system. The City of San Marcos will also provide opportunities for people to dispose of unwanted aquatic animals and plants to deter aquarium dumps into the river system.

2013 Compliance Actions:
All of the pet stores in the City of San Marcos were visited and given materials advertising a "give-back" program to reduce aquaria dumping in the San Marcos River. Only one pet store agreed to take aquaria species back so the City will be concentrating on contained ponds as the centerpiece of the "give-back" program. The City is collaborating with the University to identify a location for a pond that would function as a drop-off location for unwanted aquaria plants and animals for students. Similarly, the City has purchased a receptacle for unwanted aquaria species which will be placed at the San Marcos Nature Center. Nature Center staff will maintain the pond and the aquaria species.

The San Marcos Nature Center uses hands-on teaching tools for visiting school groups educating K-5 students about the importance of not dumping aquaria into the San Marcos River (or any river). Over 500 students per year visit the San Marcos Nature Center for this activity.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
The City of San Marcos, in partnership with Texas State University, will continue to provide educational information to local pet shops and commercial retailers that sell aquatic species.

3.3.6 Sediment Removal below Sewell Park (EAHCP §5.3.6)

Obligations:
The City of San Marcos will remove sediment from several areas along the river between City Park and IH 35. Sediment removal efforts will specifically target potential Texas wild-rice habitat. Collected sediment samples will be sent to the TCEQ to be tested for contaminants, per TCEQ requirements.

2013 Compliance Actions:
A 3-inch hydrosuction hose was used to remove accumulations of fine sediment within the San Marcos River. Divers were trained on equipment operations, diving safety protocols, and recognition of all stages of listed species from larval to adult prior to any sediment removal. Before dredging, vegetation was removed and the area was fanned to encourage fountain darters and other biota to move out of the area. Sediment was removed using a 3-inch suction hose with a ¼ inch strainer on the end. Removed sediment was pumped into a settling area or catchment pit that was surrounded by sediment fence and sediment noodles to prevent sediment runoff (Figure 3-30).

Topography was collected prior to dredging at river sites using the comparative cross section method. Topography measurements were collected in two reference locations (i.e., Sewell Park and just downstream of IH 35 at the Olympic Outdoor Center). Four cross sections representative of each site's topography were completed 15 m to 25 m apart, depending on river width. A minimum of 25 elevation points were collected along each cross section. Post dredging topography was only collected at the confluence of Purgatory Creek site since it was the only site dredging was completed.

The University was approved to remove fine sediment in the San Marcos River at two locations, just upstream of City Park and at the confluence with Purgatory Creek (Figure 3-32). Dredging at Site 1 was delayed until mid-November due to permitting issues and determining the most efficient method of retaining the fine sediment once it was dredged. Approximately 86 m^2 (i.e., 44 m^3) of fine sediment was removed at the confluence of Purgatory Creek and the San Marcos River from August – November 2013 (Table 3-13).

Figure 3-30. Catchment areas for suction dredge discharge at Bicentennial and City Parks.

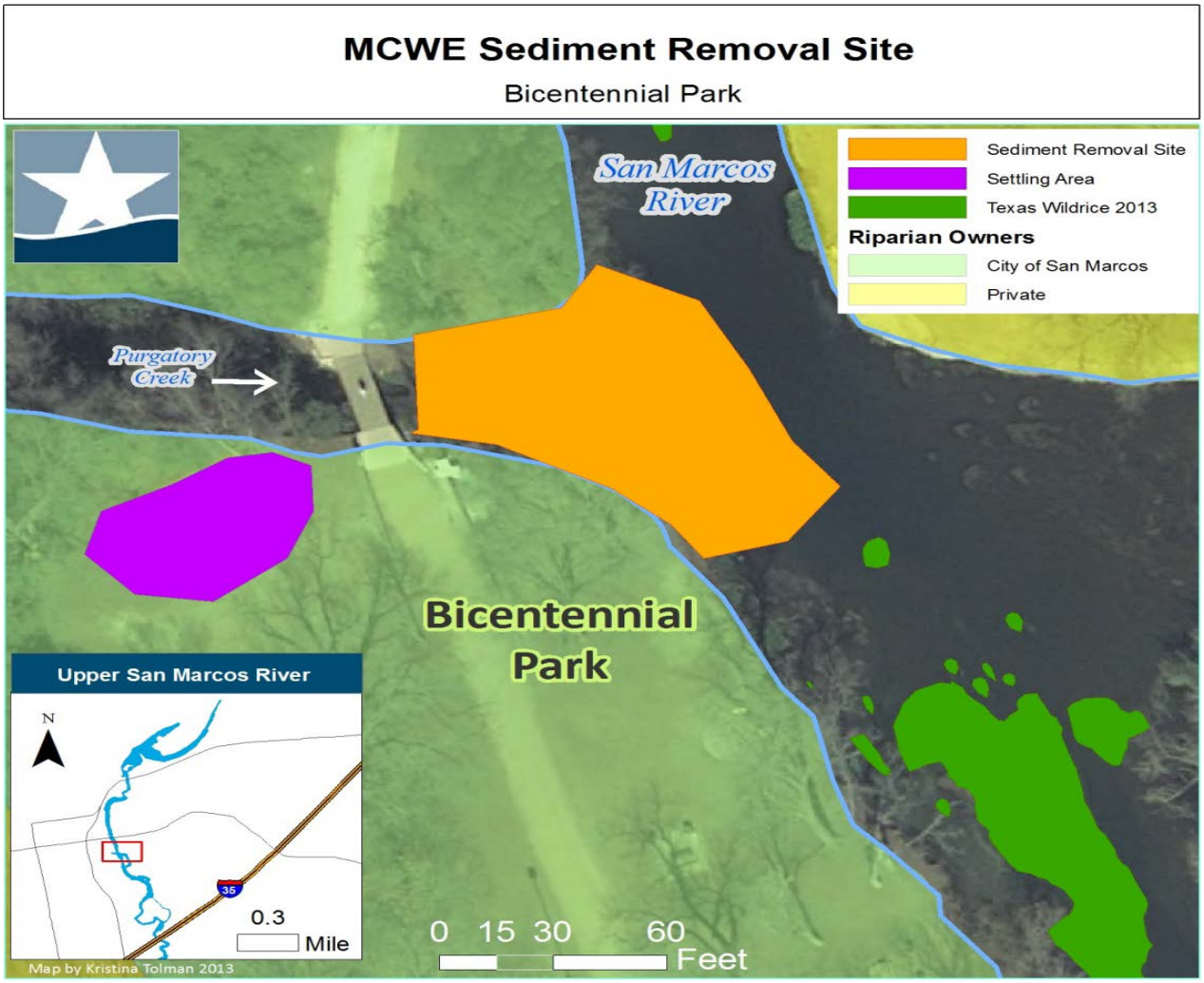

Figure 3-31. Sediment removal and discharge sites at Bicentennial Park.

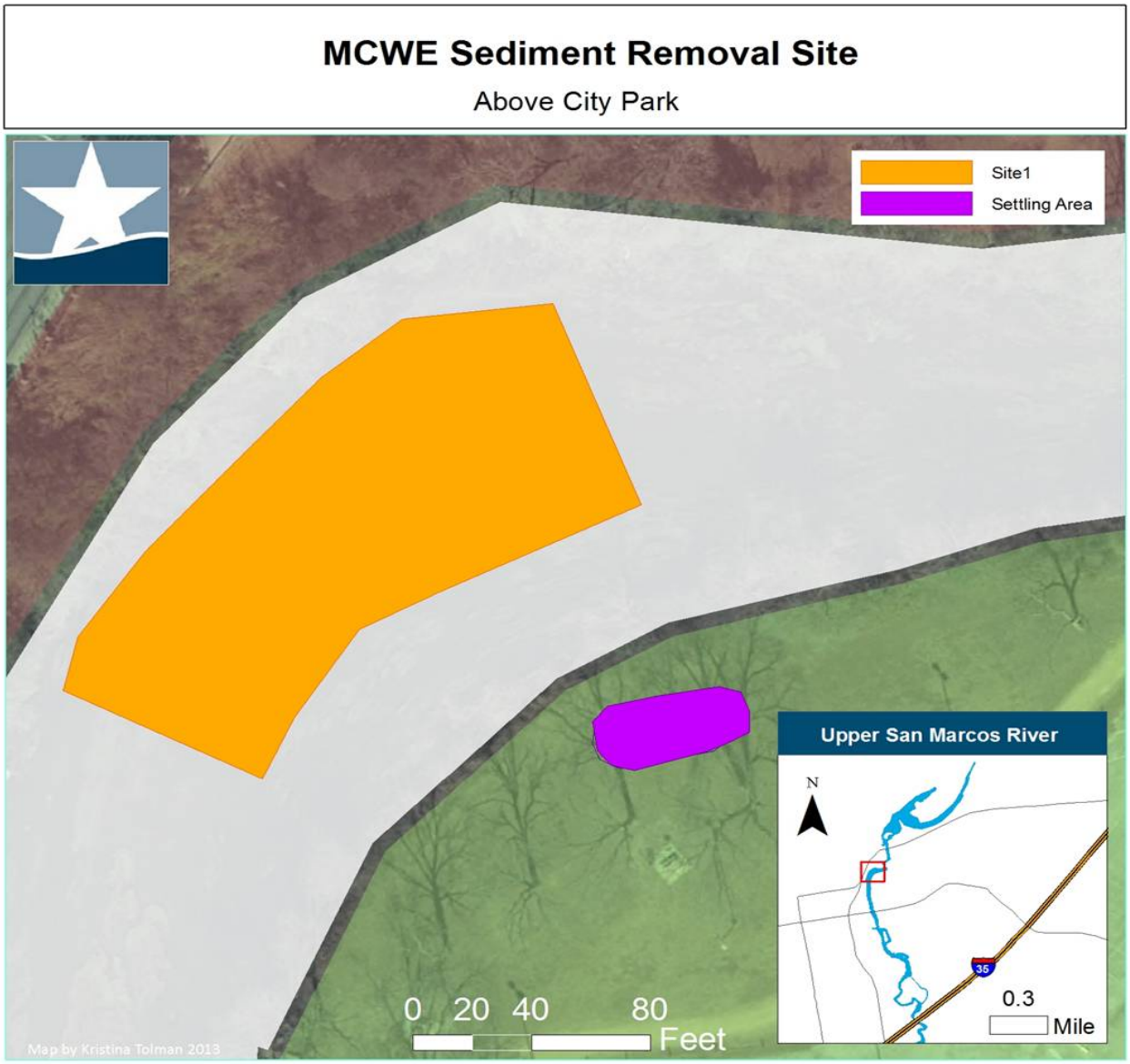

Figure 3-32. Sediment removal and discharge sites at City Park.

Table 3-13. Monthly Estimates for Fine Sediment Removal (m^2 and m^3) in the San Marcos River at the Confluence with Purgatory Creek

Month	Sediment Removed	
	m^2	m^3
August	6	3
September	38	20
October	42	21
Total	**86**	**44**

Changes in river bed elevation were only observed in cross section 3 at the dredge site located at the confluence with Purgatory Creek (Figure 3-33). Only minimal changes in bed elevation were observed in cross sections 1, 2, and 4, which were among non-dredge areas of the site. Dredging in the area of cross section two dropped the bed elevation on average two feet. The underlying sediment went from being mostly composed of silt to a mixture of clay, cobble, and sand. Figure 3-34 illustrates the drop in bed elevation in the areas dredged.

Figure 3-33. Example of bed elevation changes attributed to dredging in the San Marcos River at the confluence of Purgatory Creek. Area to left of black line has been dredged whereas the area on the right has not.

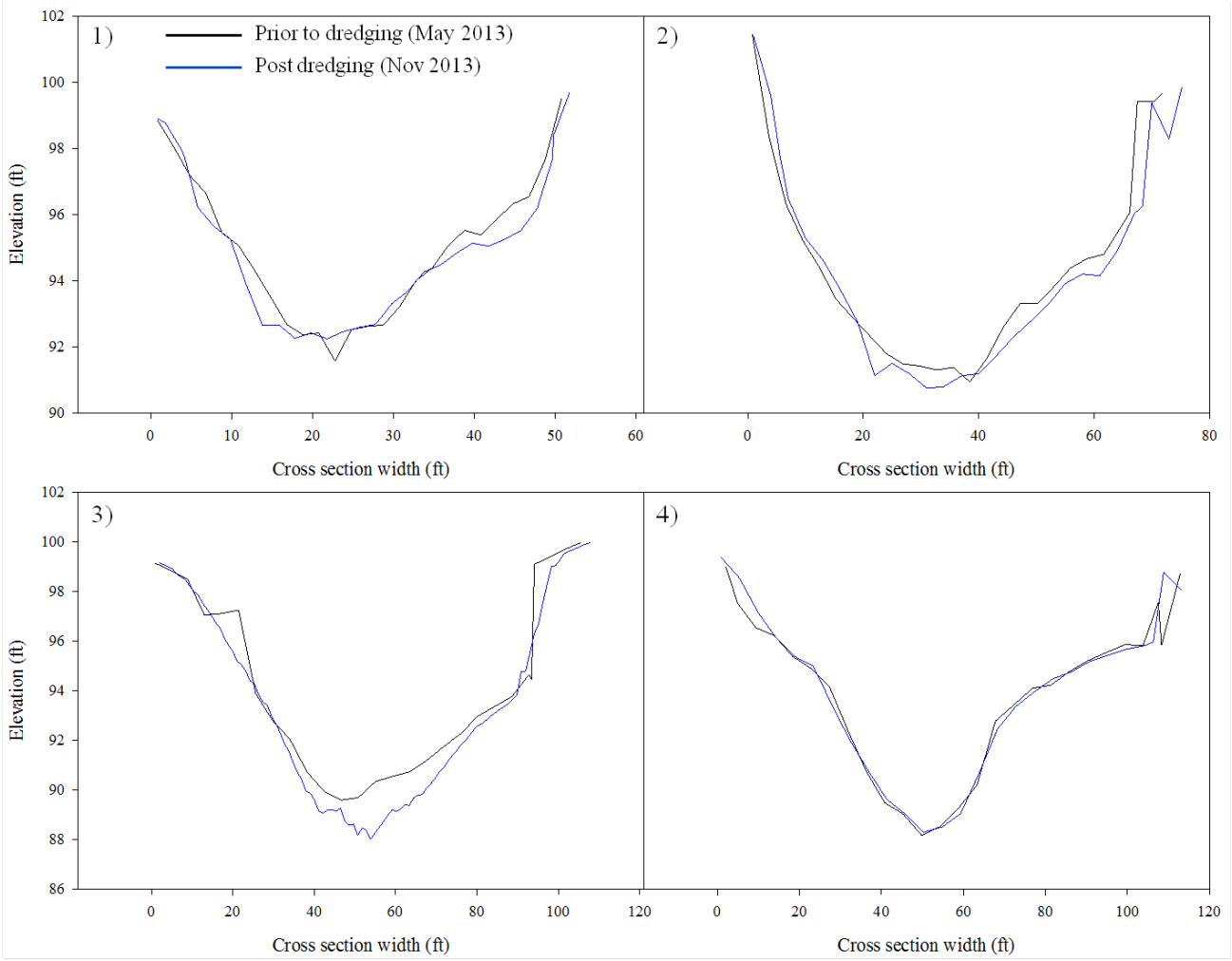

Figure 3-34. Cross section profiles prior to dredging (black line) and post dredging (blue line) for the dredge site located at the confluence of Purgatory Creek on the San Marcos River. Dredging occurred mostly around cross section 3 with little to no dredging at cross sections 1, 2, & 4.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of San Marcos will remove a total of approximately 1,000 m^2 of fine sediment from the river bottom.

3.3.7 Designation of Permanent Access Points and Bank Stabilization (EAHCP §5.3.7)

Obligations:
The City of San Marcos will stabilize banks in City Park, at the Hopkins Street underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and at the Cheatham Street underpass. Bank stabilization will be conducted using stone terraces and native vegetation along the riparian zone. The City of San Marcos

will incorporate permanent access points to facilitate river entrance by recreationists that is more protective to the species and their habitats.

2013 Compliance Actions:
One of six bank stabilization/access points was completed in December and the other five sites are under construction to be completed by March 2014 (Figure 3-35). These sites are constructed of natural rock and are strategically placed to offer the public several points of access while eliminating public access between these six sites (Figures 3-36 through 3-40).

Figure 3-35. Natural rock was used to build bank stabilization/access points.

All bank stabilization/access points were heavily eroded areas that experienced intense use by the public to access the river. This strategy of providing access points and enhancing riparian zones provides a balance between recreation and maintaining a healthy riparian buffer and river bank.

Immediately prior to construction, the area of disturbance within the river was surveyed for the presence of any biota. All observed fish were fanned away and the turbidity curtain was put in place to prevent their return. During construction, a 12-foot mulch log was staked in place along the line of open soil to prevent runoff of sediment and immediately upon completion of construction; all open soil was covered with either seed blanket or sod. The erosion control measures on the terrestrial construction area were 100% effective. The turbidity curtain retained silt for approximately ten minutes. Silt not retained washed downstream and settled within 100 feet.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
The City of San Marcos will complete the remaining five bank stabilization sites in 2014.

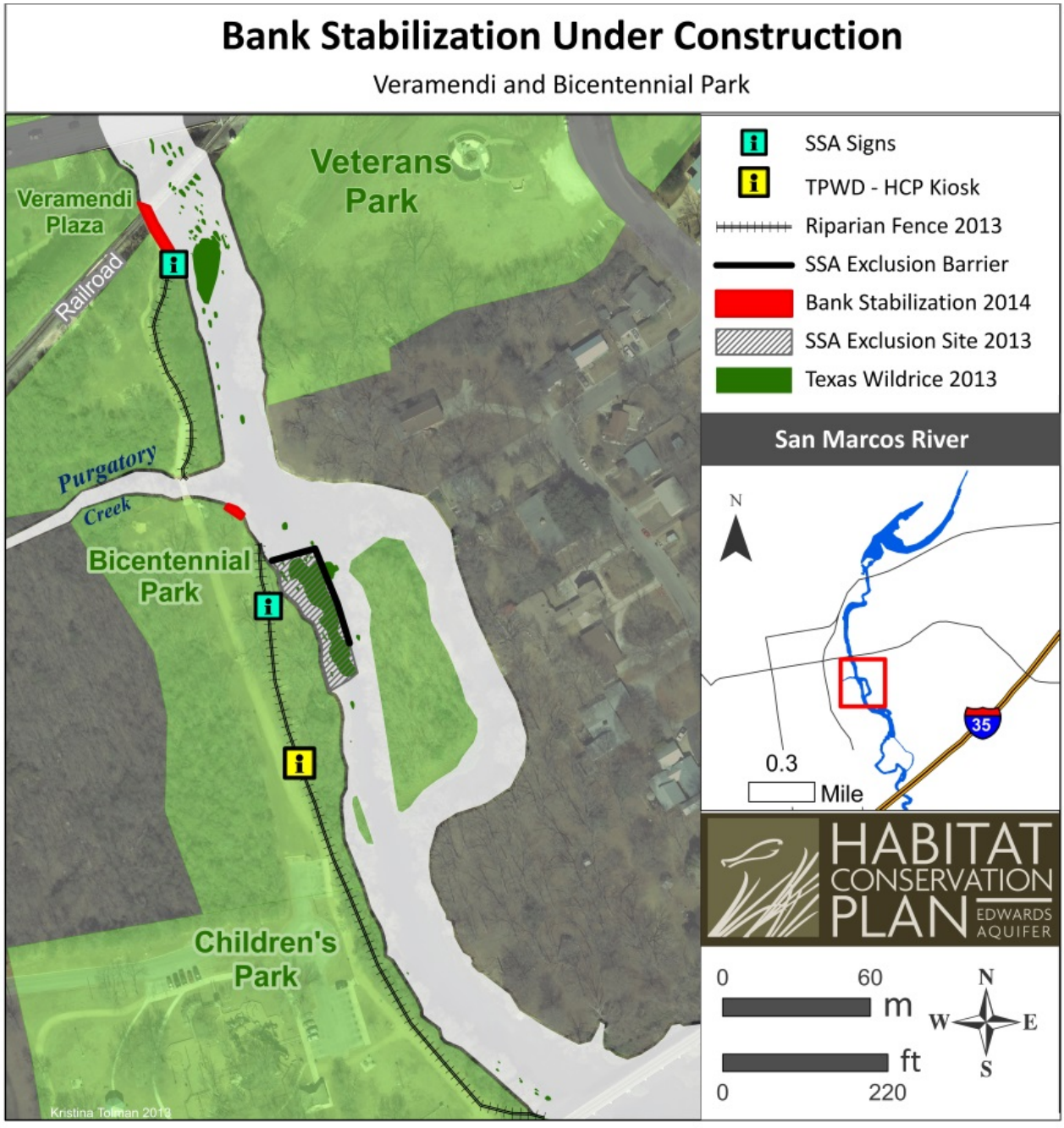

Figure 3-36. Veramendi and Bicentennial Park bank stabilization sites.

Figure 3-37. City Park—Lions Club bank stabilization site.

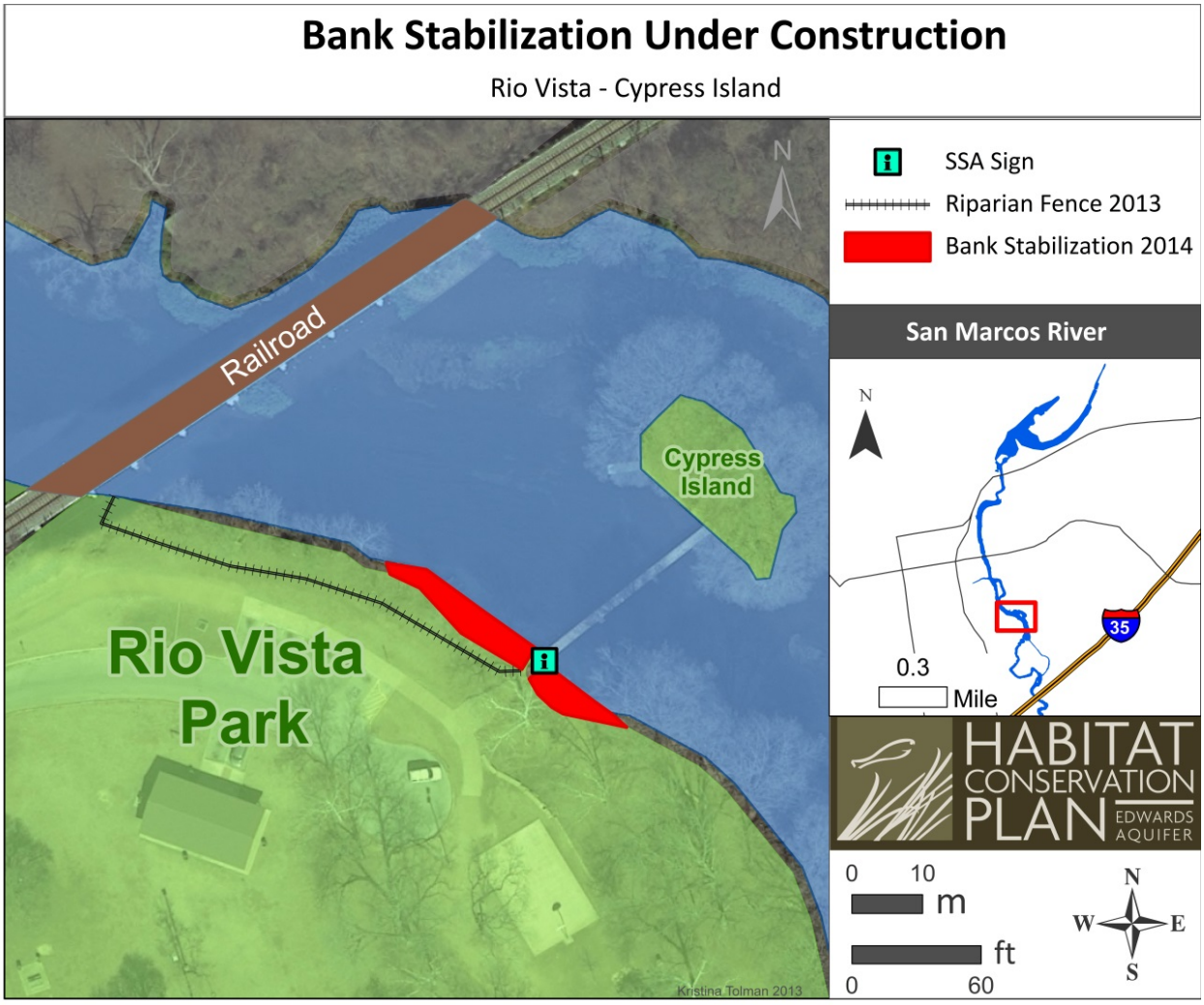

Figure 3-38. Rio-Vista—Cypress Island bank stabilization site.

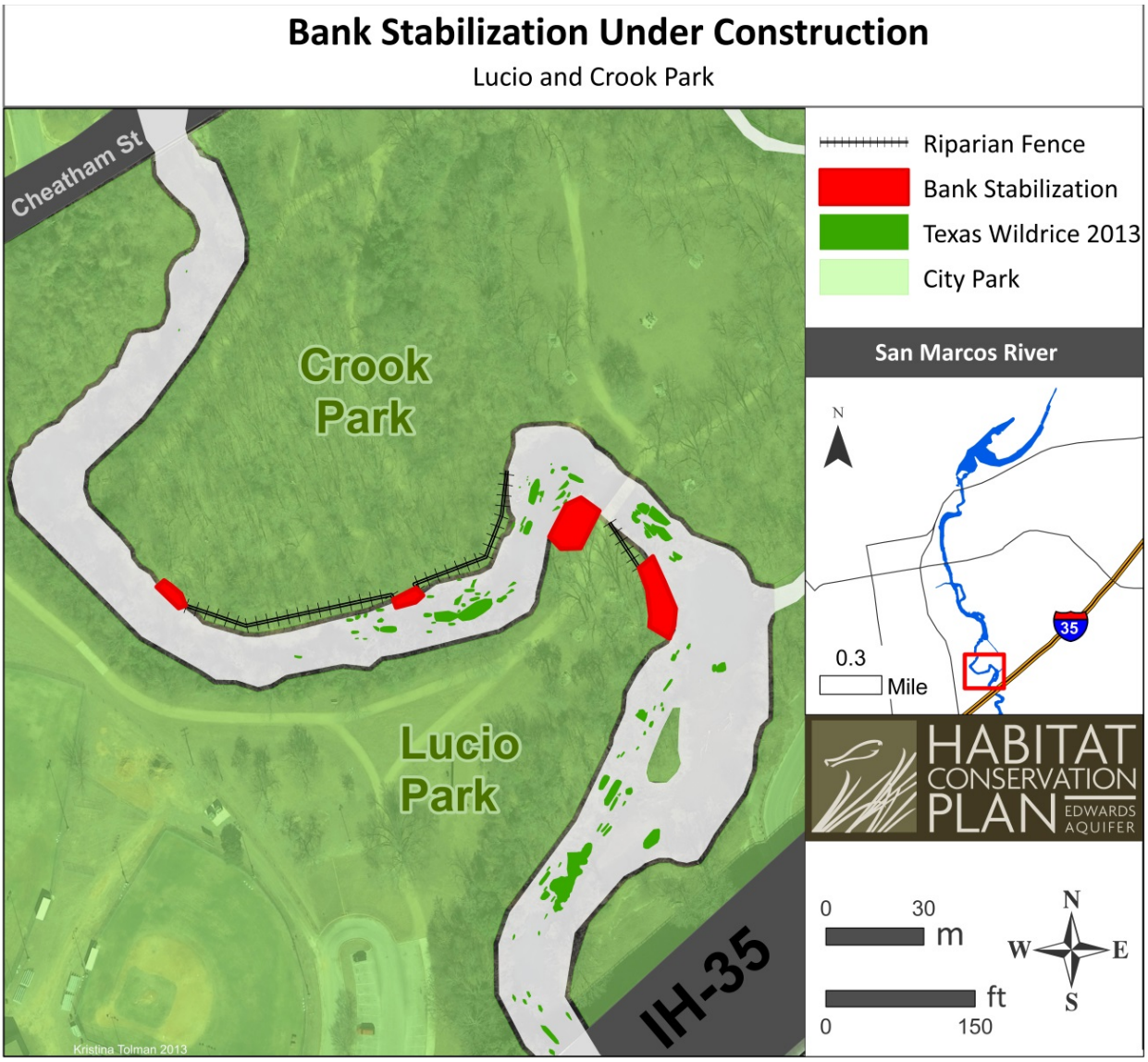

Figure 3-39. Lucio and Crook Park bank stabilization site.

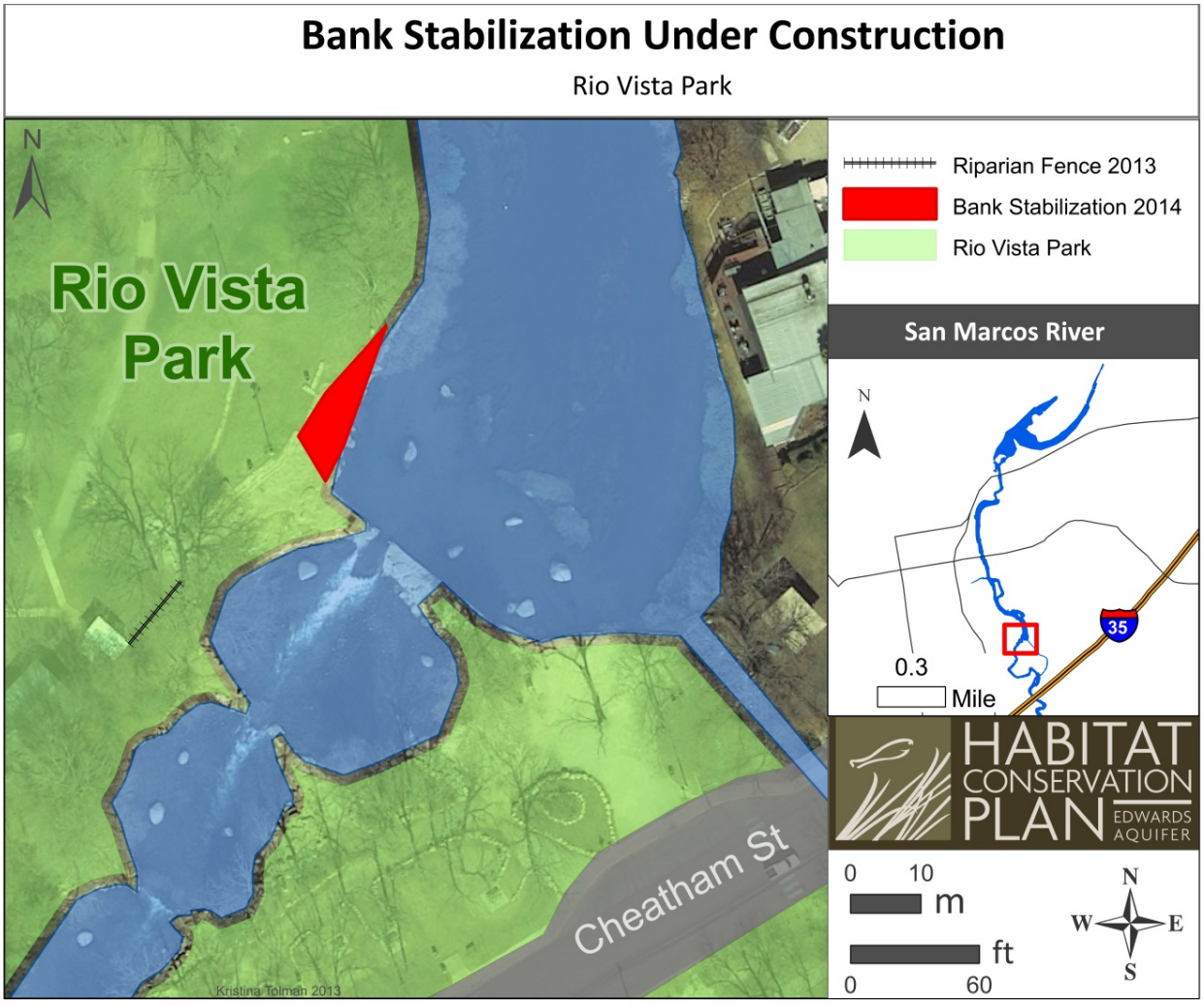

Figure 3-40. Rio Vista Park bank stabilization site.

3.3.8 Control of Non-Native Plant Species (EAHCP §5.3.8)

Obligations:
The City of San Marcos will partner with Texas State University to develop and implement a non-native plant removal program reaching from Spring Lake downstream to the city boundary. Aquatic, littoral, and riparian non-native plant species will be removed and replaced with native species. The riparian zone will be replanted to cover 15 meters in width where possible. Planting will be conducted at a ratio of three hard mast trees for every one soft mast tree, with 20% of plantings consisting of fruit-bearing shrubs. The City may install temporary fencing to protect the sensitive restored vegetation while it matures.

During sediment removal, divers will remove non-native plants from the riverbed, focusing particularly on hydrilla (*Hydrilla verticillata*); all removed non-natives will be bagged and disposed of in accordance with state laws.

2013 Compliance Actions:
Non-native Aquatic Plant Removal
Non-native aquatic vegetation removal focused on *Hydrilla verticillata* and *Hygrophila polysperma* as these species are the most actively invasive. Prior to non-native vegetation removal, the area was fanned to minimize incidental take of fountain darters and other native species. The non-native aquatic vegetation was removed, shaken and bagged for disposal at the City of San Marcos or Spring Lake composting facility. Denuded areas were targeted for Texas wild-rice or selected native aquatic species planting based on habitat preferences for each native species. Texas wild-rice and native species were obtained from the SMARC or from raceways located at the Freeman Aquatic Building. Initial efforts for restoration of Texas wild-rice or native vegetation were targeted at planting approximately 20% of the surface area restored. Aquatic vegetation was mapped using Trimble GPS units in work areas prior to non-native vegetation removal and native planting to assess changes in the vegetation community.

An estimated 1,513 m^2 of non-native aquatic vegetation was removed in the San Marcos River downstream of Spring Lake Dam to just upstream of City Park from May – November 2013 among areas physically worked by MCWE staff (Figure 3-41, Table 3-14). Changes in vegetation outside of the areas worked were not included since differences observed could not be attributed to work by the MCWE staff. The predominant non-native vegetation species removed were *Hydrilla verticillata* (~879 m^2) and *Hygrophila polysperma* (~576 m^2).

Removal of non-native vegetation just downstream of Sewell Park (top) and planting of native species. Red polygon denotes planted TWR.

Figure 3-41. Non-native plant removal (upper) with subsequent planting of Texas wild-rice (lower).

Table 3-14. Difference in Area (m^2) of Non-Native Vegetation Species in the San Marcos River Prior to (April 2013) and After (November 2013) Removal Activities

Species	April 2013	November 2013	Difference
Hydrilla verticillata	1004	125	-879
Hygrophilia polysperma	874	298	-576
Nasturtium officinale	58	0	-58

Ten fountain darter individuals were collected during non-native aquatic vegetation removal and returned to the river. One San Marcos salamander individual was also collected and returned to the river promptly. Other species collected and returned to the river included crayfish, sunfish species, and mosquito fish (Table 3-15).

Table 3-15. Animal Species Collected and Returned to the San Marcos River During Non-Native Vegetation Removal (2013)

Species	Month							
	May	June	July	August	September	October	November	**Total**
Lepomis sp. (sunfishes)	5	-	17	-	-	5	-	**27**
Etheostoma fonticola (fountain darter)	-	-	3	3	2	2	-	**10**
Gambusia sp. (mosquito fish)	1	1	1	2	2	2	-	**9**
Oreochromis aurea (tilapia)	-	-	-	1	-	-	-	**1**
Ameiurus sp. (bullhead catfish)	-	8	4	4	-	1	1	**18**
Poecilia sp. (mollies)	-	1	-	1	-	-	-	**2**
Micropterus salmoides (largemouth bass)	-	-	1	-	-	-	-	**1**
Ambloplites rupestris (rockbass)	-	7	4	-	-	-	1	**12**
Eurycea nana (San Marcos salamander)	-	-	1	-	-	-	-	**1**
Cambaridae (crayfish)	357	457	546	152	129-	135	20	**1,796**
Hirudinea (leech)	-	-	6	-	-	-	-	**6**

Table 3-16 denotes the number of each native vegetation species planted once an area was denuded of non-native vegetation. The highest number of individuals planted was Texas wild-rice (1,534) followed by *Sagittaria platyphylla* (1,290) and *Lugwigia repens* (982). Other native species planted were *Heteranthera dubia* and *Hydrocotyle umbellata*.

Table 3-16. Number of Each Native Vegetation Species Planted Monthly in the San Marcos River Downstream of Sewell Park (2013)

	Month					
	June	July	August	September	October	**Total**
Zizania texana	521	487	49	84	393	1,534
Ludwig repens	154	152	38	191	447	982
Sagittaria platyphylla	157	38	72	44	978	1,290
Heteranthera dubia	23	-	-	5	125	153
Hydrocotyle umbellate	-	-	-	-	15	15

An estimated 621 m^2 (540 m^2 net gain) increase in native vegetation species in the San Marcos River was observed within areas of removed non-native vegetation and followed with planting of native vegetation (Table 3-17, Figures 3-42, 3-43 and 2-44). Changes in native vegetation outside of the areas worked were not included since differences observed could not be attributed to work by the MCWE team. Among native species, *Zizania texana* increased the most (383 m^2) followed by *Sagittaria platyphylla* (104 m^2), *Ludwigia repens* (71 m^2), and *Cabomba caroliniana* (59 m^2). A loss in area was observed for native species, *Potamogeton illinoensis* and *Hydrocotyle*. Among planted native vegetation species, pondweed constituted only 1.6% of total effort and *Hydrocotyle* was even less than that. For these two species, we mainly removed non-native vegetation surrounding them and allowed them to expand. We only planted few individuals for these two species and they still persist. The loss in pondweed and *Hydrocotyle* was mainly attributed to a large area scoured during the October 31, 2013 rain event. Much of the loss of pondweed and *Hydrocotyle* was observed just downstream of Aquarena Bridge where the high flows were funneled during the rain event, causing extensive scouring. We completed our mapping just one week after this rain event and therefore, there was insufficient time for the pondweed to expand after such an event. Since the flood, the pondweed has reestablished in the scoured area and we no longer see a loss in pondweed.

Table 3-17. Difference in Area (m^2) of Native Vegetation Species in the San Marcos River Prior to (April 2013) and Post (November 2013) Non-Native Vegetation Removal and Native Planting Activities

Species	April 2013	November 2013	Difference
Zizania texana	1182	1565	383
Ludwig repens	0	71	71
Sagittaria platyphylla	37	141	104
Potamogeton illinoensis	532	439	-93
Cabomba caroliniana	71	130	59
Heteranthera dubia	0	4	4
Hydrocotyle	27	15	-12

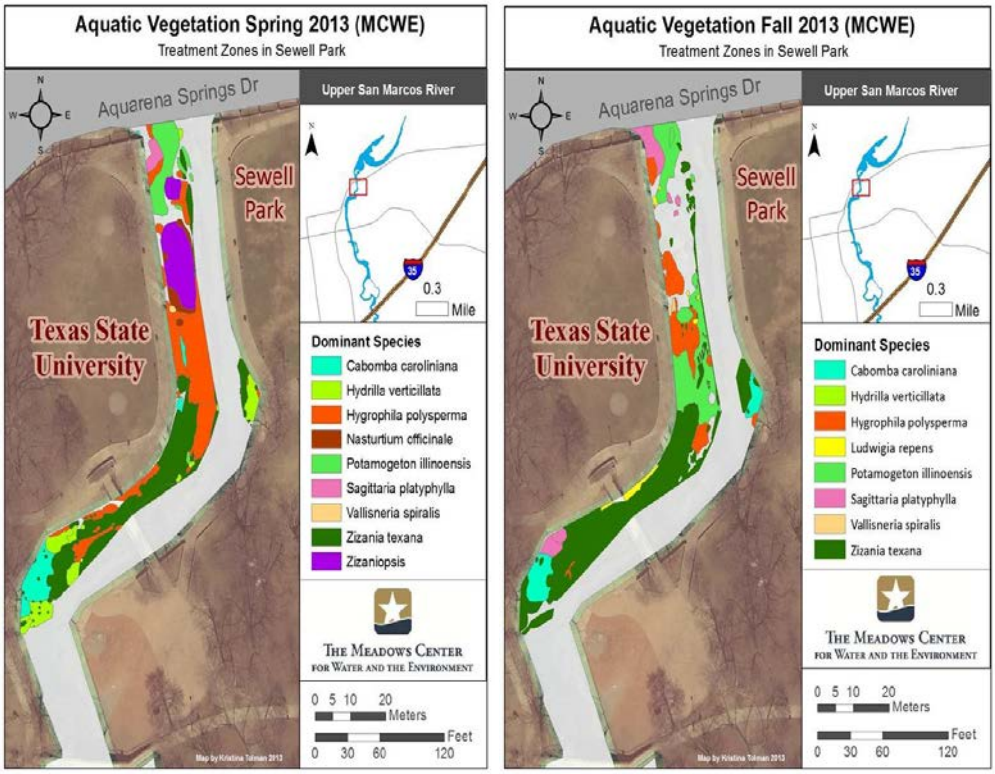

Figure 3-42. Transect map of treated areas in Sewell Park before and after non-native plant removal.

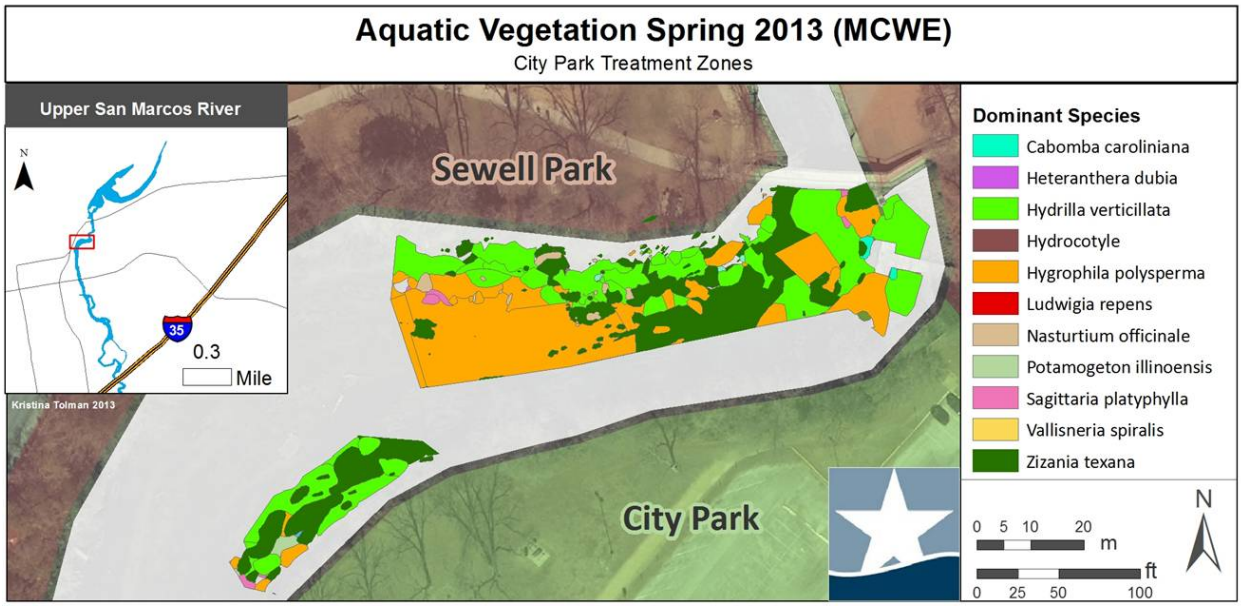

Figure 3-43. Transect map of river segment along City Park before non-native plant removal.

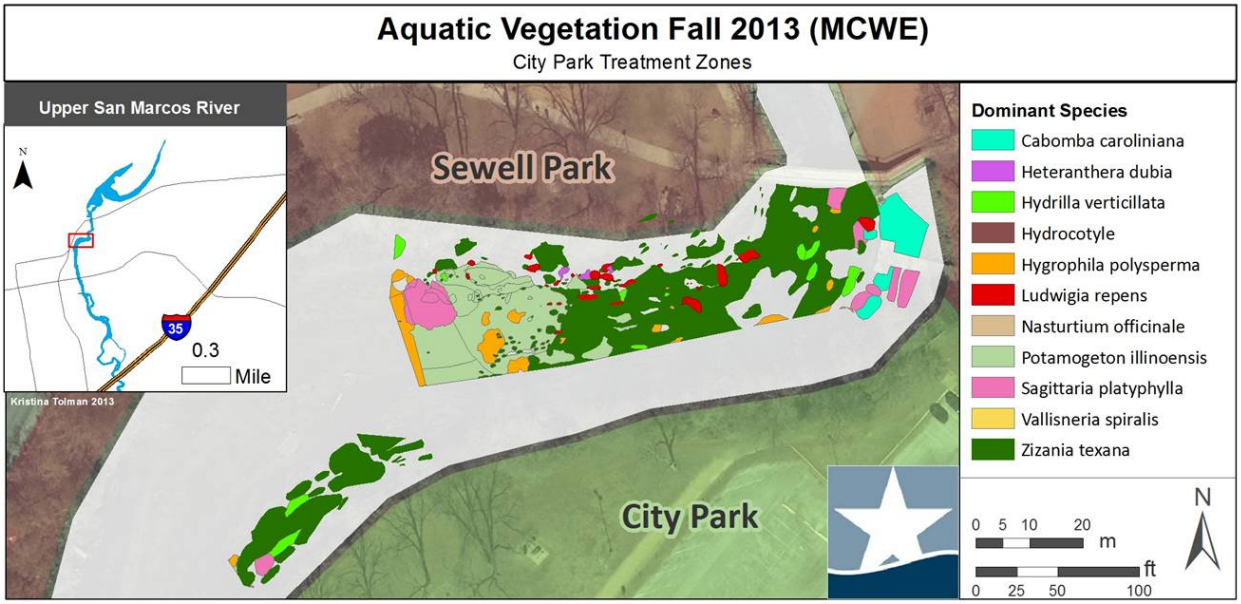

Figure 3-44. Transect map of river segment along City Park after non-native plant removal.

Non-native Littoral Plant Removal

EBR Enterprises began removal of non-native littoral plant species in February 2013. Removal began at Spring Lake continuing down along both banks to San Marcos Plaza Park at specified locations (Figures 3-45, 3-46 and 3-47). EBR treated a total of 7,758 m^2 and replanted 1,580 m^2 with native plants in 2013.

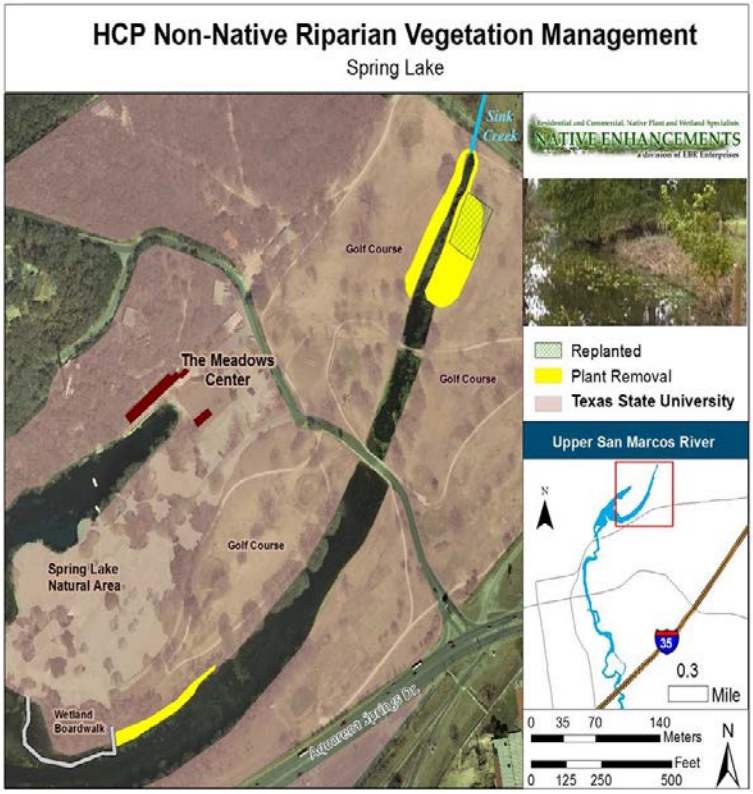

Figure 3-45. Areas of removal and replanting along Sink Creek.

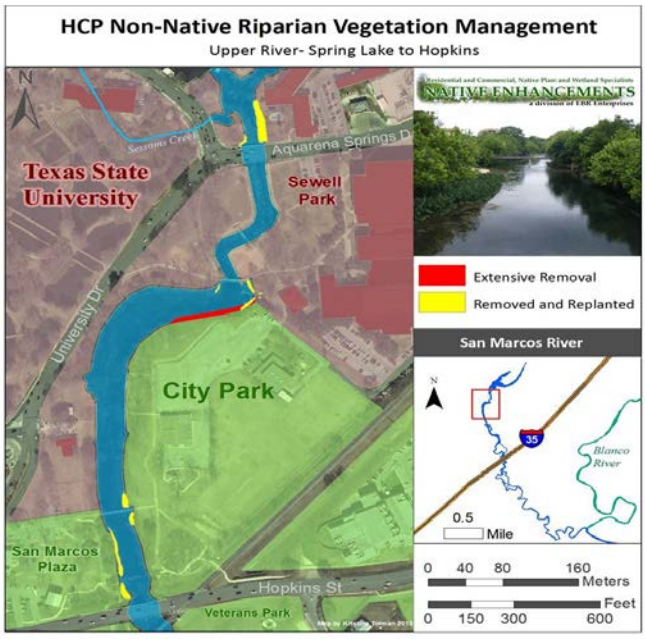

Figure 3-46. Areas of removal and replanting below Spring Lake.

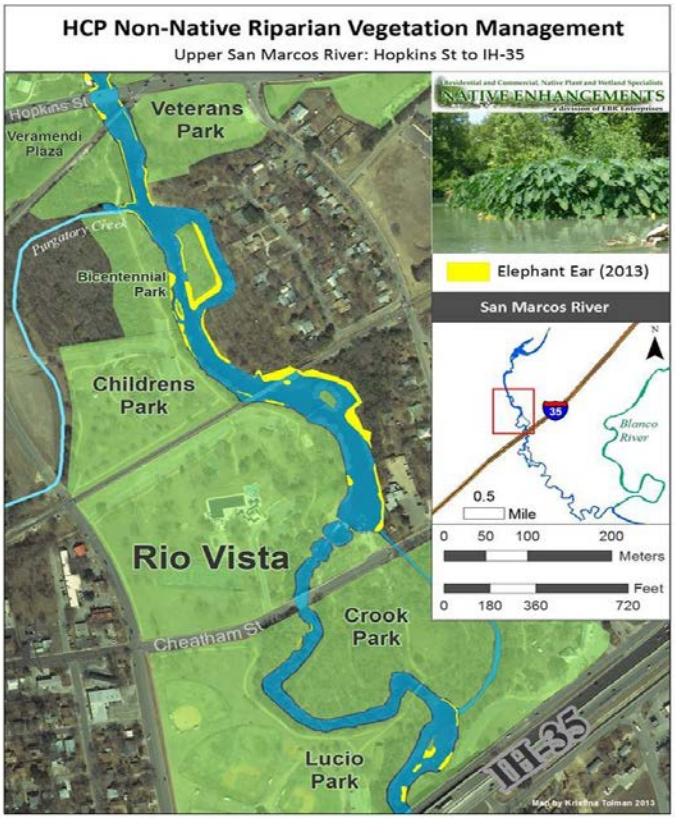

Figure 3-47. Treated areas from Hopkins Street to IH-35.

Table 3-18. Treated Areas from Spring Lake to Hopkins RR Bridge

Location	Area (m^2)	Treatment
1. Spring Lake – Sink Creek	5276	Remove invasives
2. Spring Lake – Replanted area	1580	Replant
3. Spring Lake - Boardwalk	1086	Remove invasives
4. Sewell Park – Clear Springs	415	Remove elephant ear
5. Sewell Park – Above Aquarena Dr.	35	Remove elephant ear
6. Below Sewell Park – small	18	Remove elephant ear
7. City Park – large	507	Remove elephant ear
8. City Park – Bridge	151	Remove invasives
9. San Marcos Plaza	161	Remove elephant ear
10. San Marcos Plaza	109	Remove elephant ear

EBR uses Aquaneat (glyphosate-based herbicide) for elephant ears, yellow iris, and other non-native plants encountered in the littoral zone (10.25 oz per gallon). This herbicide is mixed with Aqua King Plus Surfactant (1 oz per gallon) and Turf Mark Blue, Blue Dye. On the upland tree, shrub stumps and root buttresses, EBR uses Relegate **(**Triclopyr-based herbicide) at 10 oz per gallon. This is mixed with glyphosate (10.25 oz per gallon or less), and Drexel Surf Ac 820 Surfactant (1 oz per gallon) and Turf Mark Blue, Blue Dye. Chemicals are applied with a one gallon pump-up sprayer set on a steady stream for a more precise target hit which minimizes leaching and non-target plant damage. Woody plants are scarred up with a machete to expose more of the cambium layer and treated with an herbicide mix.

EBR worked an average of two days each week at four hours or less per day to remove non-natives and replant treated areas. EBR commented in his June report that he was observing an increase in Texas wild-rice stands in the upper portion of the river as a result of elephant ear removal, non-native aquatic plant removal and Texas wild-rice plantings.

Table 3-19. Non-Native Species (< 4 inches) Removed from the Littoral Zone of the San Marcos River

Common Name	Scientific Name
Arrowhead vine	*Syngonium podophyllum*
Chinaberry tree	*Melia azedarach*
Chinese tallow	*Triadica sebifera*
Chinese privet	*Ligustrum sinense*
Elephant ear	*Colocasia esculenta*
Japanese honeysuckle	*Lonicera japonica*
Ligustrum	*Ligustrum japonicum* and/or *Ligustrum lucidum*
Nandina	*Nandina domestica*
Umbrella sedge	*Cyperus alternifolius*
Water hyacinth	*Eichhornia crassipes*
Yellow iris	*Iris pseudacorus*

Table 3-20. Native Species Planted in the Littoral Zone of the San Marcos River

Common Name	Scientific Name
American beautyberry	*Callicarpa americana*
Bald cypress	*Taxodium distichum*
Black-eyed Susan	*Rudbeckia hirta* (seed)
Buffalograss	*Buchloe dactyloides* (seed)
Black willow	*Salix nigra* (live stakes)
Bur oak	*Quercus macrocarpa*
Buttonbush	*Cephalanthus occidentalis*
Cabomba	*Cabomba caroliniana*
Chili pequin	*Capsicum annuum var. aviculare*
Clasping coneflower	*Dracopis amplexicaulis* (seed)
Coralbean	*Erythrina herbacea*
Coralberry	*Symphoricarpos orbiculatus*
Cottonwood	*Populus deltoides*
Delta Arrowhead	*Sagittaria platyphylla*
Eastern Redbud	*Cercis canadensis*
Eastern Red Cedar	*Juniperus virginiana*
Elbow Bush	*Forestiera pubescens*
Eve's necklace	*Styphnolobium affine*
Huisache	*Acacia farnesiana*
Hornwort	*Ceratophyllum demersum*
Horsetail reed	*Equisetum hyemale*
Indian blanket	*Gaillardia pulchella* (seed)
Indigobush	*Amorpha fruticosa*
Inland sea oats	*Chasmanthium latifolium*
Lemon mint	*Monarda citriodora* (seed)
Little bluestem	*Schizachyrium scoparium* (seed)
Mexican hat	*Ratibida columnifera* (seed)
Mexican plum	*Prunus mexicana*
Palmetto	*Sabal minor*
Pecan	*Carya illinoiensis*
Pigeonberry	*Rivina humilis*
Plains coreopsis	*Coreopsis tinctoria* (seed)
Purple pickerelweed	*Pontederia cordata*
Rockrose	*Pavonia lasiopetala*
Roughleaf dogwood	*Cornus drummondii*
Sideoats grama	*Bouteloua curtipendula* (seed)
Smooth water hyssop	*Bacopa monnieri*

Common Name	Scientific Name
Sycamore	*Platanus occidentalis*
Texas bluebonnet	*Lupinus texensis* (seed)
Texas lantana	*Lantana urticoides (horrida)*
Texas mountain laurel	*Sophora secundiflora*
Texas sage	*Leucophyllum frutescens*
Turk's cap	*Malvaviscus drummondii*
Virginia wildrye	*Elymus virginicus* (seed)
Water canna	*Canna glauca*
Yaupon	*Ilex vomitoria*

Modifications Due to Drought Conditions:
In regards to non-native littoral removal and plantings, planting was delayed until the rainy season (October) to avoid the need for weekly watering. Additionally, a larger amount of elephant ears were exposed due to the drought and easier to treat due to lower river levels.

Proposed Activities for 2014:
In 2014, the City of San Marcos will remove 3,000 square meters of non-native plant material. Stands of elephant ears already treated will continue to be weeded for regrowth and removal will continue to IH 35. Native littorals will be planted in their place.

3.3.9 Control of Harmful Non-Native and Predator Species (EAHCP §5.3.9)

Obligations:
The City of San Marcos, in partnership with Texas State University, will implement a non-native species control program that targets the suckermouth catfish, tilapia, the sailfin catfish, and the *Melanoides tuberculata* and giant ramshorn *(Marisa cornuarietis)* snails. The City of San Marcos will conduct annual monitoring and maintenance activities to ensure continued control of the invasive population within the San Marcos system.

While the City of San Marcos is not implementing a program for the gill parasite in the early years of program implementation, they will monitor for parasite carrying snails, and should targeted removal programs become warranted, they will be addressed through the Adaptive Management Process.

2013 Compliance Actions:
Atlas Environmental researched literature to determine the life history and preferred habitat of the targeted fish and snails. Through research and river surveys, Atlas developed locations and methods to capture the target species.

Tilapia
Atlas targeted *Tilapia* in Spring Lake twice each month using gill nets, seine nets and pole spears, but also captured *Tilapia* in areas downstream of Spring Lake during *Plecostomus* removal. While pole spears were predominately used to capture *Tilapia*, gill and seine nets were most successful downstream of vegetation mats close to banks. Fence segments were used to channel *Tilapia* into live traps but this method was not as successful and eliminated. Table 3-21 and Figure 3-49 show the number of *Tilapia* captured over time in the San Marcos River.

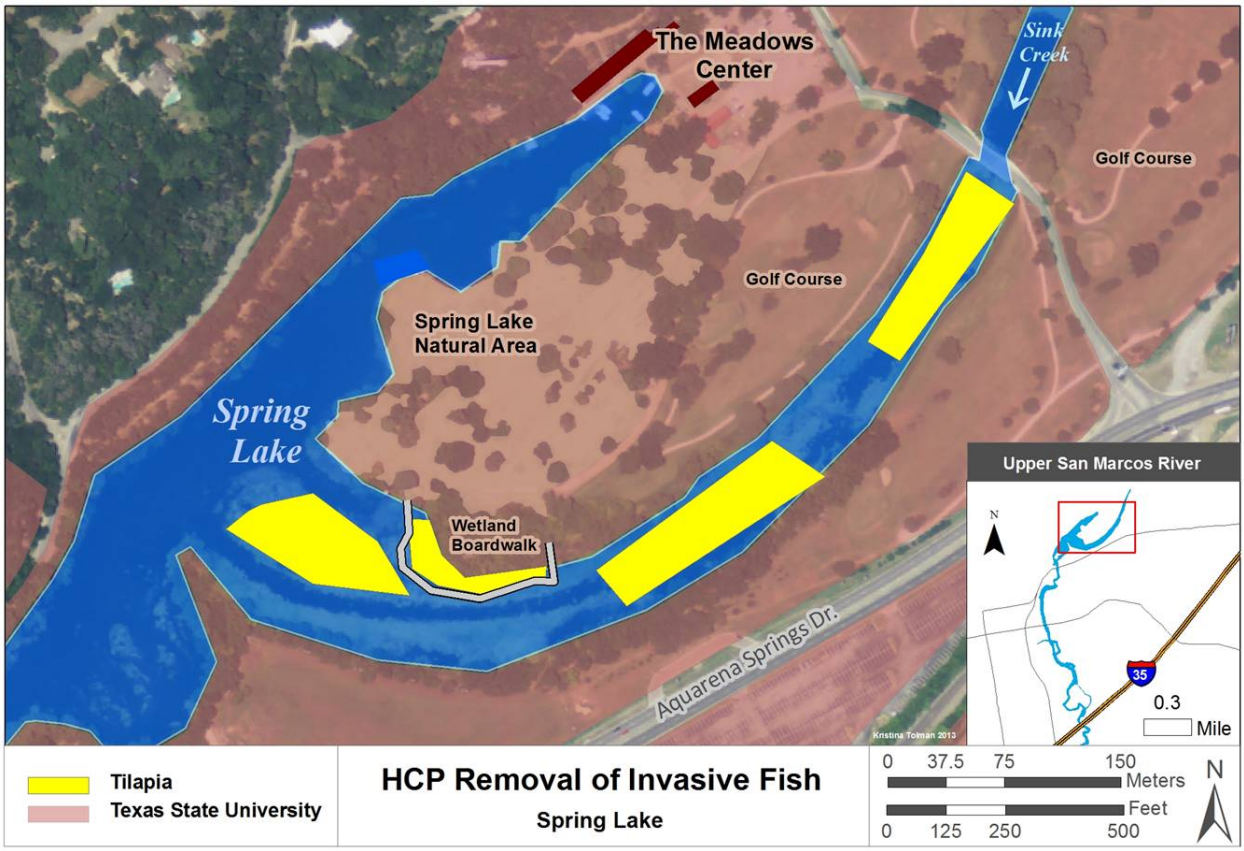

Figure 3-48. Area of *Tilapia* removal in Spring Lake.

Table 3-21. Count and Weight Data for *Tilapia* Captured from February to November 2013

	Feb-May	June	July	August	September	October	November	Annual
Count (# of Fish)	16	2	20	31	37	21	5	132
Total Weight (lbs)	41.4	8.1	59.7	55.6	56.8	36.6	6.9	265
Average (lbs) per Fish	2.6	4.1	3.0	1.8	1.5	1.7	1.4	2
Fishing Events per month	X	2	5	10	8	12	1	38
Average # Fish per Catch	X	1	4	3	4	2	5	3.5
Minimum (lbs) per Catch	X	4.0	1.6	1.1	1.6	1.7	6.9	1.1
Median (lbs) per Catch	X	4.0	7.1	4.5	4.7	2.6	6.9	4.1
Maximum (lbs) per Catch	X	4.1	27.4	11.9	17.9	5.9	6.9	27.4

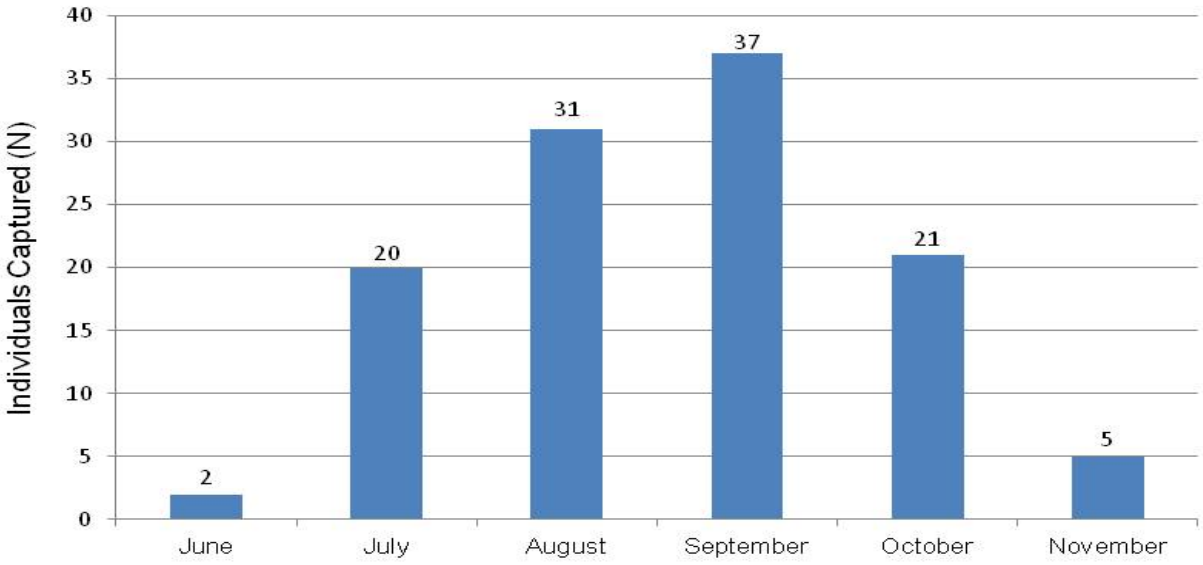

Figure 3-49. Number of individual *Tilapia* captured from June to November 2013.

Plecostomus

Plecostomus were captured in areas downstream of Spring Lake using pole spears and hand collection while snorkeling (Figure 3-50).

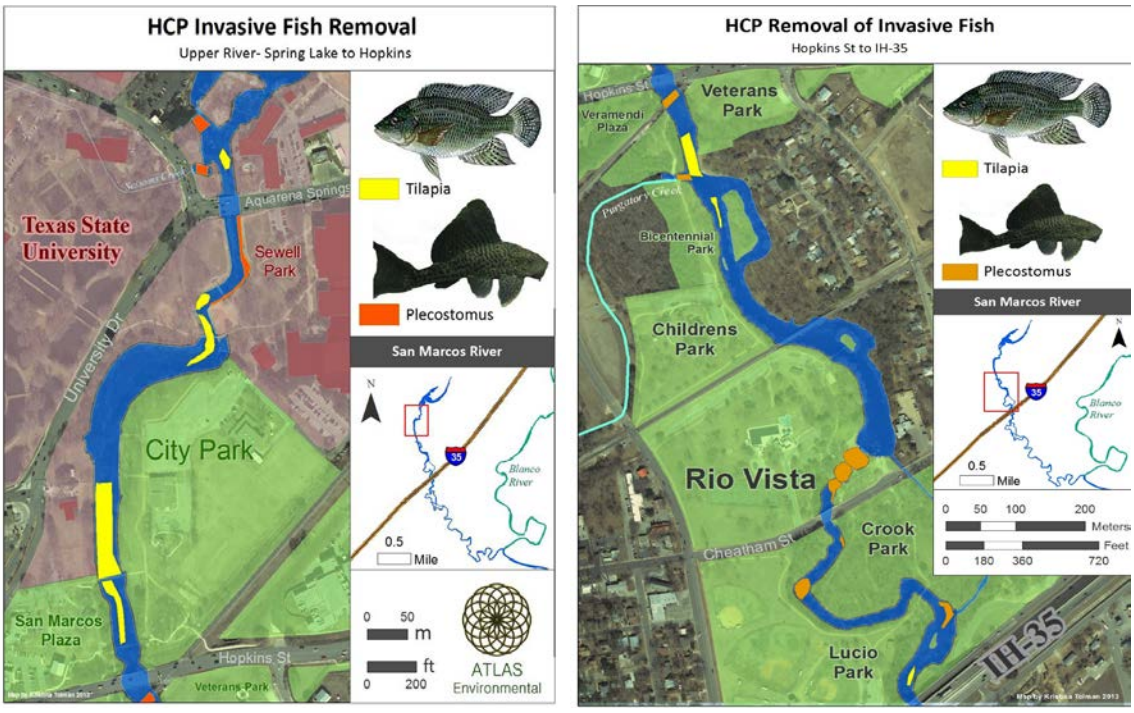

Figure 3-50. Treatment areas for *Plecostomus* and *Tilapia* from Spring Lake Dam to IH-35.

Plecostomus are speared at both night and day, but during the recreation season Atlas dives only at night due to the constant turbidity of the water during the day. Table 3-22 and Figure 3-51 shows the number of *Plecostomus* captured over time in the San Marcos River.

Table 3-22. Count and Weight Data for *Plecostomus* Captured from February to November 2013

	Feb-May	June	July	August	September	October	November	Annual
Count (# of Fish)	309	31	79	159	261	241	121	1201
Total Weight (lbs)	189	17.9	52.2	109	181	173	92.4	815
Average (lbs) per Fish	0.6	0.6	0.7	0.7	0.7	0.7	0.8	1
Catch per month	X	6	8	13	10	19	7	63
Average # Fish per Catch	X	5	9	12	26	12	17	19
Minimum (lbs) per Catch	X	2.1	2.9	2.5	9.8	1.1	4.7	1.1
Median (lbs) per Catch	X	2.9	5.8	5.9	18.8	7.9	14.7	8.6
Maximum (lbs) per Catch	X	4.2	13.3	18.0	23.1	23.0	23.8	23.8

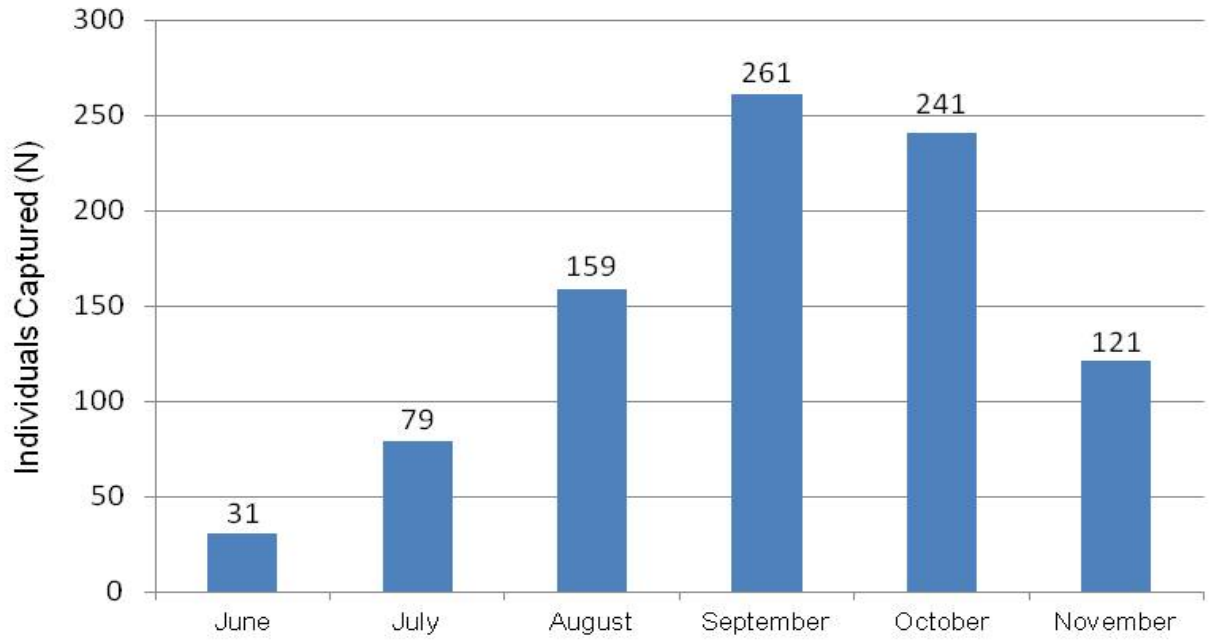

Figure 3-51. Number of *Plecostomus* captured from June to November 2013.

Marisa cornuarietis and *Melanoides* Removal

Early in 2013, Atlas built traps to capture snails in areas of highest concentrations both during the day and at night. However, traps were not as successful or selective as hand-picking snails. Atlas worked areas of large concentrations primarily in Spring Lake and by Clear Springs Apartments.

Atlas participates in the EAHCP's public outreach efforts using brochures and posters to inform on the impacts of dumping aquaria into rivers. These have been distributed at local pet stores, schools, San Marcos Nature Center and the University.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of San Marcos will refine their population estimates for non-native species targeted for removal. Removal techniques will be refined and regular removal of the sucker-mouth catfish, tilapia, and snails will continue. Monthly maps showing changes in non-native populations will be generated.

3.3.10 Native Riparian Habitat Restoration (EAHCP §5.7.1)

Obligations:
The City of San Marcos will restore riparian habitats with native species on city property from City Park to IH 35. The City of San Marcos will establish a program for private landowners to implement riparian restoration on their properties with the opportunity for reimbursement of plant acquisition costs if program criteria are met.

2013 Compliance Actions:
Heritage Tree Care completed base map preparation and two site visits to determine location and species of plantings in Bicentennial and Veramendi Parks. Upon completion of the conceptual design, the City and University held a public meeting in March to gather public input on all EAHCP measures. The meeting was well-attended (50 citizens) and comments were supportive, particularly for the riparian restoration plans.

Heritage Tree Care accomplished non-native tree, shrub and vine removal and native replanting in Veramendi and Bicentennial Parks throughout the month of April. Plant removal was performed with chainsaws and hand tools. Stumps were treated with painted Glyphosate plus (41%). Approximately 10% of chinaberry, ligustrum and paper mulberry sprouted and a second pass was performed through October and November. The cut logs were used to create on-site erosion control by laying them parallel to the slope and mulching to fill in all open soil areas. In total, they removed 2,322 m^2 at Veramendi and 8,826 m^2 at Bicentennial. Ligustrum was the dominant non-native with paper mulberry dominating the south end of Bicentennial Park. Heritage found that Glyphosate was not as effective on the paper mulberry trees. The remainder of the non-native invasives were chinaberry and Chinese tallow.

A five- to ten-foot buffer zone of access-prohibitive trees, shrubs and vines was planted along the length of the zone. This buffer zone of plants was fenced by the City to protect it from trampling. The buffer area incorporates the bank along one of the designated exclusion zones for Texas wild-rice stands (Figure 3-52 and 3-53). Species were selected as recommended by local plant experts, the USDA, USFWS, TPWD and the TCEQ for riparian restoration projects. Plant stock primarily came from Texas Madrone Nursery for their reputation of propagating from pure local seed stock. *Condelia hookerii* was sourced from Barton Creek Nursery wholesale division. Additional woody stock was bare root stock from the Texas forest Service nursery. The existing plant species composition is very diverse, which will help the riparian restoration tremendously.

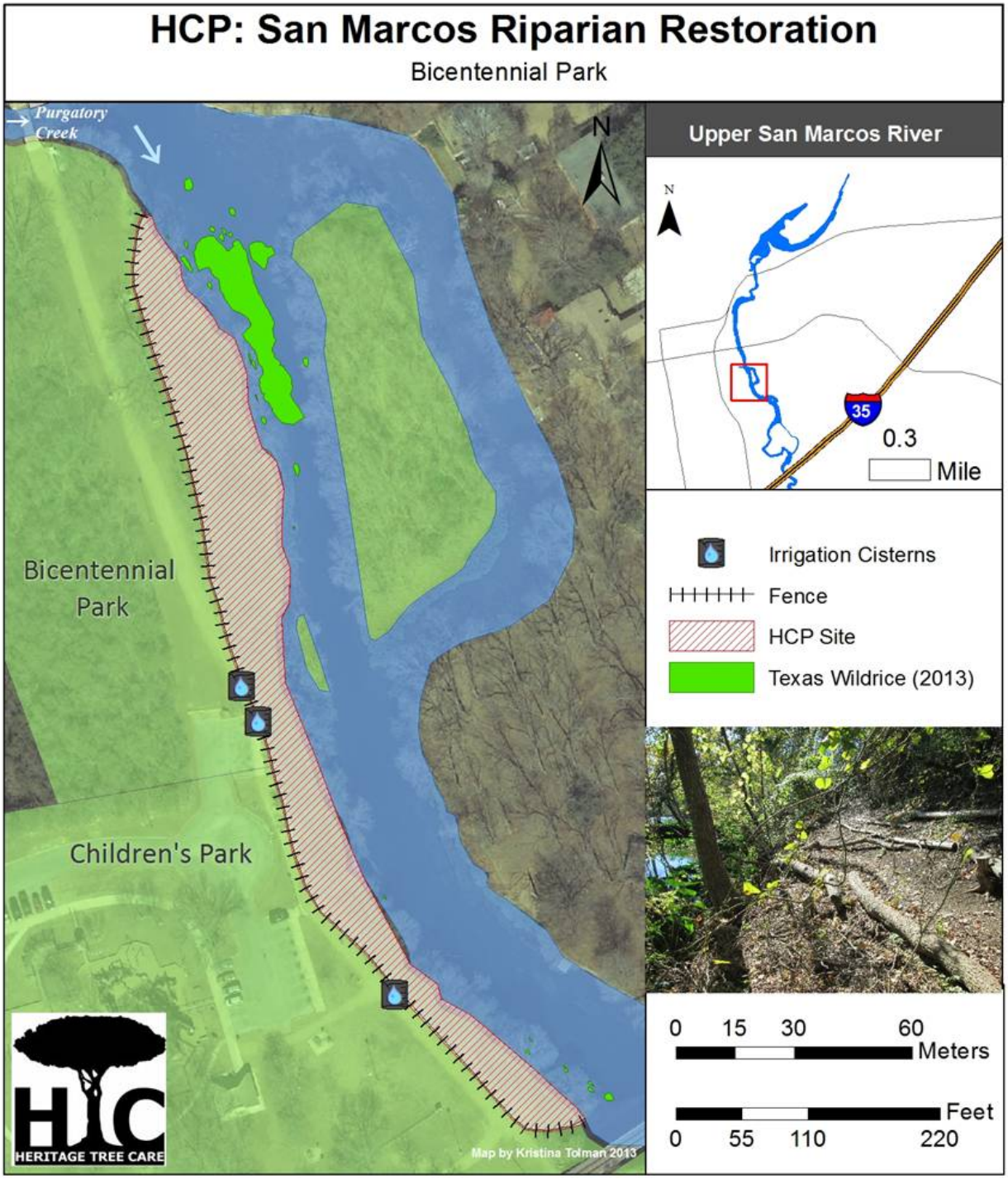

Figure 3-52. Riparian restoration site at Bicentennial Park showing protection for adjacent Texas wild-rice stand.

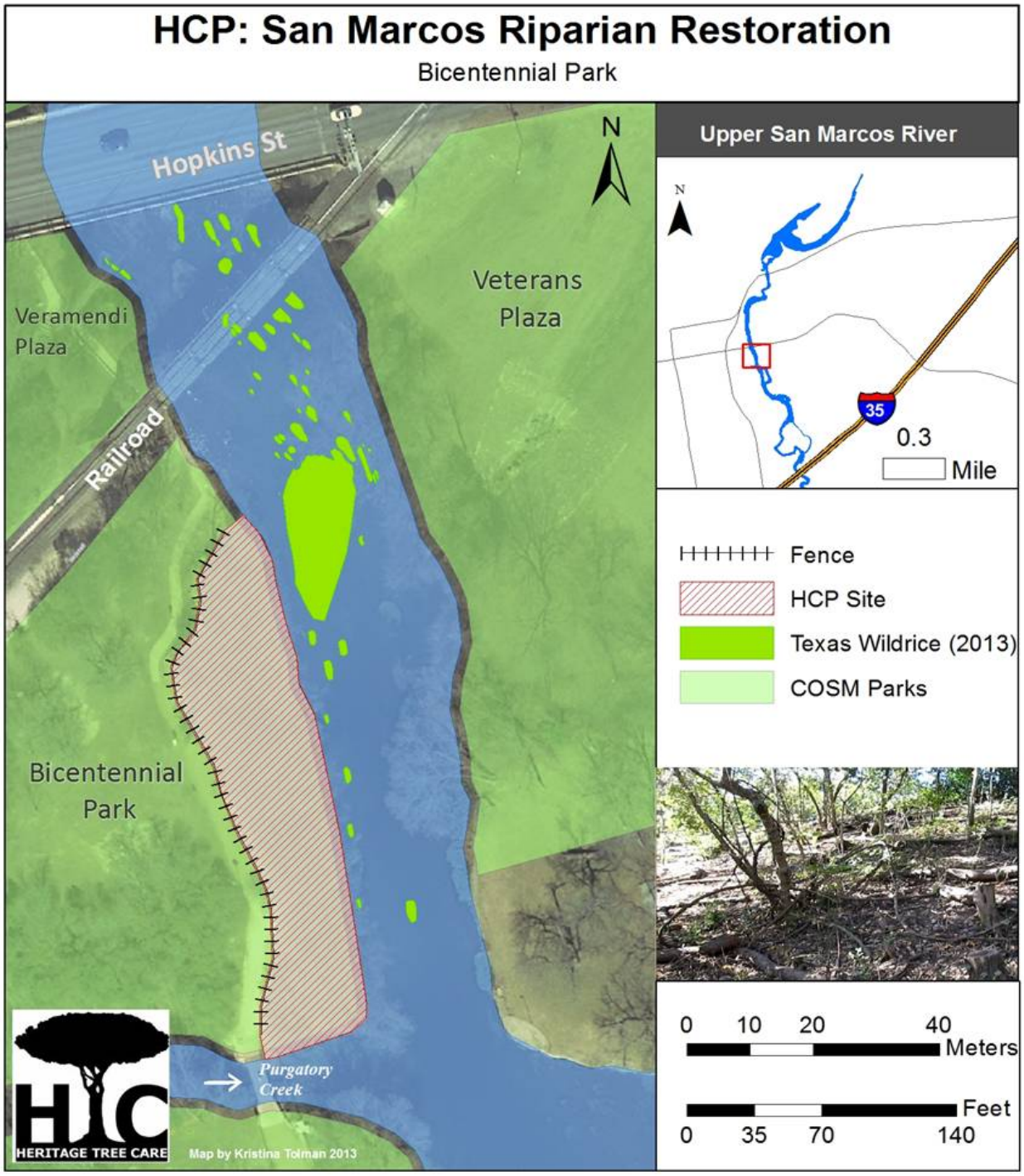

Figure 3-53. Veramendi Park restoration site showing protection for Texas wild-rice.

Gravity-fed drip irrigation with timers was installed for all woody plants we planted. The 250-gallon tanks were kept topped off during the growing season. Maintenance included pulling competing nonnative species and replanting plants that didn't survive the transplanting process. The final planting work days occurred in November and December. Heritage also assisted with all of the volunteer planting workdays with San Marcos River Foundation and the San Marcos Nature Center. Heritage had 90% transplant survival rate for woody species and 50% for small herbaceous herbs and grasses.

Table 3-24. List of Species Planted at Bicentennial and Veramendi Parks

Common Name	Plant / Pot Size	Quantity
Bald cypress	5 gal.	10
Sycamore	5 gal.	30
Eastern persimmon	5 gal.	5
Texas ash	5 gal.	10
Arizona walnut	5 gal.	8
Mexican plum	5 gal.	4
Fragrant sumac	5 gal.	15
Cedar elm	5 gal.	20
Red mulberry	1 gal.	3
Palmetto "Brazoria"	5 gal.	10
Coral bean	1 gal.	40
Mexican olive	1 gal.	40
Chinquapin	5 gal.	10
Carolina buckthorn	5 gal.	10
Nimblewill	1 gal.	10
Buttonbush	1 gal.	40
Red buckeye	3 gal.	5
Bur oak	5 gal.	10
Bald cypress	3 gal. sapling	30
Shumard red oak	3 gal. sapling	25
Chinquapin oak	3 gal. sapling	25
American plum	3 gal. sapling	10
Honey locust	3 gal. sapling	10
Fragrant mimosa	1 gal.	100
False indigo	1 gal.	100
Switchgrass	4", 1 gal.	400
Inland sea oats	4"	200

Modifications Due to Drought Conditions:
Low rainfall conditions in combination with planting in April demanded an intense irrigation program throughout the summer.

Proposed Activities for 2014:
In 2014, the City of San Marcos will implement native riparian habitat restoration in 3.5 segments from Veramendi Park upstream. Where elephant ears have already been removed, or are removed in the future, the City will replant and provide fencing to protect the plants while they mature.

Plants identified for replanting in these areas of removal come from the following list as appropriate for that location:

American Beauty Berry – *Callicarpa americana*
Bald Cypress – *Taxodium distichum*
Black Eyed Susan – *Rudbeckia hirta* (seed)
Buffalo Grass – *Buchloe dactyloides* (seed)
Black Willow – *Salix nigra* (live stakes)
Bur Oak – *Quercus macrocarpa*
Buttonbush – *Cephalanthus occidentalis*
Cabomba – *Cabomba caroliniana*
Chili Pequin – *Capsicum annuum var. aviculare*
*C*lasping Coneflower – *Dracopis amplexicaulis* (seed)
Coralbean – *Erythrina herbacea*
Coralberry – *Symphoricarpos orbiculatus*
Cottonwood – *Populus deltoides*
Delta Arrowhead - *Sagittaria platyphylla*
Eastern Redbud – *Cercis canadensis*
Eastern Red Cedar – *Juniperus virginiana*
Elbow Bush – *Forestiera pubescens*
Eve's Necklace – *Styphnolobium affine*
Huisache – *Acacia farnesiana*
Hornwort – *Ceratophyllum demersum*
Horsetail Reed – *Equisetum hyemale*
Indian Blanket – *Gaillardia pulchella* (seed)
Indigobush – *Amorpha fruticosa*
Inland Sea Oats – *Chasmanthium latifolium*
Lemon Mint – *Monarda citriodora* (seed)
Little Bluestem – *Schizachyrium scoparium*(seed)
Mexican Hat – *Ratibida columnifera* (seed)
Mexican Plum – *Prunus mexicana*
Palmetto – *Sabal minor*
Pecan – *Carya illinoiensis*
Pigeonberry – *Rivina humilis*
Plains Coreopsis – *Coreopsis tinctoria* (seed)
Purple Pickerel Weed – *Pontederia cordata*
Rockkrose – *Pavonia lasiopetala*
Roughleaf Dogwood – *Cornus drummondii*
Sideoats Gramma – *Bouteloua curtipendula* (seed)
Smooth Water Hyssop – *Bacopa monnieri*
Sycamore – *Platanus occidentalis*
Texas Bluebonnet – *Lupinus texensis* (seed)
Texas Lantana – *Lantana urticoides (horrida)*
Texas Mountain Laurel – *Sophora secundiflora*
Texas Sage – *Leucophyllum frutescens*
Turk's Cap – *Malvaviscus* drummondii
Virginia Wildrye – *Elymus virginicus* (seed)
Water Canna – *Canna glauca*

3.3.11 Septic System Registration and Permitting Program (EAHCP §5.7.3)

Obligations:
The City of San Marcos will establish a registration, evaluation, and permitting program for aerobic and anaerobic septic systems.

2013 Compliance Actions:
As of January 1, 2013 the San Marcos Environmental Health Department had registration records for 594 recorded septic systems within City jurisdiction. Since January 1, 2013 three new septic systems were added and two older systems were removed from service. The total number of septic systems on December 4, 2013 was 595. These systems have been permitted and evaluated to prevent subsurface pollutant loadings into the Edwards Aquifer or San Marcos River.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
The City of San Marcos will continue to implement their septic system registration and permitting program. This program includes the required connection to municipal sewer lines according to city ordinance Section 86.152.

3.3.12 Minimizing Impacts of Contaminated Runoff (EAHCP §5.7.4)

Obligations:
The City of San Marcos will excavate and stabilize two areas for the construction of two sedimentation ponds (one in Veramendi Park and one alongside Hopkins Street) in the vicinity of the San Marcos River. As the ponds are designed, they will be considered through the Adaptive Management Process. Implementation will include erosion minimization measures and construction will be closely monitored for potential impacts to the river system.

Once completed, the City of San Marcos will regularly monitor these ponds, and remove and properly dispose of accumulated sediments off-site.

2013 Compliance Actions:
The EAHCP calls for the design and construction of two water quality BMPs located at Veramendi and Hopkins Street bridge capturing stormwater runoff before it enters the San Marcos River. John Gleason LLC has included the conceptual design of BMPs at these locations in the Water Quality Protection Plan to begin implementation in 2014(Section 1.1.17).

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
Design plans for the two sedimentation ponds described in the EAHCP will be completed and presented to the Science Committee for review. The City of San Marcos will conduct water quality sampling prior to, and after installation of the sedimentation ponds to monitor their effects.

3.3.13 Management of Household Hazardous Wastes (EAHCP §5.7.5)

Obligations:
The City of San Marcos will continue and expand its existing household hazardous waste program. This program will include opportunities for collection locations available to the general public.

2013 Compliance Actions:
The San Marcos HHW has an annual outreach goal of 1400 HHW drop-offs per month (Figure 3-54). From January to December 2013, 1379 people from San Marcos, Buda, Dripping Springs, Driftwood, Kyle, Mountain City, Wimberley, Woodcreek and areas within Hays County dropped HHW and recyclables off at the City's recycling center. Through this program, the center diverted a total of 160,218 pounds of HHW and recyclables from the waste stream and kept them out of the Edwards Aquifer and San Marcos River. The center takes in HHW, steel, cardboard, batteries, paper, plastic and cans. If any of the dropped-off items are reusable, the center will sell them to the public; for example, they remix and resell all collected paint. At the center, public information materials are available, including a brochure entitled have taken the "Toxic-Free Cleaning" booklets, spreading the message of using simpler ingredients instead of harmful chemicals.

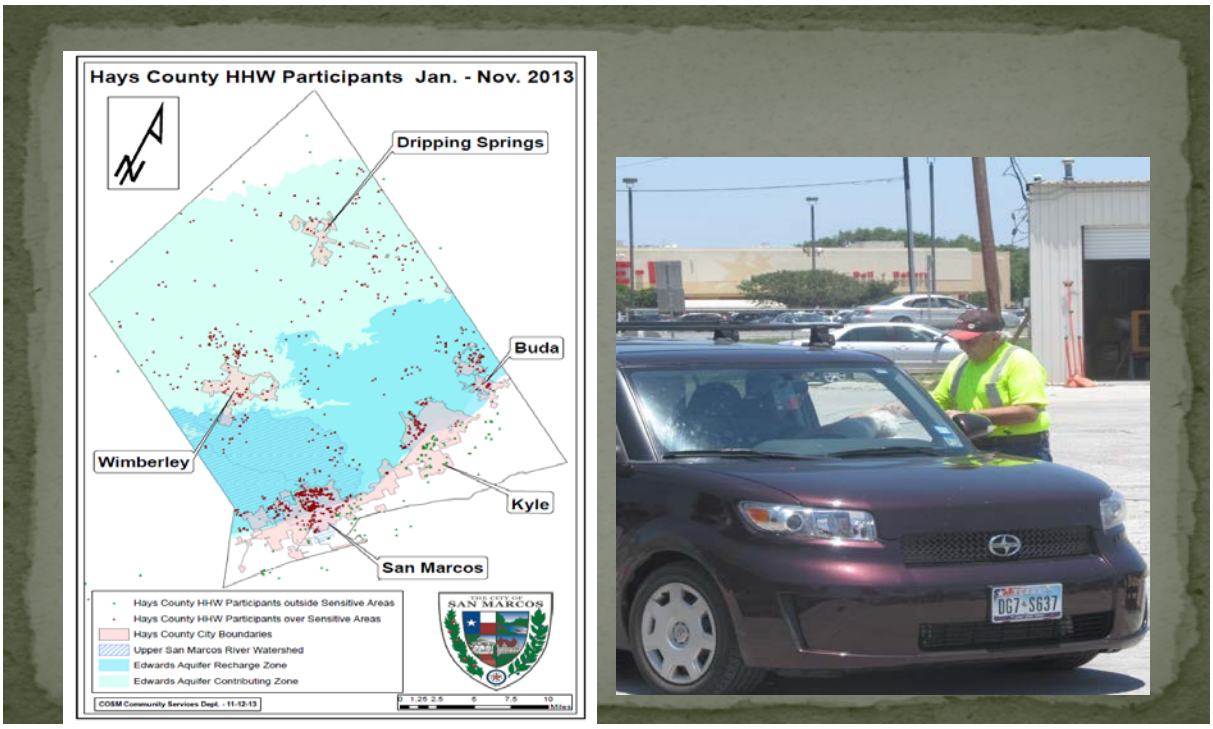

Figure 3-54. HHW participation over areas impacting the San Marcos River.

In summary for 2013, the HHW/recycle program exceeded their outreach goal of 1,400 participants with 1,379 drop-off and 686 reuse participants equaling a total of 2,065 participants.

The program also sponsors special events such as e-waste and pharmaceutical drop-off, as well as multiple neighborhood cleanups.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of San Marcos will expand their existing program to increase the amount of community outreach activities that occur. The City will additionally extend its support to communities within the watershed that are not within the city limits.

3.3.14 Impervious Cover and Water Quality Protection (EAHCP §5.7.6)

Obligations:
The City of San Marcos will establish a program to protect water quality and reduce the impact of impervious cover. Target programs will be identified consistent with the recommendations of the LID/Water Quality Work Group Report developed during the EARIP and included as Appendix Q to the EAHCP.

2013 Compliance Actions:
The San Marcos Water Quality Protection Plan (WQPP) is a locally developed approach for compliance with the federal Endangered Species Act (ESA) in San Marcos, Texas. The intent of the Plan is to provide a holistic, integrated approach for Texas State University and the City of San Marcos in regards to water quality concerns associated with impervious cover and urban development. In addition to protecting habitat for endangered species, the WQPP will help the entities serve the needs of their growing populations and promote responsible economic development, good public infrastructure, and preserve open space.

Description of the Plan Area
The Plan includes all areas that drain to critical habitat for listed species, either by surface water runoff or by groundwater flow or both. This includes the Upper San Marcos River watershed and the Edwards Aquifer Zone, extending to the limits of the City's Extra-Territorial Jurisdiction (ETJ), as shown below in Figure 3-55, WQPP Plan Area (including areas on both sides of IH 35).

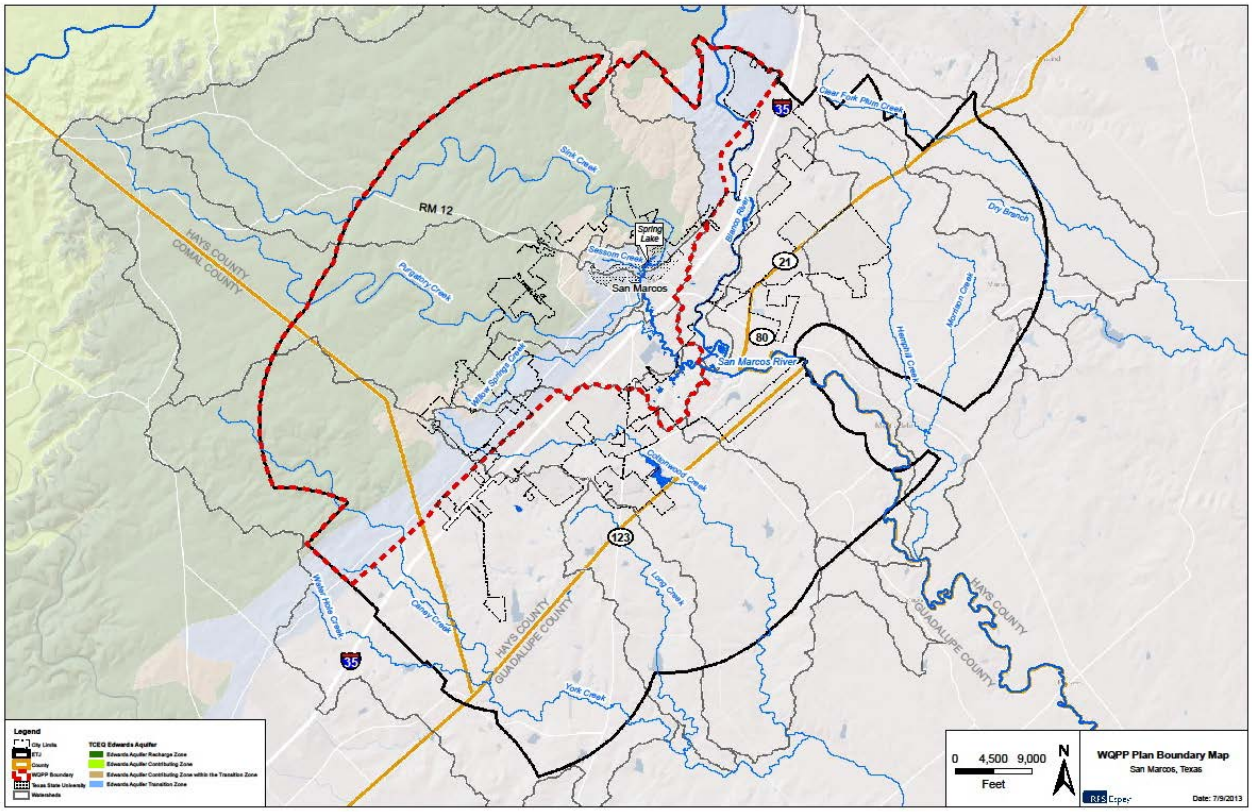

Figure 3-55. WQPP Plan Area.

Related Plans and Planning Efforts
The WQPP is intended to complement ongoing stormwater-related planning efforts sponsored by Texas State University and the City.

Texas State University-San Marcos
Development activities on land owned by Texas State University are subject to University guidance documents including the Campus Master Plan and Construction Standards.

The San Marcos Watershed Initiative (SMWI) is a three year Watershed Protection Planning process, beginning in 2013, which will allow the community to protect and restore water quality in the river, lake and creeks. MCWE provides technical support and guidance to both the WQPP and the SMWI-WPP.

City of San Marcos
The City of San Marcos has full jurisdiction over land development within the City limits, excepting land owned by other jurisdictions including Texas State University and Hays County. Land development activities within City limits are governed by the Land Development Code (LDC). The City also exercises extraterritorial jurisdiction (ETJ) over much of the surrounding unincorporated land where land development activities are subject to water quality protection measures administered by the TCEQ.

The City's Comprehensive Plan describes a preferred scenario for future growth. Following up on this recently completed Plan, the City of San Marcos Planning and Development Review Department has initiated a total re-write of their LDC. The WQPP is providing water quality recommendations for future inclusion in the City LDC and in the Stormwater Technical Manual (STM). The STM will contain design

criteria that define the technical requirements that will allow land development projects to comply with the City LDC. Ongoing efforts of the WQPP will be synchronized with those of each of the plans and processes noted above. These planning projects have implemented a process for sharing ideas with stakeholders and gaining community input.

Guiding Principles and Plan Objectives
A set of guiding principles apply to the San Marcos WQPP Plan and stakeholder process. They state the intent to protect our water, respect each other, establish responsibilities, minimize the risk of failure, be mindful of economic impacts, and strive for fairness and balance.

The objectives of the Plan are to identify causes of water quality problems, standards for protection, protection measures that are already in place and new measures that are needed. The proposed water quality protection measures will include standards, regulations, and criteria for stormwater treatment by new land development. They will also include planning tools, programs and policies for implementation by each entity. Stormwater retrofit opportunities are identified for runoff from existing impervious cover at suitable locations on the campus and in the City.

What Does the Plan Protect?
The Plan is intended to protect the quality of the water that provides critical habitat for the Listed Species. The water resources that form critical habitat include the Edwards Aquifer, Spring Lake and the Upper San Marcos River. The Plan also proposes protection measures in the form of dedicated offsets for Critical Environmental Features (CEFs) including recharge features, streams, floodplains, wetlands, and aquifer discharge areas.

Water Quality Parameters
Nutrient concerns apply to the Upper San Marcos River system, and Spring Lake is known to be susceptible to phosphorus, in particular (Nowlin and Schwartz 2012). Total Nitrogen (TN) and Total Phosphorus (TP) concentrations in stormwater runoff often exceed criteria developed for reference conditions for Central Texas ecoregions, thus impacts are likely unless effective source control and treatment BMPs are implemented. Total Phosphorus (TP) is the recommended indicator of nutrient impacts.

Monitoring and Modeling
Historical monitoring for water quality has occurred in the Plan Area for a number of years. Monitoring data, analysis and associated documentation demonstrate that degradation has occurred and is likely to continue if protection measures are not implemented. The MCWE performed water quality modeling to assess existing land use conditions as well as identify areas and potential sources of nonpoint source pollutants. The Hydrological Simulation Program –Fortran (HSPF) was utilized through BASINS 4 to perform the analysis. The results of this investigation characterize effects of land use and impervious cover relative to existing development patterns. The simulated output for each drainage basin characterizes discharge and pollutant loadings for nitrate, phosphorous, dissolved oxygen, bio oxygen demand, ammonia, *E coli* bacteria, and total suspended sediments.

Water Quality and Threats
Urbanization and impervious cover provide the greatest threats to critical habitat. The negative impacts of unmanaged urban stormwater runoff are well-known, have been documented for the local area, and include the following:

- Diminishing groundwater recharge (with an associated decrease in stream baseflow)
- Declining water quality

- Degradation of stream channels
- Increased overbank flooding
- Floodplain expansion

Due to the importance of impervious cover, the WQPP team conducted an analysis of impervious cover thresholds at the national, regional and local levels. The evidence indicates that impacts to water resources can occur at impervious cover less than 5%, and are generally apparent in the 10-25% impervious cover range. Proposed water quality treatment standards are based on these thresholds.

Description of Water Quality Protection Measures
An important goal of the water quality protection measures presented in this Plan is to maintain or enhance the existing water quality, including both surface water and groundwater. To accomplish this objective, the strategy has been to select measures that facilitate little to no net increase in anticipated pollutant loadings for individual sites or developments. The measures outlined in this Plan include a combination of structural and non-structural BMPs.

A wide variety of different water quality protection measures were considered and evaluated during the process of preparing the WQPP. They are presented in a general order based on the scale of their impact and the level of water quality protection provided.

Intensity and Location of Development
The Plan proposes that the City and the University update water quality requirements for new development within their individual jurisdictions. The new requirements are to be based on the water quality zones. The proposed Water Quality Zones are based on designated receiving waters, their connection to critical habitat, and WQPP goals. They include:

Table 3-25. Proposed Water Quality Zones

Symbol	Water Quality Zone	Description
AR	Aquifer Recharge Zone	Based on the TCEQ Edwards Aquifer designation
C	Contributing Zone	Based on the TCEQ Edwards Aquifer designation
T/R	Transition/River Zone	A zone that combines the area designated as the Transition Zone by the TCEQ and the land area that drains to Critical Habitat of the San Marcos River

The table below lists the zones and summarizes their proposed water quality requirements including pollutant load target conditions and impervious cover limits. Pollutant load targets refer to a target impervious cover percentage that a developed site will match in terms of pollution loading and hydrologic conditions. For example, a developed site has 50% impervious cover yet, through the use of LID and BMPs, generates the pollution load of 10% impervious cover. To minimize the potential for impervious cover to cause stream erosion, developed sites are to provide extended detention that will meet stream protection volume requirements.

Table 3-26. Proposed Targets for Water Quality Zones

Symbol	Water Quality Zone	Pollutant Load Target	Impervious Cover Limit
AR	Aquifer Recharge Zone	0% (Non-degradation)	20%
C	Contributing Zone	0% (Non-degradation)	None
T/R	Transition[1]/River Zone	10%	None

Natural Area Conservation
The Plan recommends that the City implement protection measures including the acquisition of land and the establishment of conservation easements. These measures will provide benefits in perpetuity by preventing future development and associated pollutants. The City shall collaborate with Hays County, local environmental organizations, conservancies and trusts.

Transferable Development Rights
This concept would allow development rights to be transferred from one property to another, while ensuring that the net effect complied with the water quality protection measures presented in the Plan. The intended outcome of this concept is to direct higher intensity development either outside the Plan Area or into preferred growth areas

Comprehensive Site Planning and Pre-Development Review
To ensure that the water quality protection measures are properly incorporated into site designs for new development, a comprehensive site plan should be prepared that includes a technical demonstration that it meets the water quality objectives of the plan. To determine the adequacy of the site plan review process for the City and the University, an assessment of the process is to be conducted next year as part of the 2014 WQPP Work Plan.

Watershed Stewardship
Watershed stewardship is an ethic that embodies the responsible planning and management of environmental resources. The practical manifestation of this ethic will be better organized, more effective stormwater management programs at the City of San Marcos and at Texas State University.

Public Education and Outreach
Education can increase understanding in the development community and public of current water quality impacts and what they can do to potentially lessen the impact of their projects or daily activities. In addition, education can promote better private land stewardship and create a constituency that may be willing to fund and sustain watershed management efforts.

As a group, City and University staff are a critical constituency that must be educated regarding water quality planning and stormwater treatment design. Developers, consulting engineers, and contractors are other important stakeholder groups that require training.

Stormwater Retrofit Projects

The Plan recommends the implementation of stormwater retrofit projects to counteract impacts of existing development on critical habitat. Retrofit projects consist of new installations or upgrades to existing Best Management Practices (BMPs) in developed areas lacking adequate stormwater treatment. These projects can be challenging due to existing site constraints that reduce flexibility in selecting and sizing BMPs.

This WQPP Project Team undertook a rigorous selection process to identify and prioritize stormwater retrofit project opportunities to be considered by the City of San Marcos and Texas State University. The process recently identified a number of feasible, cost-effective stormwater retrofit opportunities that might serve as valuable community investments. The work products developed also provide a solid starting point for an ongoing Water Quality Retrofit Program. A prioritized ranking of selected potential projects is shown below.

Prioritized City Retrofit Opportunities

1. Wastewater Treatment Plant: The proposed infiltration and extended detention pond will treat 176 acres at 93% capture efficiency and remove 141 lbs of phosphorus annually.

2. Downtown Biofiltration: This facility near C.M. Allen Parkway is under construction and nearing completion. It treats runoff from 32 acres that are 60% impervious.

3. The Big Ditch: This existing channel drains 320 acres in the mid-town area that are 43% impervious. Proposed improvements will remove 147 lbs of phosphorus annually.

4. Veterans Memorial Park: Proposed biofiltration will treat 86 acres that are 55% impervious and include most of Springtown Mall and many municipal facilities.

5. City Park: Biofiltration, rain gardens and rainwater harvesting are proposed in association with a new parking facility. This will also serve as a demonstration site.

Prioritized University Retrofit Opportunities

1. Fish Ponds (Option 3): The existing fish ponds are to be retrofitted as constructed wetlands. They will treat 413 acres and remove 184 lbs of phosphorus annually.
2. Sessom Creek Wet Pond (Option 3): The existing wet pond is under-sized and needs maintenance. Improvements allow it to treat 476 acres, removing 253 lbs TP annually.
3. The Gulch: Biofiltration is proposed at the existing facility, which drains 57 campus acres. 27 lbs. of phosphorus will be removed annually.
4. Jowers Center: Rainwater harvesting and rain gardens are proposed to treat 10 acres with 67% impervious cover yielding 15 lbs. of phosphorus annually.
5. The Glade: A series of rain gardens and biofiltration will treat 26 acres at 40% IC. Improvements will also address problematic storm flows at the adjacent recycling center.

Implementation
The WQPP recommends that generally, water quality requirements apply equally to the City and Texas State University. With equal compliance by the City and University, the recommended approach:

- Brings uniformity to protection measures provided by each entity
- Advances the sustainability goals of each entity
- Appeals to an overall sense of fairness

The application of these water quality requirements to Texas State University will require that they be interpreted for the campus environment. In the municipal environment, the water quality requirements are designed to apply to land parcels of varied ownership and oversight. Individual lot lines and subdivided land parcels do not apply to the campus as they do in the municipal setting. The University is a single owner, not under the jurisdiction of the City, responsible for the infrastructure of a large, contiguous area within the Plan boundary. This is an advantage in that it allows a more holistic approach that may be customized for the needs of the receiving waters. A logical approach would be to apply water quality requirements for new development on the basis of the potential impact of the facility to campus subwatersheds (drainage areas). As a starting point, the WQPP proposes that the requirements be applied on a trial basis to selected campus improvement projects as identified in the 2012 – 2017 Campus Master Plan.

The following constitutes the primary recommendations for water quality measures, tasks and objectives in San Marcos (Table 3-27):

Table 3-27. Recommended Water Quality Measures, Tasks and Objectives

Recommendation	Objective
Coordination with all entities' ongoing activities in study area	Maximize data exchange, funding opportunities, and partnerships
Upgrade San Marcos water quality regulations	Minimize stormwater runoff pollution and accelerated creek erosion from new development
Continue 20% IC limit for new development in the recharge zone	Increase groundwater recharge and reduce impacts to receiving water bodies
Actively participate in the City Land Development Code revision process	Support City staff to incorporate recommended water quality regulations, and respond to stakeholder input
Integrate water quality recommendations w/ City SmartCode	Determine Code, Criteria, programs, BMPs and incentives to accommodate WQ downtown
Include Low Impact Development (LID) design option in the LDC revisions	Provide a permitted approach that manages runoff quality, maximizes stormwater as a resource, and reduces water demand.
Develop a regional detention and water quality strategy (including fee-in-lieu)	Improve land efficiency, affordability, and efficacy of systems
Initiate a land conservation with other entities in Hays County	Maintain recharge, water quality and maximize the amount of avoided pollution into the river
Audit the effectiveness of Environmental Code Compliance	Use this information to recommend staffing levels, training, and code changes
Model sustainable practices in infrastructure, operations, and facilities in City and University projects	Reduce landscape irrigation with potable water by ≥ 50% by implementing water conservation practices and stormwater capture and reuse
Initiate a water quality education program for the City and TX State	Inform public of the ongoing water quality protection measures and identify activities they can participate in to reduce pollution
Conduct erosion control training with staff, engineers and contractors	Minimize construction related sediment runoff to the tributaries and San Marcos River
Implement and monitor the TX State Golf Course IPM Plan	Minimize the runoff of fertilizers, pesticides, herbicides to Spring Lake and reduce water usage
Design and construct water quality retrofits in the City and on the TX State campus	Treat un-managed stormwater discharge outfalls to reduce pollutant loadings to the urban creeks and San Marcos River
Actively participate in the EAHCP Adaptive Management Program	Monitor performance of implemented projects and programs; adjust or develop programs as needed

The entire WQPP is located in Appendix HH.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, the City of San Marcos and Texas State University will begin implementation of the Water Quality Protection Plan including participation from all jurisdictional watershed areas that directly or indirectly impact the covered species. The City of San Marcos will develop an educational program to accompany the roll-out of the Protection Plan. The Science Committee will review the plan as appropriate.

3.3.15 Challenges Observed and Identified Solutions

In 2013, the City of San Marcos experienced the following challenges:

- The grids used to monitor Texas wild-rice expansion were a challenge because many of the rebar used to help locate our monitoring locations were lost or removed. The small flood on October 31, 2013 buried or dislodged most of our rebar. For 2014, we propose to measure the basal and leaf areas of Texas wild-rice patches to monitor the expansion of Texas wild-rice after removal of non-native aquatic vegetation.
- Litter boats filled up quickly so more boats are needed, but there are only two bridges across the river. The bridges are the only locations that provide accessibility for tubers. The river will be canvassed by Conservation Crew in summer 2014 to locate any other possible locations.
- A high amount of liquid accumulated in the litter boats (canned beverages) creating an unhealthy and unpleasant situation. Also, boats with liquid must be pulled to the shore and cleaned out which is time-consuming and laborious. No solution has been identified for this challenge at this time.
- While the State Scientific Area infrastructure fulfilled the intended purpose, it required a significant effort to build. Therefore, two structures were left in place after the 2013 recreation season, but have required continued maintenance. At the end of the 2014 recreation season, the Conservation Crew will disassemble the structures to avoid continued maintenance and potential public safety issues. Conservation Crew hours will be maximized at the beginning and end of each recreation season to assemble and dissemble the structures. During summer 2014, four additional SSAs will be built. The City will evaluate the benefit of the SSAs compared to the effort of assembly after the end of the 2014 recreation season. Additionally, public acceptance of the SSAs is a challenge. Signage posted on the SSAs was not sufficient to obtain public acceptance, so the Conservation Crew will rotate between the SSAs to ensure public compliance and understanding.
- Turbidity during the recreation season decreases the window of time to remove litter. Pristine Texas Rivers (the contractor) arrives as early as possible and works early in the week in an effort to avoid decreased visibility resulting from river recreation.
- Avoiding damage to Texas wild-rice is difficult while removing floating vegetation mats; Pristine Texas Rivers developed an effective method of raking the stands in a downstream direction to minimize physical damage. Pristine Texas Rivers also began lifting and removing the floating vegetation so it did not simply float downstream and re-gather on other Texas wild-rice stands.

- Several of the signs promoting EAHCP projects were spray painted and torn by the public. We will keep back-up signs in storage and replace as many as is affordable. Conservation Crew will be instructed to monitor the signage as part of their daily patrols.
- While working in the tributaries, our contractor has observed hot spots of litter associated with commercial and industrial businesses; these locations have been reported to the appropriate city staff for follow-up.
- Major rain events deposit litter requiring increased hours of litter removal. A potential solution is increasing collection hours after a rain event, then decreasing hours during normal times to stay within contract requirements.
- For sediment removal, the EAHCP identifies the use of a ¼ inch strainer on the suction pump. However, at this small of diameter, the strainer became clogged very quickly and slowed the dredging process. The use of a 1.0 inch strainer to increase dredging efficiency was proposed for approval. This request has been submitted to the USFWS.
- Determining the most efficient, cost effective, and practical method in collecting fine sediment once it is dredged from the river. Initially tried a reusable Geo Tube bag but this method was not efficient because we quickly filled the bag and the Geo Tube bag did not retain the fine sediment. The next method tried was to dredge the fine sediment into a large storage tank. However, this method ended with similar results with the tank filling up very quickly. We determined using a settling area or catchment pit was the most effective and efficient method to collect the sediment once it is dredged from the river. However, it has space limitations. Options are under consideration.
- The removal of elephant ear left behind a bare bank which was sometimes used as access by recreationists thus causing bank damage. In 2014, these areas will be fenced and heavily planted with larger species such as Mexican buckeye *(Ungnadia speciosa)*, red buckeye *(Aesculus pavia)*, and rice cutgrass *(Leersia oryzoides)*.
- There is a large seedbank of invasive non-native plants, such as ligustrum in the San Marcos River watershed. A plan for continuing removal and prohibition of future plantings needs to be developed. Areas close to the river have already been identified and would serve as a starting point; removal should begin near Sink Creek and fan out from there.
- Several areas along the river cannot be planted until the large invasive non-native plants are removed by the contractor (too much shade, or danger of damage later). The riparian contractor will coordinate with littoral removal contractor to ensure this objective is met.
- Tilapia is skittish and difficult to capture; gill nets will be used more frequently and use of the hookah system in combination with spearing should capture higher numbers.
- Turbidity during recreation season restricts ability to capture fish. The contractors will work at night; long-term reduction of silt through the sediment removal EAHCP measure will contribute to reduced turbidity.
- Newly planted tree and potted plants were stolen in April. To minimize further theft, a surveillance camera was installed, enforcement and educational signs were placed on the entire length of the fence and the Conservation Crew monitored the area closely during their work day.
- Limited funding has allowed limited planting of native plants, so the City is sponsoring volunteer planting workshops. Maintenance of the volunteer plantings will be a challenge, but it is critical to plant the open areas to ensure a dense riparian zone. The USFWS is developing a maintenance plan with costs for the City's consideration.

- The large quantity of canopy removal was cause for concern as most of the ground was bare in the area where invasive species were in high concentration thereby causing a potential for severe erosion. To prevent erosion, keep moisture level in the soil and promote germination of seed bank, no stumps were removed and the cut logs and mulch from the woody invasive removal were used to setup log terraces on contour and mulch all bare areas, using existing stumps when possible. This method worked well as the largest flooding rain event from late October only shifted a few logs where the water level rose and 3-4 logs where the stakes did not hold. Regular events were fully controlled. They also used 18 inch stakes instead of Rebar, mostly for safety concern of having re-bar in a public park or in a vegetated work area. Overall, 18 inch wood stakes seem to last one year without much trouble. A follow up on the log terraces in 2014 may be needed if vegetation is not filling in the terraces quick enough.
- Flood events: October 2013 flood drowned a small area of bicentennial below the purgatory estuary. No damage was done to plantings as they were already rooted. Minor damage to lowest log terraces.
- Plant sourcing is an issue as custom growing is needed for planting: the nursery industry does not usually grow *Condalia hookerii* and likes to sell larger specimen. Ordering needs to be done well ahead but can only be done based on a contractual agreement. A minimum of 2 years on contract seems to be needed for this, unless the contracting entity provides the plants based on earlier studies. We fell back on fragrant mimosa and a few other species when the *Condalia* stock was depleted. Most other species were available and still should be for the next phases.
- River users occasionally floated or swam over the infrastructure in place to keep human traffic out of large Texas wild-rice stands. Enforcement and educational signage was placed on the structure; and the Conservation Crew either kayaked or walked the area to further educate river users and help them navigate around.
- Both Conservation Crew and contractors observed river users uprooting Texas wild-rice particularly in upper Sewell Park. Education, monitoring, and signage helped minimize the problem and will be continued in 2014.

3.4 TEXAS STATE UNIVERSITY

Texas State University is responsible for the following sections:

Texas Wild-Rice Enhancement and Restoration (Section 5.4.1)
Control of Recreation in Key Areas (Section 5.4.2)
Management of Vegetation (Section 5.4.3)
Sediment Removal in Spring Lake and Sewell Park (Section 5.4.4)
Diversion of Surface Water (Section 5.4.5)
Sessom Creek Sand Bar Removal (Section 5.4.6)
Diving Classes in Spring Lake (Section 5.4.7)
Research Programs in Spring Lake (Section 5.4.8)
Management of Golf Course and Grounds (Section 5.4.9)
Boating in Spring Lake and Sewell Park (Section 5.4.10)
Reduction of Non-Native Species Introduction (Section 5.4.11)
Control of Non-Native Plant Species (Section 5.4.12)
Control of Harmful Non-Native and Predator Species (Section 5.4.13)

All measures have been implemented according to the reviewed and approved 2013 work plans. Implementation of these measures has been accomplished in partnership with the City of San Marcos as specified in the EAHCP. None of the measures specified above were substantially modified in response to

drought conditions and any changes are noted under each EAHCP measure. All measures are in full compliance with the EAHCP and ITP. Texas State University extended its EAHCP obligations in partnership with the COSM to maintain consistency in implementation of EAHCP measures that jointly affect the listed species and their habitats in the San Marcos River. Texas

3.4.1 Wild-Rice Enhancement and Restoration (EAHCP §5.4.1)

Obligations:
Texas State University, in partnership with the City of San Marcos, will identify optimal habitat areas for Texas wild-rice and target those areas for restoration. Restoration will involve the removal of non-native plant species, propagation of new wild-rice plants, and continued monitoring of the new stands. The City will use modeling results from BIO-WEST and TPWD to determine appropriate sites for restoration to ensure the best possible success rate.

2013 Compliance Actions:
Non-native aquatic vegetation was removed in areas suggested as optimal Texas wild-rice habitat based on modeling results from Hardy et al. 2011 (Appendix GG). Non-native vegetation was also removed in mixed stands of Texas wild-rice and the original Texas wild-rice stand monitored for expansion. Similarly, for Texas wild-rice stands occupying optimal areas with adjacent non-native vegetation, the non-native vegetation was removed and the Texas wild-rice monitored for expansion. Non-native vegetation was fanned to displace fountain darters prior to uprooting the vegetation. After removal, all non-native vegetation was sorted and any fountain darters (or other native species) were salvaged and returned to the river. The non-native vegetation was disposed at the City of San Marcos composting facility. Denuded areas were planted with Texas wild-rice obtained from the SMARC or from raceways located at the Freeman Aquatic Building, Texas State University campus.

After removing the non-native vegetation, the MCWE team used a 0.25 m^2 grid to monitor Texas wild-rice expansion. They established known locations and used pieces of rebar embedded into the substrate to locate our grid positions. At each location, the grid was used to quantify the area of expansion (i.e., growth) of the Texas wild-rice on a monthly basis. At each grid, MCWE recorded habitat characteristics (e.g., water depth, canopy cover, current velocity) and vegetation growth. A total of 48 grids were placed in the San Marcos River to monitor the expansion of Texas wild-rice patches following the removal of *Hydrilla verticillata* and *Hygrophila polysperma*. Grids were located within a range of depths (0.22 m – 0.68 m), current velocities (0.02 m/s – 0.41 m/s), and substrates (i.e., silt, sand, clay, gravel, and cobble).

Texas wild-rice was planted in areas denuded of non-native aquatic vegetation in the San Marcos River downstream of Spring Lake Dam to just upstream of City Park. An estimated total number of Texas wild-rice planted within this section of the San Marcos River in 2013 was 1,531 individuals (59% obtained from SMARC and 41% from Freeman Aquatic Building) that covered 20-50% of the denuded area (Table 3-28). Net gain of Texas wild-rice area was 383 m^2 within all areas denuded of non-native vegetation followed with Texas wild-rice planting. A majority of Texas wild-rice area increase was observed downstream of Sewell Park (203 m^2), however, MCWE observed Texas wild-rice loss in Sewell Park (169 m^2). The loss of Texas wild-rice area in Sewell Park was attributed to multiple factors including: low flows during the summer causing several stands to become emergent and seed, high recreational use within Sewell Park, and a moderate flood occurring on October 31, 2013 (~700 cfs) that scoured patches of Texas wild-rice located just downstream of the Aquarena Springs bridge.

Table 3-28. Number of Each Native Vegetation Species Planted Monthly in the San Marcos River from Spring Lake Dam to Just Downstream of Sewell Park (2013)

Native Species Planted (N)	Month					
	June	July	August	September	October	**Total**
Zizania texana	521	487	49	84	393	1,534
Ludwig repens	232	227	58	286	670	1,473
Sagittaria platyphylla	39	10	18	11	245	322
Heteranthera dubia	-	-	-	-	100	100
Potamogeton illinoensis	-	-	1	-	54	55

Among the grids, we observed tiller growth and plant expansion in 95% with growth observed in as little as a month (Figure 3-56). Texas wild-rice expansion was generally observed laterally to an existing patch or on the downstream portion of the patch among all ranges of depths and current velocities measured. No growth was observed at the upstream side of a Texas wild-rice patch.

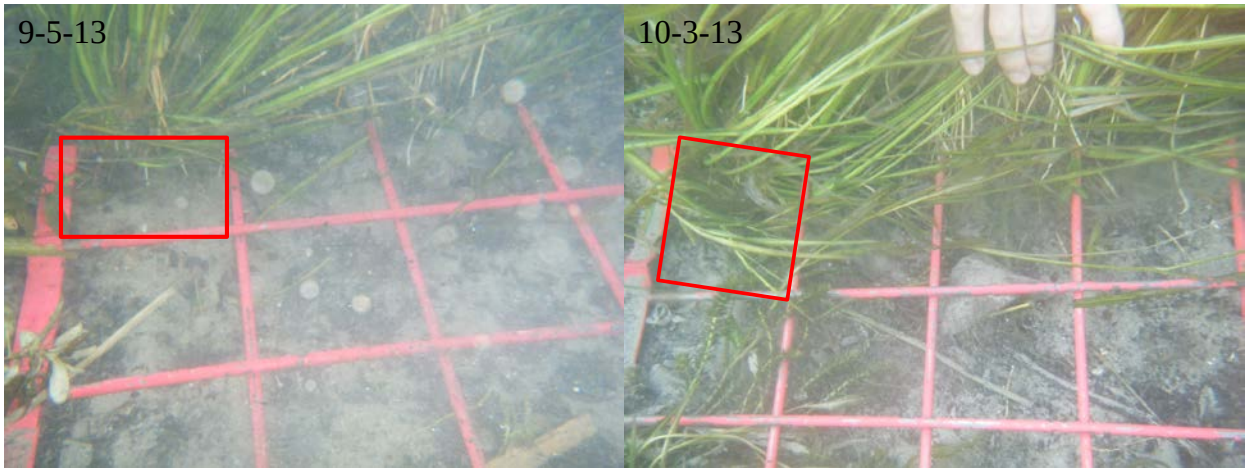

Figure 3-56. Example of Texas wild-rice growth (red polygons) observed in one month after non-native aquatic vegetation removal.

Modifications Due to Drought Conditions:
Texas wild-rice planting was shifted to areas of greater depth to prevent the stand from becoming emergent with any further decrease in flow.

Proposed Activities for 2014:
In 2014, Texas State University will continue to maintain existing Texas wild-rice stands and plant stands in areas where new habitat has been created through sediment removal and aquatic vegetation restoration. The 2014 goal is to add 1,100 m^2 of additional Texas wild-rice to the system.

3.4.2 Management of Recreation in Key Areas (EAHCP §5.4.2)

Obligations:
Texas State University will work with the City of San Marcos to implement recreation restrictions in Spring Lake and the San Marcos River within the jurisdiction of the university. Texas State will incorporate permanent access points along the east and west banks of the San Marcos River to direct recreationists. Texas State will additionally develop kiosks to educate the public regarding recreation restrictions within their property limits.

2013 Compliance Actions:
1. Access control. Working in collaboration with the City of San Marcos, the eastern shoreline below the eastern spillway of Spring Lake adjacent to the Clear Springs Apartments downstream to Aquarena Drive Bridge was fenced to block access to the river and is targeted for riparian vegetation restoration. An access point is being designed at the Aquarena Drive Bridge that avoids the Texas wild-rice stands in this section of the river. Access on the western shoreline upstream of the Aquarena Drive Bridge remains unchanged but is being evaluated as an integral part of the Sessom Creek sediment removal EAHCP measure (5.4.6) as part of 2014 Work Plans.

2. State Scientific Areas. During 2012 the Texas Parks and Wildlife Department (TPWD) designated the segment of the river from the Spring Lake Dam to the San Marcos wastewater treatment plant as the San Marcos River State Scientific Area (SSA). The SSA designation established state regulations prohibiting uprooting of Texas wild-rice within the designated segment. TPWD authorized the placement of physical barriers around vulnerable stands of Texas wild-rice when flows within the designated segment are 120 cubic feet per second or lower to help people avoid the plant while recreating in the river. Flows in the San Marcos River were below 120 cfs during the summer of 2013 when the decision was made to deploy barriers around two select stands of Texas wild-rice. The two barriers were constructed at Bicentennial Park and the other at the eastern spillway by Clear Springs Apartments with four more barriers proposed for 2014. Efforts by the Conservation Crew to educate people about the SSA and the six exclusion areas along with signage on the barriers furthered public awareness.

3. Signage. Two kiosks were constructed to display signs produced by the Texas Parks and Wildlife Department in Sewell Park. The TPWD is currently working to produce Spanish language versions of the signs for existing and future kiosks. Additionally, signs were placed at multiple locations on the SSA barriers which was critical because people in the river cannot see the signs on the banks.

4. Conservation Crew. This work team was developed to educate the public about the EAHCP, but their primary focus was on Texas wild-rice stands in high recreation areas. The team was composed of nine university students. They began work May 27th with an orientation at the San Marcos Aquatic Resource Center (SMARC). On June 5th, the Conservation Crew began working Wednesday-Sunday, and worked through the Labor Day weekend. Four crewmembers worked in teams of two each day from 11:00 AM – 7:00 PM with two crewmembers kayaking the river and two crewmembers walking the banks in an effort to maximize river user contact.

Duties performed by the crew included:

- Interacting with people using the river and riverside parks to help increase public knowledge about Texas wild-rice. Conservation Crew pointed out Texas wild-rice stands, presented actions river users could take to help protect Texas wild-rice and discussed other San Marcos River listed species and park rules.

- Clearing vegetation mats from surface of Texas Wild Rice stands. These mats accumulate quickly and degrade the plant stand. This is particularly important during low flows when the stands are exposed.
- Emptying litter boats. During the recreation season, boats are tied under the two railroad bridges. The crew emptied these boats four times a week.
- Monitoring SSAs. The EAHCP 2013 work plan has designated six areas within the SSA to be areas of recreation-exclusion. Two were constructed in 2013 by the crews. These areas required frequent monitoring for structure maintenance and cleaning of floating vegetation mats.
- Pick up litter along and in the river. This was a continual effort that enabled the EAHCP litter contractor to spend more time in the tributaries which are heavily littered.
- All projects and tasks were used as "public education opportunities".

5. Establishment of a recreational baseline. MCWE took video at hourly intervals at four locations along the river from Sewell Park to Rio Vista Falls to obtain a baseline of recreational use. These data are being summarized and correlated with turbidity and other water quality readings from these sections of the river.

6. Section 5.3.2.1 for the City of San Marcos was coordinated with Texas State University and action was taken on the following tasks:

- Education - Signage – kiosks and fence signs have been posted at upper Sewell Park, Sewell Park, and Bicentennial Park. TPWD and City/University are working on Spanish translations of their signs. The EAA sign template is used as the background for most of the signs.
- Partnership between the City and University. The Conservation Crew monitors both City and University property and is supported by City Park Rangers and University Police. A pre-recreation season meeting is held with University and City law enforcement to ensure a cohesive approach to recreation management. Additionally, the City of San Marcos Habitat Conservation Plan Manager is funded equally by the University and the City to ensure a unified approach.

Modifications Due to Drought Conditions:
The drought caused lower flow rates in the San Marcos River which resulted in increased accumulation of floating vegetation on Texas wild-rice stands and litter on the substrate. Therefore, removal of vegetation mats from Texas wild-rice stands as well as litter removal frequency increased as flows decreased to minimize potential impacts.

Proposed Activities for 2014:
Texas State University will continue to implement education programs targeting river users about sustainable river use and the listed species. The University will gather information on recreational use of the river and potential impacts of those activities on the ecosystem. The Conservation Crew, a paid group of individuals responsible for educating the public, informing authorities of destructive behavior, and conducting miscellaneous clean-up of the system will be present from Memorial Day to Labor Day.

3.4.3 Management of Vegetation (EAHCP §5.4.3)

Obligations:
Teas State University will utilize hand-cutting and a harvester boat to manage aquatic vegetation in Spring Lake. Related activities include:

- Weekly, floating vegetative mats will be dislodged in five springs; each spring will be addressed every two-three weeks.
- Floating vegetation mats will be dislodged more frequently in the summer.
- Floating vegetation mats will be dislodged from Texas wild-rice stands weekly.
- Algae will be removed regularly in the summer.
- Accumulated sediments around spring orifices will be removed within a 1.5-meter buffer radius.
- From 1.5 to 3.0 meters from spring orifices, vegetation will be sheared to a height of 30 centimeters (cm) and from 3.0 to 6.0 meters from the orifice, vegetation will be sheared to a height of one meter.
- Fifteen to twenty boatloads of plant material will be removed by the harvester boat monthly; including weekly removal from designated zones one, two, and three (Figure 5.2 in the EAHCP).
- Removed vegetation will be inspected for aquatic species which will be returned to the river system immediately.
- Vegetation mats will be removed from zones 4 and 5 (Figure 5.2 in the EAHCP) on an as-needed basis.
- Inorganic litter will be removed weekly from Memorial Day to Labor Day, and monthly from Labor Day to Memorial Day, but divers will be extremely cautious around Texas wild-rice stands.
- University employees or others working with and around Texas wild-rice will be trained by TPWD to recognize and protect the plant while doing work in the San Marcos system.
- All vegetation removal activities on Texas State property will be managed by a full-time staff person responsible for operating the harvester boat, manually removing floating vegetative mats, and ensuring all staff and volunteers involved in vegetation removal are familiar with the aquatic ecosystem and able to recognize listed species.

2013 Compliance Actions:
<u>Management of Submerged and Floating Aquatic Vegetation in Spring Lake</u>
Spring Orifice Maintenance - Texas State University personnel at the MCWE in conjunction with qualified Diving for Science volunteers removed accumulated sediment where necessary from target springs in Spring Lake by finning the substrate away. In addition, aquatic vegetation was removed from an approximately 1.5 meter radius of each target spring with a scythe. The aquatic vegetation within next 1.5 meter radius area around each target spring was then cut a height of 30 cm with the cut material allowed to flow downstream with the current. Aquatic vegetation within the next 3 meter radius of target springs was then sheared to height of 1 meter and cut vegetation allowed to drift downstream. Table 3-29 provides a summary of work conducted for this EAHCP measure.

Table 3-29. Aquatic Vegetation Maintenance Activities within Spring Lake

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Totals
Aquatic Maintenance (approximate dives)	30	30	30	30	30	30	30	30	240
Aquatic Maintenance Dive Hours (average 1:15 hours/dive)	37.5	37.5	37.5	37.5	37.5	37.5	37.5	30	300
Diving for Science Volunteers	24	64	64	55	65	79	81	33	465
D4S Dive Hours (average 1:15 hours/dive)	30	80	80	68.75	81.25	98.75	101.25	41.25	581

Harvester Boat – Maintenance of submerged and floating aquatic vegetation followed the protocols outlined in the EAHCP (Section 5.4.3.1) and the approved Spring Lake Management Plan. The harvesting schedule targets three cuts per week, typically Monday, Wednesday, and Friday mornings. Scheduled harvesting of each zone rotates in order to allow each zone adequate recovery time and ensure that a specific zone is not over cut. This results in each zone being cut 2-3 times a month. The estimated aquatic vegetation harvest is approximately 10-12 cubic yards/per cutting. The total estimated harvest is approximately 1,500 cubic yards for the year.

Management of Aquatic Vegetation from Sewell Park to City Park

Texas State University collaborated with the City of San Marcos to control aquatic vegetation mats entrained on Texas wild-rice stands below Spring Lake Dam to the end of Sewell Park. Aquatic vegetation removal was conducted by Pristine Texas Rivers Inc. (PTR) by pushing floating mats downstream as specified in the EAHCP. In addition, personnel at the Meadows Center for Water and Environment and members of the City of San Marcos Conservation Crew supplemented vegetation removal during low flows

Modifications Due to Drought Conditions:

Increased frequency of aquatic vegetation removal activities.

Proposed Activities for 2014:

In 2014, Texas State University will continue to implement floating vegetation mat and litter removal consistent with protocols established in the EAHCP and in the 2013 program.

3.4.4 Sediment Removal in Spring Lake and from Spring Lake Dam to City Park (EAHCP §5.4.4)

Obligations:

Texas State will remove accumulated sediments from Texas wild-rice habitat in Spring Lake and from Spring Lake Dam to City Park. Sediments will be removed using hydrosuction covered by a ¼ inch mesh screen. Additional measures including finning, controlled use of the vacuum hose, and clear boundaries for dives will limit any impacts to the species.

2013 Compliance Actions:

Texas State University was approved to dredge in the diving area of Spring Lake to remove fine sediment and concrete material (i.e., slurry) that accidently spilled into the lake while restoring a retaining wall. Approximately 20 m^2 (i.e., 4 m^3) of fine sediment was removed in Spring Lake from April to May 2013 (Table 3-30). Fine sediment was removed until divers reached more suitable substrate to plant Texas wild-rice beginning in 2014 (Figure 3-57). No sediment was removed from the San Marcos River between Spring Lake Dam and the bottom of Sewell Park.

Table 3-30. Monthly Estimates for Fine Sediment Removal (m^2 and m^3) in Spring Lake

Month	Sediment Removed	
	m^2	m^3
April	8	1.6
May	12	2.4
Total	**20**	**4**

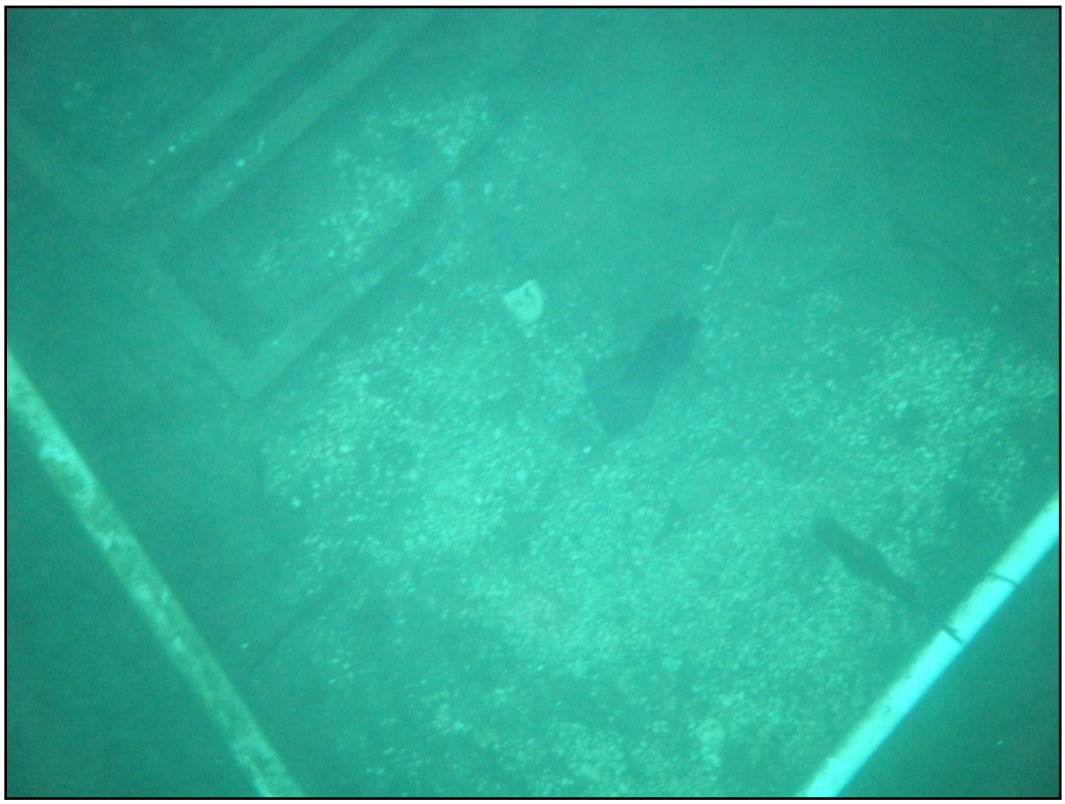

Figure 3-57. Example of gravel substrate exposed in Spring Lake after Texas State University staff dredged overlaying fine sediment.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State does not have any areas proposed for sediment removal. Approximately 1,000 m^2 are targeted for removal in City Park and Bicentennial.

3.4.5 Diversion of Surface Water (EAHCP §5.4.5)

Obligations:
Texas State University will lessen the amount of surface water they divert from the San Marcos River in accordance with the following conditions:

- Reduce diversion by 2 cfs when the USGS gauge at University Bridge reads 80 cfs (reduction made below Spring Lake Dam).

- Reduce diversion by an additional 2 cfs (total 4 cfs) when the USGS gauge at University Bridge reads 60 cfs (reduction made in Spring Lake).
- Reduce diversion by all but 1 cfs when the USGS gauge at University Bridge reads 49 cfs (reduction made in the Sewell Park reach).
- Cease all surface water diversions when the USGS gauge at University Bridge reads 45 cfs.

The University will additionally use, maintain, and monitor ¼ inch mesh screen covers at the intake for the surface water diversion.

2013 Compliance Actions:
Texas State University did not reduce permitted pumping in 2013 due to EAHCP requirements since total San Marcos River flows did not reach trigger points (i.e., < 80 cfs). Texas State University did however, continued to voluntarily suspend pumping from the San Marcos River at Sewell Park (Certificate 18-3866). The total volume of surface water diversions from Spring Lake was 38 ac-ft/year for 2013 and below the permitted 100 ac-ft/year. Maximum instantaneous diversion rates did not exceed the permitted amount of 1.33 cfs.

Texas State University continued to use a ¼ inch mesh screen to cover the intake for surface water diversions. The screens were routinely inspected and cleaned as part of regular operations. No fountain darters were observed when the screens were cleaned.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will reduce or cease the diversion of surface water as required by flow conditions and described in the EAHCP.

3.4.6 Sessom Creek Sand Bar Removal (EAHCP §5.4.6)

Obligations:
Texas State, in partnership with the City of San Marcos, will conduct a study to determine the most appropriate technique for removal of the Sessom Creek Sand Bar. Once completed, the study will be considered through the Adaptive Management Process to refine the scope for successful removal of this sand bar.

2013 Compliance Actions:
The Adaptive Hydraulics Modeling System (version 4.31, Berger et al. 2013) was utilized to model existing conditions and three alternative scenarios that ranged from full sediment bar removal versus differential channel configurations. The technical report is provided in Appendix II and is currently under review as part of the AMP. The current configuration of the outlet of Sessom Creek into the San Marcos River is causing severe bank erosion along the northern shoreline (Figure 3-58).

Figure 3-58. Bank erosion in the San Marcos River at the Sessom Creek outflow.

The continued erosion threatens to undermine the bank control structure along the western shore below the Salt Grass Restaurant and toppling the large cypress tree in this area. The modeling report recommends that a design of a bank erosion control structure in conjunction with an extension of the Sessom Creek outflow apron be considered to stop the bank erosion and better control the sediment dynamics at the Sessom Creek confluence.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
Based on the results of feasibility assessments conducted in 2013, Texas State University will remove the islands at the confluence and Sewell Park. Prior to initiating removal, the assessments will be considered by the Science Committee and a turbidity report will be completed to comply with TPWD permitting conditions.

3.4.7 Diving Classes in Spring Lake (EAHCP §5.4.7)

Obligations:
Every diver participating in the Texas State Diving for Science Program will need to show an understanding of the listed species found in Spring Lake and their habitats, laws and regulations relevant to these species. Divers must exhibit good buoyancy control, have the ability to avoid contact with listed species and critical habitat, and maintain a distance from the lake bottom.

No more than 16 trained divers may be present in Spring Lake at any time. Texas State University will conduct training for check-out dives and SCUBA classes no more than three times per day, and classes will include a maximum of twelve students per class.

2013 Compliance Actions:
MCWE updated the Spring Lake Management Plan to reflect all the requirements under the EAHCP and ITP. This includes the following EAHCP measures:

- Diving for Science Program (5.4.7.1)
- Texas State University Continuing Education (5.4.2)
- Texas State SCUBA Classes (5.4.7.3)

The revised plan implements the EAHCP requirements with the following restrictions:

- Diving for Science Program – No more than 16 volunteer divers/day and $\leq$ 8 at one time
- Texas State University Continuing Education – 12 divers/class; $\leq$ 3 classes/day; restricted to the Dive Training Area
- Texas State SCUBA Classes – 12 students/class; $\leq$ 3 classes/day; restricted to the Dive Training Area

The revised Spring Lake Management Plan was submitted and approved by the President's Cabinet. As part of this effort, MCWE has implemented a Diving Program Control Board that reviews all diving activities within Spring Lake to ensure they comply with the Spring Lake Management Plan (Appendix JJ) and the EAHCP. These efforts also included the development of the Spring Lake Dive Accident Management Plan and revised Diving for Science program, which has implemented a more rigorous training program that includes expanded training and orientation on the endangered species. Diving activities in Spring Lake are provided in Table 3-31.

Table 3-31. Diving Activities in Spring Lake

Activity FY 2013	January	February	March	April	May	June	July	August	September	October	November	December	Reporting Period Totals
Aquatic Maintenance (approximate dives)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	15.00	10.00	8.00	6.00	279.00
Aquatic Maintenance Dive Hours (average 1:15 hours/dive)	37.50	37.50	37.50	37.50	37.50	37.50	37.50	37.50	18.75	12.50	10.00	7.50	348.75
Diving for Science Volunteers	24.00	64.00	64.00	55.00	65.00	79.00	81.00	33.00	50.00	77.00	57.00	39.00	688.00
D4S Dive Hours (average 1:15 hours/dive)	30.00	80.00	80.00	68.75	81.25	98.75	101.25	41.25	62.50	96.25	71.25	48.75	860.00
Classes: Fritz, Wounded Warriors	30.00	40.00	30.00	40.00	40.00	20.00	0.00	0.00	0.00	135.00	48.00	0.00	383.00
Class Dive Hours (average 1:15 hours/dive)	37.50	50.00	37.50	50.00	50.00	25.00	0.00	0.00	0.00	168.75	60.00	0.00	478.75
Research	5.00	20.00	13.00	28.00	23.00	7.00	0.00	2.00	5.00	10.00	1.00	1.00	115.00
Research Dive Hours (average 1:15 hours/dive)	6.25	25.00	16.25	35.00	28.75	8.75	0.00	2.50	6.25	12.50	1.25	1.25	143.75
Total Dives/Divers	**89.00**	**154.00**	**137.00**	**153.00**	**158.00**	**136.00**	**111.00**	**65.00**	**70.00**	**232.00**	**114.00**	**46.00**	**1465.00**
Total Dive Hours	**111.25**	**192.50**	**171.25**	**191.25**	**197.50**	**170.00**	**138.75**	**81.25**	**87.50**	**290.00**	**142.50**	**57.50**	**1831.25**

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will implement their diving class program consistent with the protocols identified in the EAHCP.

3.4.8 Research Programs in Spring Lake (EAHCP §5.4.8)

Obligations:
No research will be conducted in Spring Lake without prior review and approval by the Meadows Center for Water and the Environment (MCWE) to assess impacts to the covered species. Where take cannot be avoided, Texas State University will provide education to researches regarding the species and their habitats. Independent researchers may need to obtain individual permits from the USFWS.

2013 Compliance Actions:
The Chief Science Officer at the MCWE chairs the Spring Lake Environmental Committee which oversees all access to Spring Lake. MCWE developed an online access request form (http://www.aquarena.txstate.edu/Diving-for-Science/Access.html). Each request is reviewed by the eight-member committee and if a vertebrate animal is the target of research the Institutional Animal Care and Use Committee is also consulted for approval. In the event that the proposed research involved diving, the application and methods are reviewed by the Spring Lake Diving Control Board and if necessary, Scientific Diving training is required prior to access. Table 3-32 summarizes the research/access activities in Spring Lake.

Table 3-32. Research and/or Access Activities on Spring Lake

Approved Research Activities FY 2013					
Researcher	**Department/Agency**	**Duration**		**Description**	**Impact +/-**
Joe Fries	USFWS	9/13/2012	9/13/2013	Collecting San Marcos salamanders for the Fish Hatchery refugia	Minimal
Kerstin Hoesel	Biology	9/17/2012	11/1/2012	Pending	Minimal
Jen Sembera	Agricultural Education	10/5/2012	10/5/2012	Elephant ear/taro composting	Minimal
Benjamin Hutchins	Department of Biology	6/13/2012	5/1/2013	Invertebrate research	Minimal
Francis Rose	Biology	9/1/2012	12/1/2015	Herpetology	Minimal
Edmund Oborny	EAA-BioWest	10/28/2012	12/31/2013	San Marcos salamander population counts	Minimal
Amanda Moore	Wildlife ecology	3/1/2013	9/30/2014	Green heron study	Minimal
James Tennant	Biology	11/13/2012	11/14/2012	Practicing dredging operations	Minimal
Jon Lohse	Anthropology	5/1/2013	12/31/2013	Archaeology/core sampling	Minimal
Geary Schindel	EAA	3/1/2013	12/30/2013	Water sampling/dye tracing	Minimal
Thomas Hardy	Biology	3/28/2013	4/30/2013	Remove concrete spill from dive training area	Minimal
Valentin Cantu	USFWS	3/22/2013	3/25/2013	Collecting San Marcos salamanders for the Fish Hatchery refugia	Minimal
Caitlin Gabor	Biology	4/3/2013	4/3/2013	Catching mollies and gambusia for class demonstration	Minimal
McLean Worsham	Biology	4/8/2013	10/31/2014	Sampling benthic sediments for aquatic invertebrates using a ponar, netting, or turkey baster and/or slurp guns	Minimal
Kristina Zabierek	Population and Conservation Biology	7/2/2013	10/26/2013	Pending	Minimal
Jeffery Hutchinson		9/18/2013	9/15/2014	EAHCP propagation of riparian and terrestrial plants from seeds for restoration efforts on the San Marcos River.	

Approved Contractor/Other Activities FY 2013					
Researcher	**Department/Agency**	**Duration**		**Description**	**Impact +/-**
Dianne Wassenich	SMRF	11/1/2012	11/1/2013	Removal of water hyacinth from Sink Creek part of the lake	Minimal
Ron Coley	Aquatic Maintenance	1/15/2013	1/22/2013	Remove concrete spill from dive training area	Minimal
Ron Coley	Aquatic Maintenance	1/16/2009	2/13/2009	TCEQ has requested repairs be made to Burleson's Dam. Facilities dept. has contracted with BenchMark Services to remove underbrush from Dam in order for engineers to do an evaluation of the condition of the dam. per Jay Cody request The initial brush clearing will occur in what has been identified as the "A" priority area	Minimal
Alex Young	Texas State Triathlon Club	4/20/2013	4/21/2013	The Texas State Triathlon Club would like to use the beautiful Spring Lake as the venue for its annual triathlon	Minimal
Stryker Saunders	Community Services	2/11/2013	2/10/2014	Management of floating vegetation and litter in river and tributaries	Minimal
Brian Calvin	Atlas Environmental	2/12/2013	12/31/2013	EAHCP funded project for aquatic invasive snail and fish removal	Minimal
Andrew Johnston	HALFF Engineering	3/11/2013	3/15/2013	Halff Associates (Austin, Texas) is under contract with Texas State University to prepare a response to the most recent TCEQ Dam Safety Inspection Report	Minimal
Eric Ruckstuhl	EBR Enterprises	3/1/2013	12/31/2013	Invasive, Exotic plant removal. Mainly elephant ears; replant furnished native plant material	Minimal
Jon Lohse	Anthropology	5/1/2013	12/31/2013	Archaeology/core sampling	Minimal
Jeremiah Pizana	Rotary Club	9/21/2013	9/21/2013	See email for document detailing our event	Minimal
Brad Smith	Grounds Operations	3/27/2013	3/27/2013	Plant trees	Minimal
Brad Smith	Grounds Operations	3/26/2013	3/26/2013	Controlled burn operation	Minimal
Jay Cody	Grounds Operations	4/9/2013	4/13/2013	Replant of four trees	Minimal
Ron Coley	Aquarena	5/2/2013	5/3/2013	Host a "Check Out Dive" for the Wounded Warriors program	Minimal
Jerry Cochran	Texas Water Safari	6/7/2013	6/8/2013	260 mile non-stop canoe race starting on Spring Lake and finishing in Seadrift Texas	Minimal
Steve Black	Anthropology-CAS Texas State	10/4/2013	10/6/2013	Earth oven demonstration at Spring Lake as part of the Sacred Springs Powwow	Minimal
Frederick Hanselmann	MCWE	9/1/2013	8/31/2014	Access to the dive training area for the express purpose of recreational open water scuba check-out dives	Minimal
Seth Hodges	Texas State Triathlon Club	4/25/2014	4/27/2014	Annual sprint triathlon_swim portion conducted in Spring Lake	Minimal
Caitlin Gabor	Biology Dept.	12/6/2013	12/6/2013	Bio 1331 class field exercise at Wetlands Boardwalk	Minimal
Maria Rocha	Indigenous Cultures Institute	1/18/2014	1/19/2014	Overnight Native American church Ceremony at the Headwaters	Minimal
Arman Bakhtiari	Texas State _Facilities	12/24/2013	1/31/2014	Installation of boat charging station and waiting area benches	Minimal

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will implement their research program consistent with the protocols identified in the EAHCP.

3.4.9 Management of Golf Course and Grounds (EAHCP §5.4.9)

Obligations:
Texas State will develop and implement a Golf Course Management Plan, including an Integrated Pest Management Plan. These plans will consider the appropriate application of environmentally sensitive chemicals to reduce negative impacts to neighboring ecosystems. Any significant changes in the management protocol will be addressed through the Adaptive Management Process.

2013 Compliance Actions:
The MCWE in collaboration with the City of San Marcos completed a revised golf course management plan that includes a draft Integrated Pest Management Plan (Appendix KK). The revisions follow the guidelines outlined in both the EAHCP (5.4.9) and the Spring Lake Management Plan. Golf course operations followed the IPMP.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will implement its Golf Course Management Plan and Integrated Pest Management Plan developed in 2013. The University will additionally research the Audubon Certification for golf courses to determine if that designation is appropriate for additional species protection.

3.4.10 Boating in Spring Lake and Sewell Park (EAHCP §4.10)

Obligations:
Boating at Spring Lake will be restricted to areas treated with the harvester, operators will enter and exit boats at designated access points, and all boats will follow USFWS standards for proper cleaning.

2013 Compliance Actions:
The Spring Lake Management Plan was modified to ensure consistency with the EAHCP measures outlined in Section 5.4.10 for activities in Spring Lake. This included limiting canoe/kayak classes to no more than 2 classes per day with a maximum duration of 1 hour and limited to 20 students in 10 canoes. In addition, the glass bottom boats are restricted to areas in Spring Lake that are mowed for aquatic vegetation control. Boat access into Spring Lake must follow the USFWS decontamination process as outlined in the Spring Lake Management Plan and only enter at specific controlled locations that minimize potential impacts to listed species or their habitats. A total of 6,855 glass bottom boat tours and 433 glass bottom kayaks were conducted in 2013.

Canoeing/kayak classes in Sewell Park were limited to the region between Sewell Park and Rio Visa Dam as specified in the EAHCP. Access to the river was confined to the floating boat dock adjacent to the

recreation center downstream of the walking bridge in Sewell Park. No more than 3 classes/day with a maximum of 20 students in 10 canoes are permitted and not to exceed 2 hours in duration.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will implement their boating program in Spring Lake and Sewell Park consistent with the protocols identified in the EAHCP.

3.4.11 Reduction of Non-Native Species Introduction (EAHCP §5.4.11)

Obligations:
Texas State University will develop an education program and alternative disposal options to deter aquarium dumps into Spring Lake and the San Marcos River. The Texas State University will work closely with the City of San Marcos in completing this measure.

2013 Compliance Actions:
Texas State University collaborated with the City of San Marcos in looking for a suitable location for a pond that would function as a drop-off location for unwanted fish and other aquaria species that students no longer want. We expect this to be operational for the 2014 school year.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
Texas State University, in partnership with the City of San Marcos will continue to provide educational information to local pet shops and commercial retailers that sell aquatic species.

3.4.12 Control of Non-Native Plant Species (EAHCP §5.4.12)

Obligations:
Texas State University, in partnership with the City of San Marcos, will develop a non-native plant species removal program within university boundaries.

2013 Compliance Actions:
Non-native aquatic vegetation removal focused on *Hydrilla verticillata* and *Hygrophila polysperma* as these species are the most actively invasive. Prior to non-native vegetation removal, the area was fanned to minimize incidental take of fountain darters and other native species. The non-native aquatic vegetation was removed, shaken, native aquatic species salvaged and returned to the river (including egg masses) and then bagged for disposal at the City of San Marcos or Spring Lake compositing facility. Denuded areas were targeted for Texas wild-rice or selected native aquatic species planting based on habitat preferences for each native species. Texas wild-rice and native species were obtained from the SMARC or from raceways located at the Freeman Aquatic Building, Texas State University campus. Initial efforts for restoration of Texas wild-rice or native vegetation were targeted at planting approximately 20% of the surface area restored. Aquatic vegetation was mapped using Trimble GPS units in work areas prior to non-native vegetation removal and native planting to assess changes in the vegetation community.

An estimated 1,513 m^2 of non-native aquatic vegetation was removed in the San Marcos River downstream of Spring Lake Dam to just upstream of City Park from May through November 2013 among

areas physically worked by Texas State University staff (Table 3-33, Figure 3-59). Changes in vegetation outside of the areas worked were not included since differences observed could not be attributed to our work. The predominant non-native vegetation species removed were *Hydrilla verticillata* (~879 m^2) and *Hygrophila polysperma* (~576 m^2). The cutgrass island (~170 m^2), although composed of a native species (*Zizaniopis miliacea*) was removed in Sewell Park to increase available Texas wild-rice habitat. The cutgrass island was causing an accumulation of sediment on the east side of Sewell Park, reducing depths and current velocities.

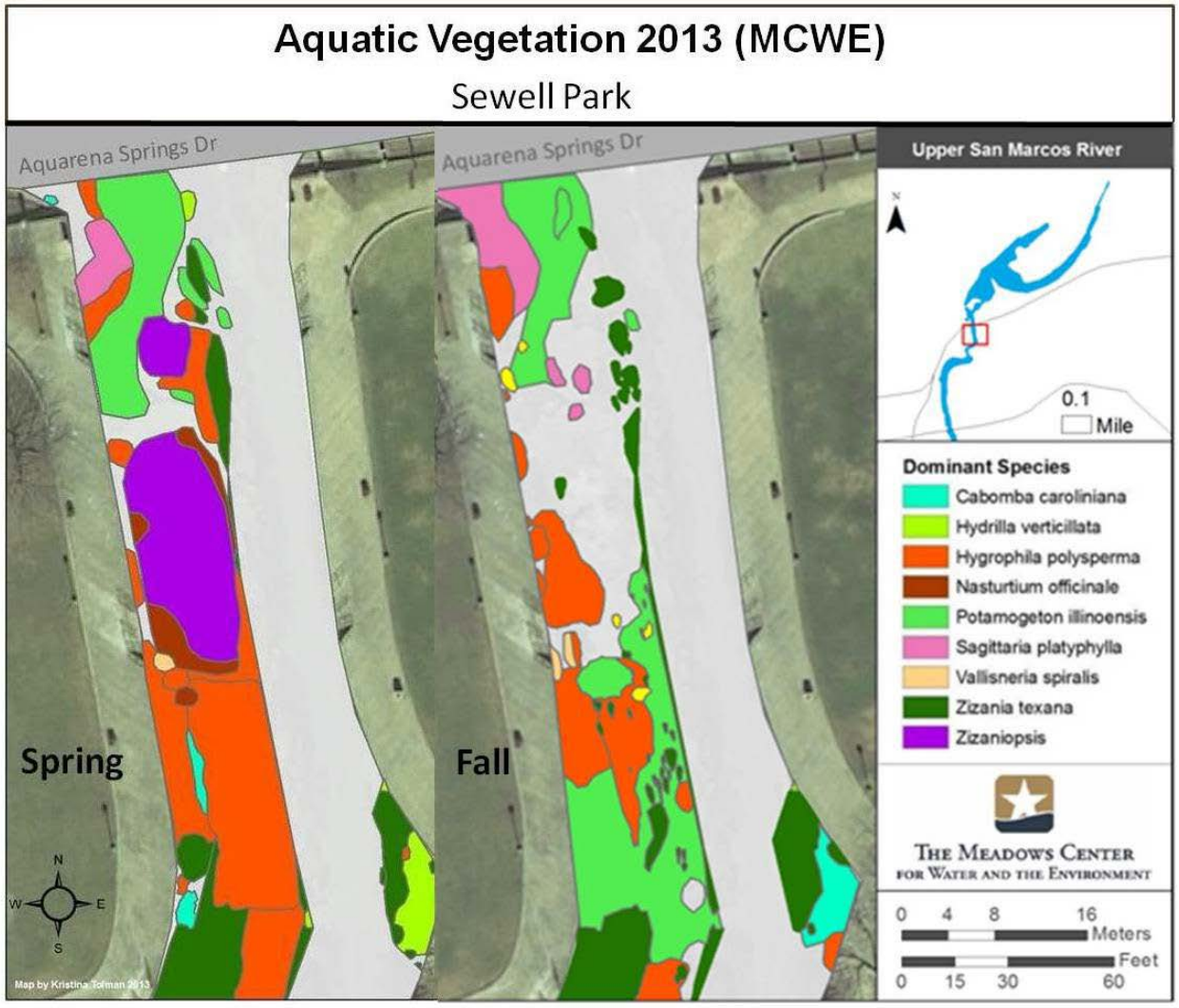

Figure 3-59. Before and after removal of cutgrass stands.

Table 3-33. Difference in area (m^2) of Non-Native Vegetation Species in the San Marcos River Prior to (April 2013) and Post (November 2013) Removal Activities

Species	April 2013	November 2013	Difference
Hydrilla verticillata	1004	125	-879
Hygrophilia polysperma	874	298	-576
Nasturtium officinale	58	0	-58

Ten fountain darter individuals were collected during non-native aquatic vegetation removal and returned to the river. One individual of another protected species, the San Marcos salamander, was also collected and returned to the river promptly. Other species collected and returned to the river included crayfish, sunfish species, and mosquito fish (Table 3-34).

Table 3-34. Animal Species Collected and Returned to the San Marcos River During Non-Native Vegetation Removal (2013)

Species	Month							
	May	June	July	August	September	October	November	**Total**
Lepomis sp. (sunfishes)	5	-	17	-	-	5	-	**27**
Etheostoma fonticola	-	-	3	3	2	2	-	**10**
Gambusia sp. (mosquito fish)	1	1	1	2	2	2	-	**9**
Oreochromis aurea (tilapia)	-	-	-	1	-	-	-	**1**
Ameiurus sp. (bullhead catfish)	-	8	4	4	-	1	1	**18**
Poecilia sp. (mollies)	-	1	-	1	-	-	-	**2**
Micropterus salmoides (largemouth bass)	-	-	1	-	-	-	-	**1**
Ambloplites rupestris (rockbass)	-	7	4	-	-	-	1	**12**
Eurycea nana (San Marcos salamander)	-	-	1	-	-	-	-	**1**
Cambaridae (crayfish)	357	457	546	152	129-	135	20	**1,796**
Hirudinea (leech)	-	-	6	-	-	-	-	**6**

Table 3-35 denotes the number of each native vegetation species planted once an area was denuded of non-native vegetation. Highest number of individuals planted were Texas wild-rice (3,067) followed by *Lugwigia repens* (2,455), and *Sagittaria platyphylla* (1,612). Other native species planted were *Heteranthera dubia, Potamogeton illinoensis,* and *Hydrocotyle umbellata*.

Table 3-35. Number of Each Native Vegetation Species Planted Monthly in the San Marcos River (2013)

	Month					
	June	July	August	September	October	**Total**
Zizania texana	521	487	49	84	393	1,534
Ludwig repens	232	227	58	286	670	1,473
Sagittaria platyphylla	39	10	18	11	245	322
Heteranthera dubia	-	-	-	-	100	100
Potamogeton illinoensis	-	-	-	-	54	55

MCWE observed an estimated 621 m^2 (540 m^2 net gain) increase in native vegetation species in the San Marcos River within areas we removed non-native vegetation and followed with planting of native vegetation (Table 3-36, Figures 3-60, 3-61, and 3-62). Changes in native vegetation outside of the areas worked were not included since differences observed could not be attributed to MCWE's work. Among native species, *Zizania texana* increased the most (383 m^2) followed by *Sagittaria platyphylla* (104 m^2), *Ludwigia repens* (71 m^2), and *Cabomba caroliniana* (59 m^2). A loss in area was observed for native species, *Potamogeton illinoensis* and *Hydrocotyle*, which we attribute to multiple factors including potential recreation effects and scouring of certain patches during a flood event on October 31, 2013. Additionally, these two species were the lowest number of individuals planted following non-native aquatic vegetation removal.

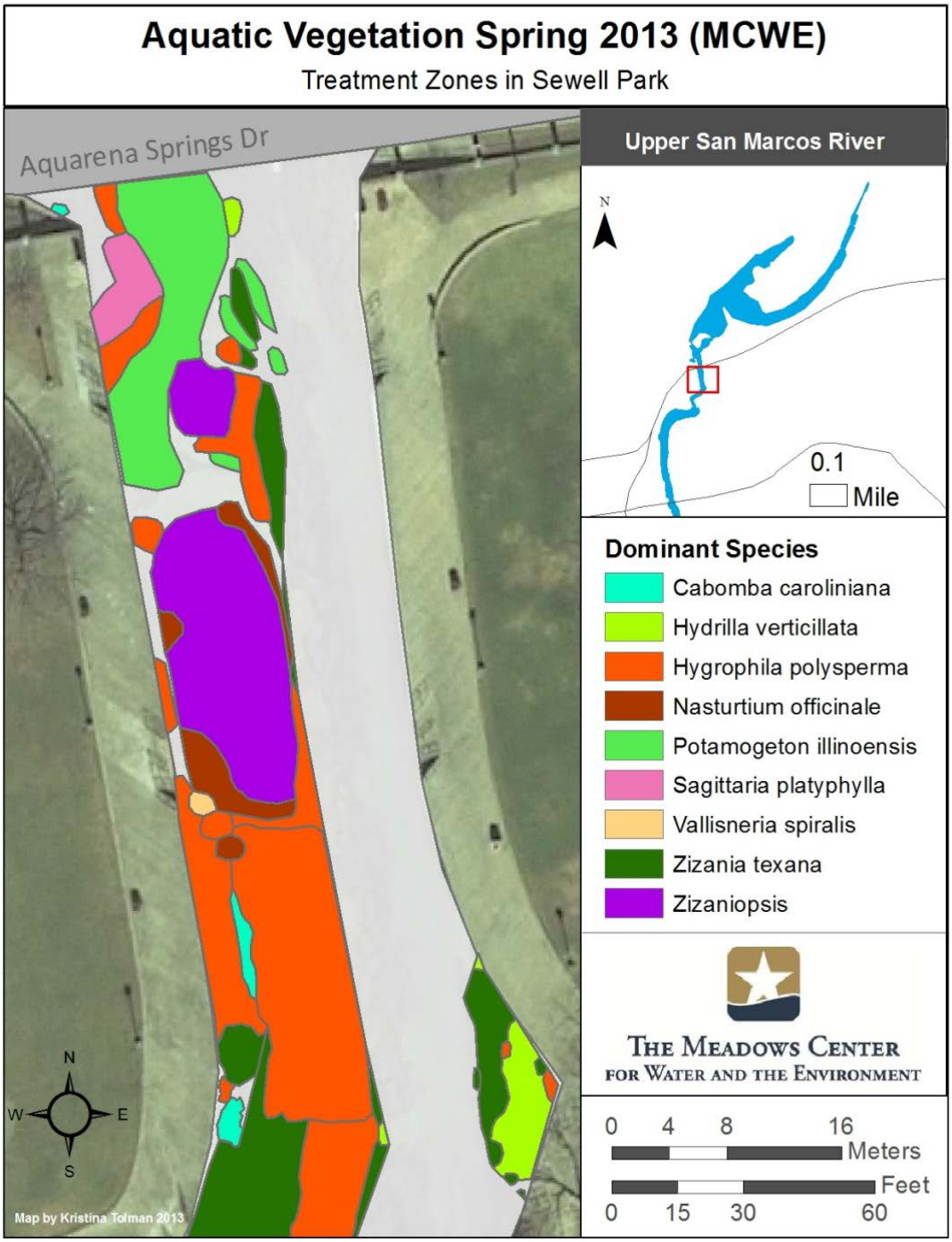

Figure 3-60. Vegetation transects showing changes as a result of removal and planting (spring 2013).

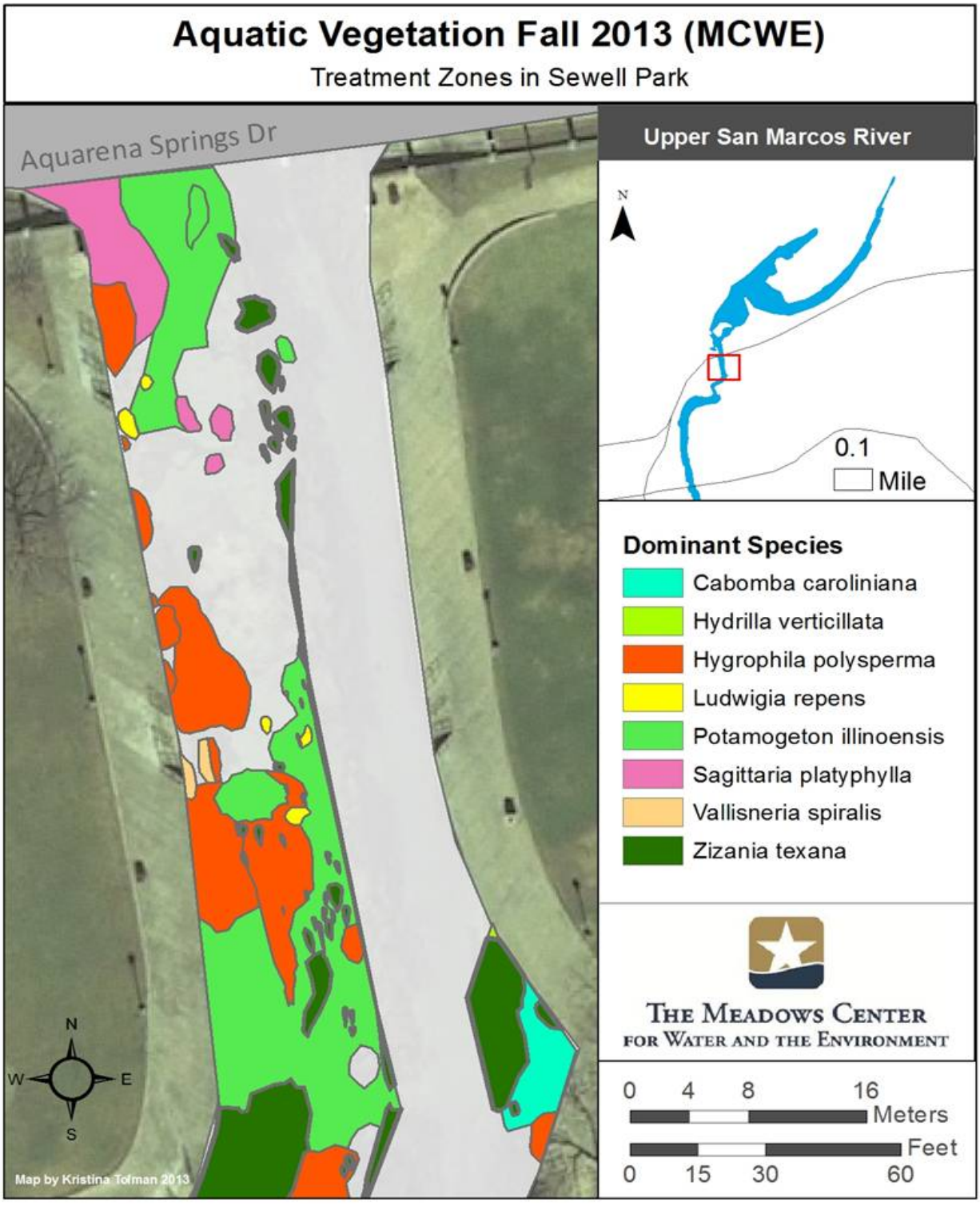

Figure 3-61. Vegetation transects showing changes as a result of removal and planting (fall 2013).

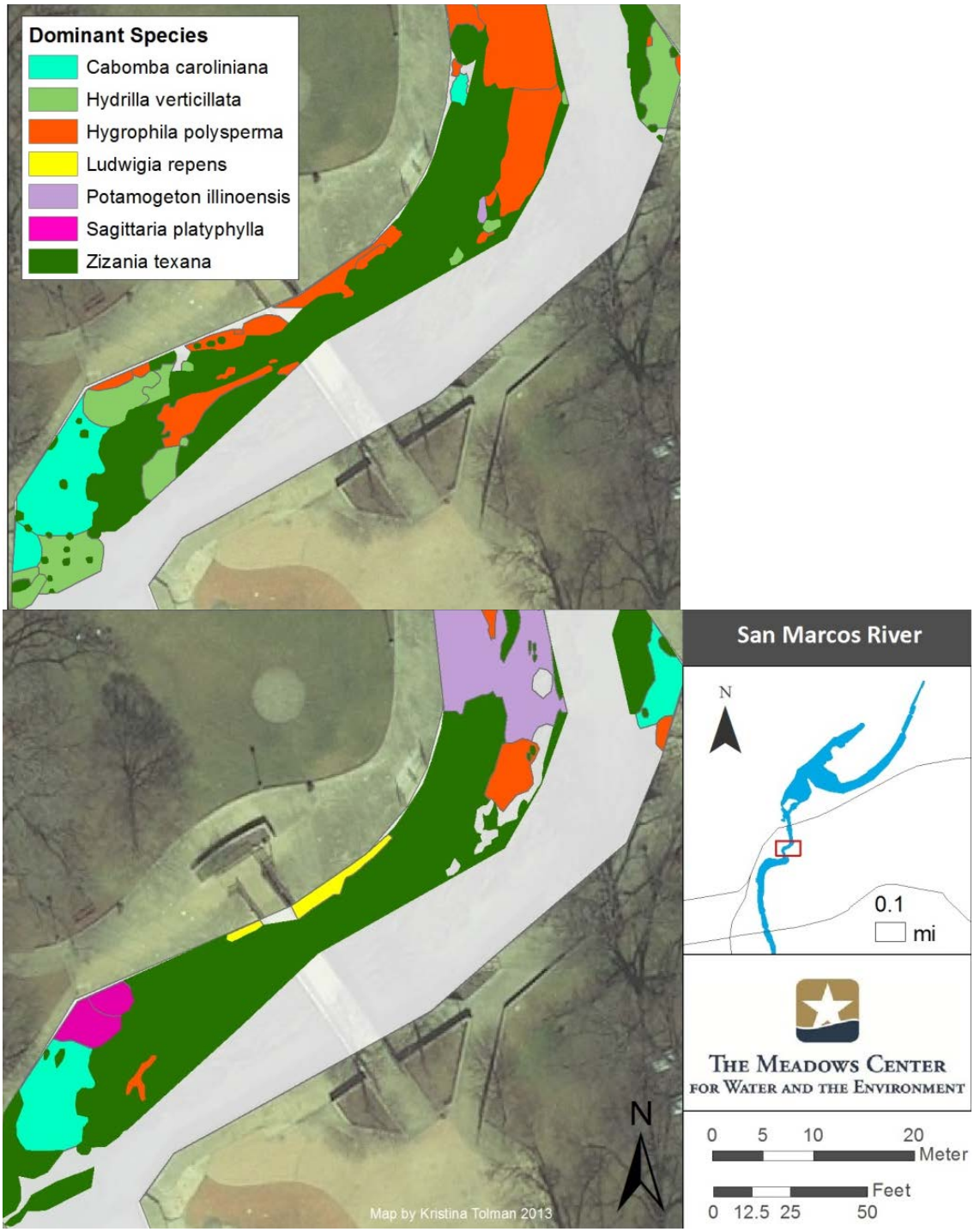

Figure 3-62. Vegetation transects showing changes as a result of removal and plantings.

Table 3-36. Difference in area (m^2) of Native Vegetation Species in the San Marcos River Prior to (April 2013) and Post (November 2013) Non-Native Vegetation Removal and Native Planting Activities

Species	April 2013	November 2013	Difference
Zizania texana	547	641	94
Ludwigia repens	0	16	16
Sagittaria platyphylla	27	45	18
Potamogeton illinoensis	212	114	-98
Cabomba caroliniana	60	85	25
Hydrocotyle	27	15	-12

Modifications Due to Drought Conditions:
MCWE shifted native vegetation planting to areas of greater depth to account for the decrease in river discharge.

Proposed Activities for 2014:
In 2014, Texas State University will remove 3,000 m^2 of non-native plant material. Additional elephant ears will be removed, and native littorals will be planted in their place.

3.4.13 Control of Harmful Non-Native and Predator Species (EAHCP §5.4.13)

Obligations:
Texas State University, in partnership with the City of San Marcos, will develop a non-native and predator species removal program within University boundaries.

2013 Compliance Actions:
Texas State University collaborated with the City of San Marcos to undertake control of harmful non-native and predatory species in Spring Lake and the San Marcos River upstream of City Park. Atlas Environmental (Atlas) researched literature to determine the life history and preferred habitat of the targeted fish and snails. Through research and river surveys, Atlas developed locations and methods to capture the target species.

Tilapia
Atlas targeted tilapia in Spring Lake twice each month using gill nets, seine nets and pole spears, but also captured tilapia in areas downstream of Spring Lake during *Plecostomus* removal (Figures 3-63, 3-64 and 3-65).

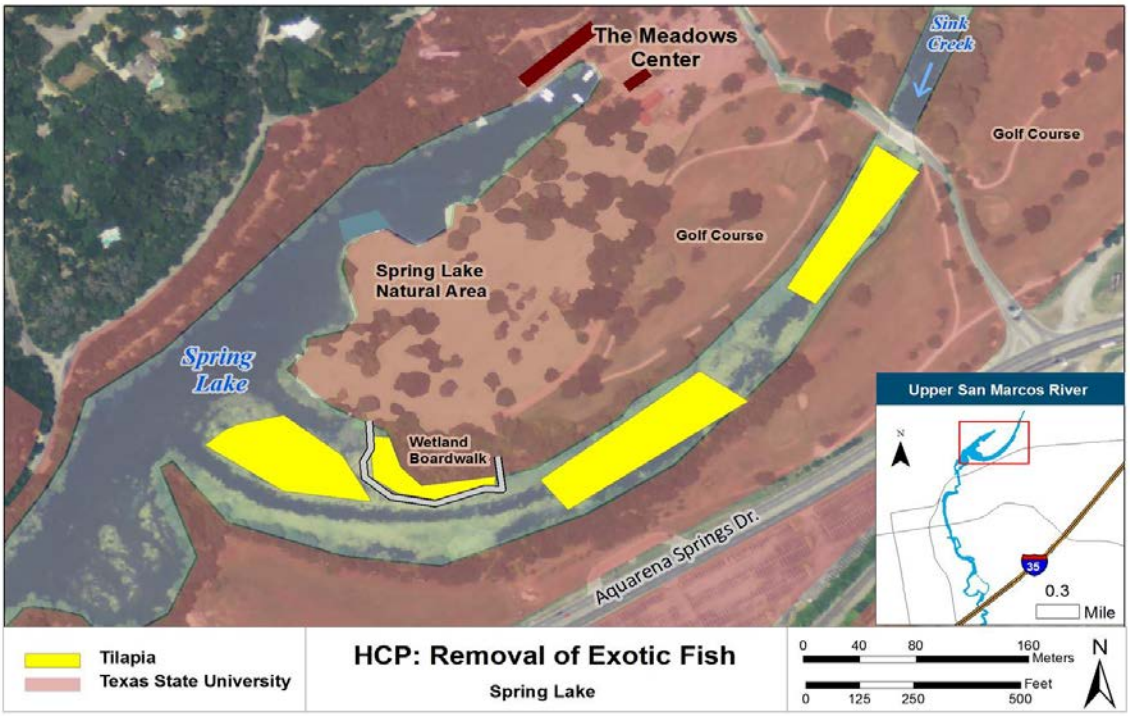

Figure 3-63. *Tilapia* treatment areas in Spring Lake and Sink Creek for 2013.

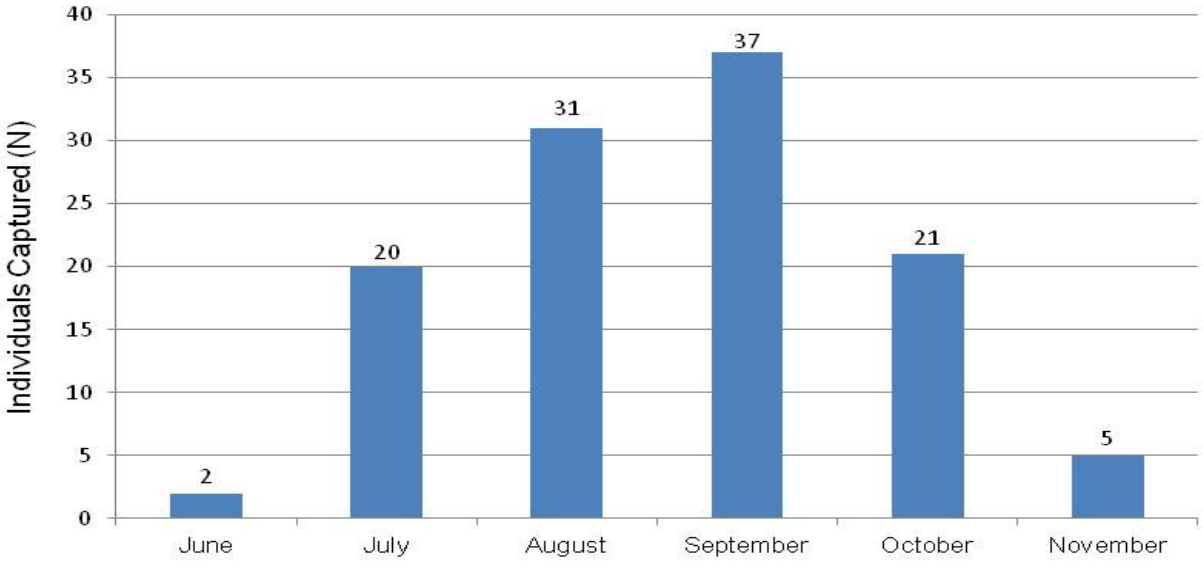

Figure 3-64. The number of individual *Tilapia* captured from June to November 2013.

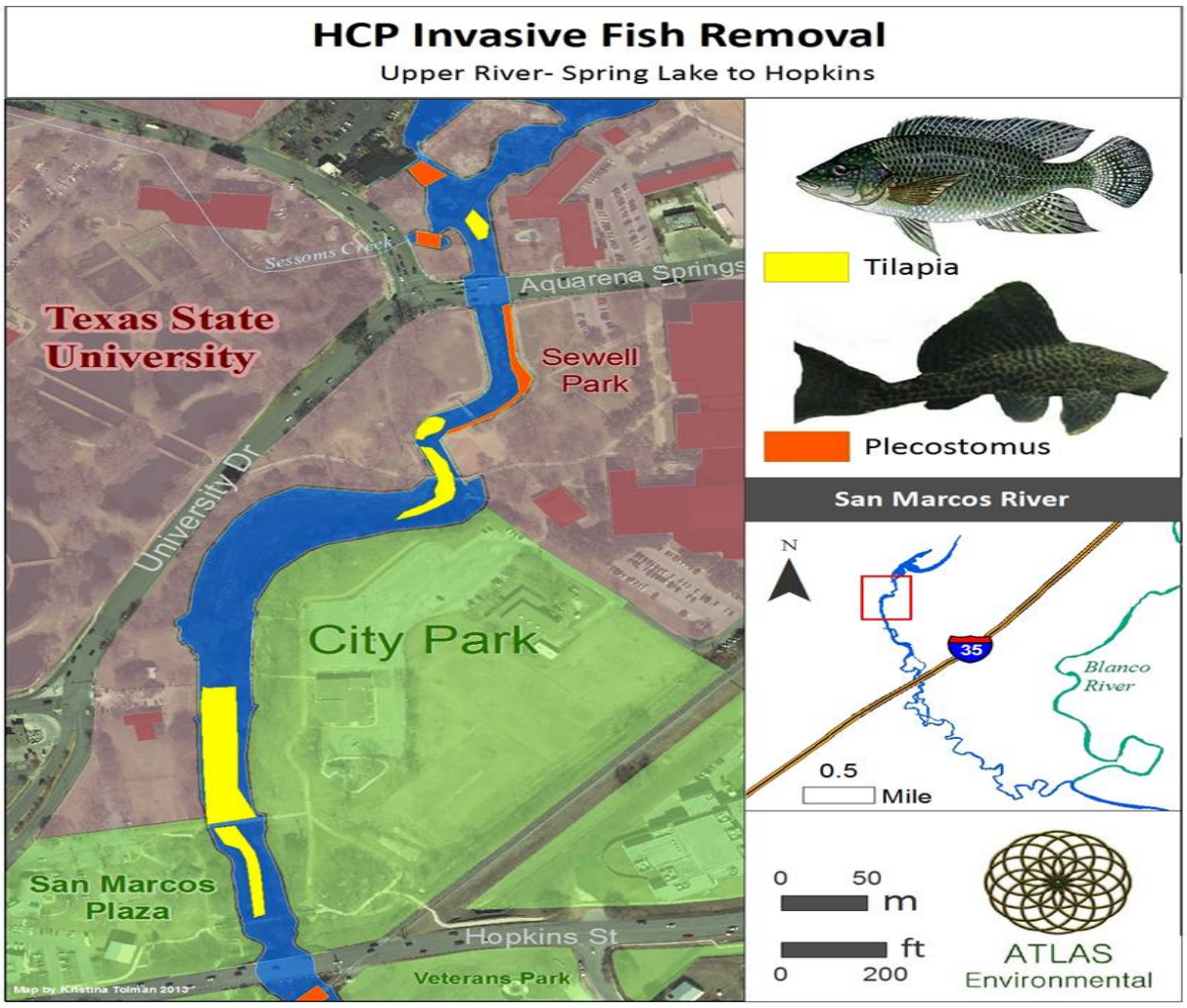

Figure 3-65. Treatment areas for *Plecostomus* and *Tilapia* from upper Sewell Park to IH-35.

Tilapia concentrations were viewed from a barge before entering the water. Pole spears were predominately used; gill and seine nets were most successful downstream of vegetation mats close to banks. A fence was used to channel tilapia into live traps but this method was not as successful and eliminated. The number of *Tilapia* captured was highest in August and September.

Modifications Due to Drought Conditions:
There were no modifications to this program due to drought conditions.

Proposed Activities for 2014:
In 2014, Texas State University will refine their population estimates for non-native species targeted for removal. Removal techniques will be refined and regular removal of the suckermouth catfish and tilapia will occur. Monthly maps showing changes in non-native populations will be generated.

3.4.14 Challenges Observed and Identified Solutions

In 2013, the City of San Marcos experienced the following challenges:

- The grids used to monitor Texas wild-rice expansion were a challenge because many of the rebar used to help locate our monitoring locations were lost or removed. The small flood on October 31, 2013 buried or dislodged most of our rebar. For 2014, we propose to measure the basal and leaf areas of Texas wild-rice patches to monitor the expansion of Texas wild-rice after removal of non-native aquatic vegetation.
- While the State Scientific Area infrastructure fulfilled the intended purpose, it required a significant effort to build. Therefore, two structures were left in place after the 2013 recreation season, but have required continued maintenance. At the end of the 2014 recreation season, the Conservation Crew will disassemble the structures to avoid continued maintenance and potential public safety issues. Conservation Crew hours will be maximized at the beginning and end of each recreation season to assemble and dissemble the structures. During summer 2014, four additional SSAs will be built. The City will evaluate the benefit of the SSAs compared to the effort of assembly after the end of the 2014 recreation season. Additionally, public acceptance of the SSAs is a challenge. Signage posted on the SSAs was not sufficient to obtain public acceptance, so the Conservation Crew will rotate between the SSAs to ensure public compliance and understanding.
- For sediment removal, the EAHCP identifies the use of a 0.25-inch strainer on the suction pump. However, at this small of diameter, the strainer became clogged very quickly and slowed the dredging process. The use of a 1.0 inch-strainer to increase dredging efficiency was proposed for approval. This request has been submitted to the USFWS.
- The current orientation of the Sessom Creek outflow is eroding the northern bank of the San Marcos River and threatens the existing bank stabilization structure on the western shoreline of the San Marcos River below Spring Lake Dam. Bank stabilization structures and a re-design on the Sessom Creek outflow will be incorporated into future plans.

3.5 SAN ANTONIO WATER SYSTEM

San Antonio Water System (SAWS) is one of the largest water and wastewater systems in the United States and serves most of Bexar County as well as portions of three adjacent counties. The municipally-owned utility serves a customer base of over 1.6 million customers that grows an additional 2% each year, as San Antonio becomes one of the fastest growing cities in the country. SAWS' Twin Oaks Aquifer Storage and Recovery (ASR) Project in southern Bexar County is a key conservation measure for the EAHCP. This conservation measure uses the storage of EAA issued Edwards Aquifer water permits leased by the EAA during favorable hydrological conditions. Under certain conditions more fully described in the EAHCP and the ASR contract entered into with the EAA, this water is recovered from storage to serve SAWS customers during certain drought conditions specified in the contract. The day-to-day operation of the ASR is managed by SAWS. A 12-person Regional Advisory Group composed of diverse stakeholders meets to advise SAWS on the implementation of the conservation measure.

The EAHCP broadly outlines how SAWS, with the assistance of the Regional Advisory Group, will describe in the Annual Report the storage and recovery activities (EAHCP page 5-38).

3.5.1 Use of the SAWS ASR for Spring Flow Protection (EAHCP §5.5.1 and §5.5.2)

Obligations:
SAWS will utilize the Twin Oaks Aquifer Storage and Recovery (ASR) Facility as a spring flow protection measure during times of certain extreme drought. When J-17 is less than or equal to 630 ft-msl and the 10-year rolling recharge to the Aquifer is less than or equal to 500,000 ac-ft/year, SAWS may return water from the ASR facility to its distribution system. Additionally, when these conditions are met, SAWS will forbear making withdrawals from the Aquifer from designated wells on the northeast side of its service area equivalent to certain forbearance schedules prescribed in the ASR contract.

SAWS will make every effort to simulate the return patterns identified in modeling by HDR during the development of the EAHCP; however, the EAHCP recognizes that future droughts may not exactly mimic the drought of record, so flexibility will be afforded SAWS.

Section 5.5.2 of the EAHCP includes a discussion on the use of the SAWS Water Resources Integration Program as the Phase II presumptive action for the EAHCP. To date, Phase II is not yet effective and has not yet been discussed by the Committees of the EAHCP, so it is not discussed at length in this Report.

The details of the SAWS ASR program have been clarified and explained in detail in a contract between the EAA and SAWS; that contract is included in Appendix LL.

2013 Compliance Actions:
In 2013, it was determined that the development of an Intergovernmental Contract (IC) was required to accomplish the conservation measure called for in the EAHCP. This IA was developed between the EAA and SAWS during a seven (7) month period in 2013. The effort culminated in the approval of the IC by the Board of Directors of the EAA and the SAWS Board of Trustees. The IC became effective August 14, 2013. IC Board Items are included in Appendix LL.

This important accomplishment translates the conceptual elements of SAWS ASR commitment in Section 5.5.1 of the EAHCP into measurable activities related to both parties' responsibilities. The development of the contract was negotiated between the agencies' respective legal counsels and staff familiar with both the EAHCP and SAWS ASR. Approval of the SAWS ASR Project IC, a highly complex and important element of the EAHCP, within five (5) months of the EAHCP's approval provides an important foundation for regional partners contributing to the success of the EAHCP.

SAWS was also responsible for organizing and facilitating an ASR Advisory Group. The IC also required formation of a staff work group. This subject will also be discussed further in this document.

Under the IC, SAWS is required to credit to the EAA as being in storage any permitted Edwards Aquifer water for which it receives a notice of availability from the EAA by certain dates detailed further in the IC, or based on meter recharge for notices of availability received by SAWS after certain dates. The initial notice of availability was issued by the EAA in 2013, on October 9th, for 2,669 acre-feet, though this amount was reduced by critical period cutbacks. A total of 1,868 acre-feet was credited to the EAA as being in storage in 2013.

Modifications Due to Drought Conditions:
No modifications to the use of SAWS' ASR due to drought conditions occurred in 2013. Trigger levels were not reached during this time period, so SAWS ASR use for EAHCP spring flow protection was not implemented.

Proposed Activities for 2014:
In 2014, SAWS will continue to manage the ASR program as described in the EAHCP and consistent with the terms identified in the SAWS ASR Contract with the EAA.

3.5.1.1 SAWS ASR Advisory Committee

Per the requirement on page 5-39 of the EAHCP, a 12-person Regional Advisory Group consisting of four representatives of SAWS, the Program Manager, and one representative each from: the EAA, an EAA permit holder for irrigation purposes, a representative of small municipal pumpers, a representative of the spring cities, an environmental representative (including TPWD), a representative of industrial aquifer users, and downstream interests will provide advice to SAWS regarding the implementation of the program.

The EAHCP and SAWS ASR IA provide for continued dialog and interaction. Under the IC, SAWS has the responsibility for facilitating two groups. The first is SAWS Aquifer Storage and Recovery Regional Advisory Group as described in the EAHCP (Appendix LL) and immediately above. The second is a Staff Work Group whose membership and general descriptions are described in Appendix LL. These groups each met in compliance with EAHCP and IA. The SAWS Aquifer Storage and Recovery Regional Advisory Group met quarterly subsequent to the approval of the EAHCP (on April 12, 2013, September 19, 2013, and December 12, 2013). Topics of these meetings included:

- 2nd Quarter - presentations on the SAWS north east service distribution infrastructure and its complex coordination with the Twin Oaks Aquifer Storage and Recovery facilities.
- 3rd Quarter - presentation on the SAWS ASR Project IC jointly prepared by EAA and SAWS attorneys, provided a visual presentation that gave hypothetical forbearance situations, and reviewed how SAWS forecast models work.
- 4th Quarter - a tour and site visit of the Twin Oaks ASR facilities and forecast briefing of expected conditions at the start of 2014..

SAWS notified EAA September 2013 to activate the Staff Work Group for 3rd Quarter 2013. It was mutually decided that the EAHCP Program Manager meeting with a SAWS Staff contact to review charges and explore agenda options would constitute the 3rd quarter meeting while the respective agencies would further explore staff assignments. The Staff Work Group held its 4th Quarter meeting on December 5, 2013, prior to the Aquifer Storage and Recovery Regional Advisory Group meeting, for member introductions, to collaboratively discuss near term forecasts stretching into 2014, and report on the status of the 2013 ASR operations for the regional EAHCP contributions.

A notice of availability (NOA) from the EAA (Appendix LL) dated October 9, 2013 was delivered to SAWS. The NOA provides that SAWS has the option to store up to 1,868.325 ac-ft of permitted Edwards withdrawal rights on behalf of the region by December 31, 2013. SAWS pursuant to the terms of the NOA began storing approximately ten million gallons per day (10 MGD) October 31, 2013. Storage at the 10 MGD rate for approximately 60 days will allow SAWS to account for storing the water in the NOA.

3.5.1.2 Status of SAWS ASR Lease Acquisition

The EAA will acquire 50,000 ac-ft of Edwards Aquifer permitted water through leases and options for use in the SAWS ASR program. Acquisition will be accomplished in three tiers.

Table 3-37. SAWS ASR Lease Structure as Identified in the EAHCP

Tier	Acre-feet	Description
I	16,667	Leased for immediate storage in the ASR
II	16,667	Acquired as options; exercised when the 10-year rolling recharge for the previous year falls below 572,000 ac-ft/year
III	16,667	Acquired as options; exercised when the 10-year rolling recharge for the previous year falls below 472,000 ac-ft/year

The total amount of water acquired through December 2013 was 4,718.995 ac-ft; 2,669.036 ac-ft was enrolled for lease terms starting in 2013, and 2,049.959 ac-ft was enrolled for lease terms starting in 2014.

Table 3-38. SAWS ASR Acquired Leases in 2013

Lease Term	Total Acre-feet Acquired in 2013	Percent of Total Tier I Target
15 years	2,252.205	13.5%
10 years	491.664	2.9%
7 years	630.626	3.8%
5 years	0.00	0.0%
3 years	1,200.00	7.2%
1 year	144.500	0.9%
Total Confirmed	4,718.995	28%

The ASR Leasing Program satisfied 28% of its enrollment goal for Tier 1 in 2013. Enrollment is on-going and the program will continue to be adjusted to respond to the dynamics of the market. In 2014, SARA will continue to work with the EAA staff to encourage and increase participation in the Program.

3.5.2 Challenges Observed and Identified Solutions

Four primary master recharge meters have been chosen to provide accounting of water storage to the degree specified by the IC. These meters on SAWS transmission infrastructure account for ASR flows proximal to SAWS primary production facilities that are delivering recharge water to Twin Oaks ASR facilities. SAWS can accomplish accounting sufficient for the IC using two of the existing meter locations and the existing Panametric meters (a brand of electromagnetic meters made by GE) identified in the IC. Data collected in 2013 verifies flows being accounted for EAA credited regional storage activities and was collected through Artesia Flowmeter – 1 and Seale Flowmeter – 2 for 2013. Due to the intense maintenance required for Panametric meters installed on the exterior of large water transmission mains, SAWS will likely replace these meters with electromagnetic insertion meters in 2014. Some of the new insertion meters have already been installed and they will run parallel to the current contractual meters at

minimum up until the time SAWS submits an amendment to the IC. SAWS anticipates submittal of a formal amendment to the IC's Exhibit D reflective of the changes described herein the first quarter of 2014.

The SAWS Twin Oaks ASR facility is gated, fenced, and patrolled, and SAWS is unaware of any unauthorized activities by the public at the ASR.

SAWS ASR use for EAHCP springflow protection was not implemented.

3.6 TEXAS PARKS AND WILDLIFE DEPARTMENT

The TPWD serves as the state agency with primary responsibility for conserving, protecting and enhancing the state's fish and wildlife resources. In this role, TPWD has the authority to establish state "scientific areas" for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value (TPW Code § 81.501). To minimize the impacts of recreation, TPWD has created a two mile segment of the public waters of the San Marcos River as a State Scientific Area in the San Marcos Springs ecosystem (30 TAC 57.910).

In order to protect existing and restored fountain darter habitat, TPWD will pursue creation of state scientific areas in the Comal Springs ecosystem. The goal of the regulations will be to minimize impacts to habitat from recreation activities.

3.6.1 State Scientific Areas (EAHCP §5.6.1)

Obligations:
The TPWD will pursue the establishment of a State Scientific Area in the San Marcos Springs ecosystem for expanded protection of Texas wild-rice along a 2-mile segment. TPWD will enter into an inter-local agreement with the City of San Marcos and Texas State University establishing criteria for in-stream enforcement of the State Scientific Area once it is in place.

Following extensive aquatic and riparian restoration implementation in the City of New Braunfels, TPWD will pursue a State Scientific Area along the Old Channel of the Comal River. Similar to with the City of San Marcos, TPWD will enter into an inter-local agreement with the City of New Braunfels establishing criteria for in-stream enforcement of the State Scientific Area once it is in place.

2013 Compliance Actions:
The Edwards Aquifer Habitat Conservation Plan requires that TPWD create state scientific areas in the San Marcos and Comal River. TPWD has the authority to establish state "scientific areas" for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value (TPW Code § 81.501). To minimize the impacts of recreation, TPWD created a two-mile segment of the public waters of the San Marcos River as a State Scientific Area in the San Marcos Springs ecosystem (30 TAC 57.910). This scientific area is designed to protect Texas wild-rice by restricting recreation in these areas during flow conditions below 120 cfs. The rule makes it unlawful for any person (1) to move, deface, alter, or destroy any sign, buoy, boom or other such marking delineating the boundaries of the area; (2) uproot Texas wild-rice within the area; and (3) enter an area that is marked. The regulations are intended to preserve at least 1,000 m^2 of Texas wild-rice (Appendix MM).

In cooperation with the City of San Marcos and Texas State University, signs and information kiosks were designed, produced and installed during the summer of 2013. The purpose of the signs and information kiosks is to educate the public about protecting the San Marcos River and its endangered

inhabitants, especially during prime recreational season. TPWD is currently working to produce Spanish language versions of the signs and kiosks. TPWD also created and distributed a news release to inform the public about the San Marcos River State Scientific Area.

Modifications Due to Drought Conditions:
When the flows within the San Marcos River State Scientific Area are 120 cubic feet per second or less, physical barriers may be placed within the State Scientific Area to help recreational users avoid vulnerable stands of Texas wild-rice while enjoying the river and to protect areas where habitat has been restored. Flows in the San Marcos River were below 120 cfs during the summer of 2013. In June the decision was made by the City of San Marcos, in consultation with TPWD and Texas State University, to deploy barriers to protect six stands of Texas wild-rice.

Proposed Activities for 2014:
In 2014, TPWD will work to expand their public education efforts to include signage in Spanish.

3.6.2 Challenges Observed and Identified Solutions

It was necessary to redesign the barrier system after the first test deployment. The initial design consisted of tall traffic cones with weighted bases that were used to secure ropes marked with brightly colored floats. Even with weighted bases the traffic cones were not sturdy enough to remain stationary given the combination of river flow and unintentional contact by recreational users (tubers). The traffic cones were replaced with fencing t-posts and the line was replaced with PVC pipe, creating a much sturdier barrier system (Figure 3-66).

Figure 3-66. City of San Marcos Conservation Crew performing public outreach at barrier.

This design was successfully deployed to protect six vulnerable stands of Texas wild-rice. No wildlife impacts were observed. On-site outreach conducted by the City of San Marcos Conservation Crew (individual in the foreground in Figure 3-66 above) was instrumental in informing the public about the purpose of the barriers, thus preventing the need for additional law enforcement.

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4.0 ADAPTIVE MANAGEMENT ACTIVITIES FOR 2013

Chapter 6 of the EAHCP addresses the adaptive management process and describes the role that adaptive management plays in the conservation of the Covered Species.

The mitigation and minimization measures assigned to each Party are the primary means of restoring spring flows and increasing habitat necessary for Covered Species survival, however, adaptive management provides the flexibility to allow for science based changes and modifications to enhance the effectiveness of the EAHCP.

Article 7 of the FMA provides the procedure and responsibilities of the Parties for making Adaptive Management Process decisions.

The adaptive management process involves several components:

- Monitoring – The Parties developed a monitoring program designed to assess potential impacts to the Covered Species. The monitoring program includes water quality monitoring (conducted by EAA staff in 2013); biological sampling; and recharge monitoring. Data from these activities will be used to guide the adaptive management process in the future.
- Compliance Monitoring – Compliance monitoring is the process of the Parties providing a public record demonstrating compliance with the requirements of the ITP.
- Effects and Effectiveness Monitoring – This process is designed to evaluate the success of the EAHCP in meeting its stated goals and objectives. In 2013, the EAA contracted for several studies to be completed to accomplish this. Namely, Biological Monitoring, Groundwater Modeling, and Ecological Modeling.
- Recharge Monitoring – EAA staff measured the amount of water estimated to be recharging the aquifer.
- Monitoring Reports – The monitoring reports are a summary of the activities and results of the items described above. The monitoring report is included in the Annual Report and provided to the USFWS each year.

4.1 AMENDMENTS TO THE ITP

Section 9.2 of the EAHCP governs how the ITP may be amended. There are Clarifications and Minor Administrative Amendments which are used to deal with issues that arise with respect to the administration, process, or precise meaning and intent of the language in the ITP.

To amend or modify the ITP, a Substantive Amendment is required. The EAHCP requires that all Substantive Amendments require written approval by the Permittees.

In 2013, the Implementing Committee authorized the Program Manager to submit one Clarification letter and one Minor Amendment to the USFWS. The Clarification letter (dated October 18, 2013) was to clarify a variance to Sections 7.10.0 and 7.11.2 of the FMA regarding the number of panel members selected to serve on the Science Review Panel and the number of meetings of the Science Review Panel. USFWS has requested additional information to support this clarification, including rationale and documentation of the process. This additional support will be provided to USFWS early in 2014. The Minor Amendment (dated November 22, 2013) was written to amend Section 5.6.5 of the FMA to allow

employees of Texas State University to be employed as contractors to the EAA when performing EAHCP related activities.

4.2 CHANGES TO OBJECTIVES OUTLINED IN THE EAHCP

In 2013, there were no changes made to the biological goals or objectives as described in the EAHCP.

4.3 ADAPTIVE MANAGEMENT PROPOSALS

In 2013, there were no proposals for Adaptive Management submitted to the Implementing Committee. Therefore, there were no Adaptive Management activities in 2013.

5.0 2013 ANNUAL TAKE ESTIMATES

The ITP specifically identifies eleven species with permissible take values. These species include the fountain darter, San Marcos salamander, Texas blind salamander, Texas cave diving beetle, Texas troglobitic water slater, San Marcos gambusia, Texas wild-rice, Comal Springs salamander, Comal Springs riffle beetle, Peck's Cave amphipod, and the Comal Springs dryopid beetle. The ITP identifies different methods for assessing impacts to habitat and the resulting take of these species within the springs ecosystems.

Flow Related Take
For the Comal Springs salamander, Texas cave diving beetle, and the Texas troglobitic water slater, take is evaluated based on flow rates in their respective systems. For these species, incidental take resulting from HCP implementation and other authorized activities is covered by the ITP as long as pre-determined minimum flow rates identified in the ITP are maintained. Those rates are as follows:

Species	Flow Requirement
Comal Springs Salamander	Incidental take of the Comal Springs salamander will be provided for individuals of the species killed, harmed, or harassed by continuous spring flows as low as 27 cfs and/or up to 75 days below 30 cfs during EAHCP Phase I and by continuous spring flows up to 45 cfs and/or 30 days below 45 cfs during Phase II at Comal Springs (BO, 136).
Texas Cave Diving Beetle and Texas Troglobitic Water Slater	Incidental take of the Texas troglobitic water slater will be provided for individuals of the species killed, harmed, or harassed buy continuous spring flows as low at 50.5 cfs and/or up to 30 days below 50 cfs during EAHCP Phase I and by continuous spring flows to 51.2 cfs and/or up to 15 days below 50 cfs during Phase II at San Marcos Springs (BO, 136).

EAHCP Implementation Related Take
In the case of the Texas blind salamander and the San Marcos gambusia, the ITP assumes that as long as the EAHCP is fully implemented and minimum flow rates are maintained, there will be limited to no incidental take. This is a result of the nature of the Texas blind salamander as a subterranean species and the opinion that the San Marcos gambusia may already be extinct. While the ITP does not stipulate a take value for the gambusia, it does quantify take of the Texas blind salamander at ten individuals over the life of the permit.

Additionally, due to how USFWS classifies endangered plants, there is no specific take quantification for Texas wild-rice. Instead, the ITP requires that per the established goal in the EAHCP, no less than 38,200 square feet of Texas wild-rice should be present in Spring Lake and the San Marcos River. This stipulation includes during a repeat of the Drought of Record.

Take Determined by Surrogate Measurement
USFWS recognizes the difficulty of quantifying the impacts to, and take of, individuals of the species included in the ITP due to their biological nature. Therefore, USFWS "evaluates the quantity of habitat affected as a surrogate for the level of incidental take impacts in some cases" (BO, 88). This surrogate is used because most "incidental take, or impacts, from covered activities are expected to occur in the form of harm and harassment through direct loss of habitat and indirect adverse effects resulting from the issuance of an Incidental Take Permit under Section 10(a)(1)(B) of the [Endangered Species] Act" (BO, 88). In determining take, USFWS considers only actual habitat; potential habitat is not considered.

To determine take for the fountain darter, San Marcos salamander, Comal Springs riffle beetle, Peck's Cave amphipod, and the Comal Springs dryopid beetle, loss of surface habitat serves as the surrogate for take of these species. The surrogate will be measured as follows:

Species	Surrogate
San Marcos Salamander	10% Surface Habitat in the San Marcos River and Spring Lake by EAHCP implementation activities
San Marcos Fountain Darter	10% Surface Habitat in the San Marcos River and 2.5% Surface Habitat impacted in Spring Lake by EAHCP implementation activities
New Braunfels Fountain Darter	10% Surface Habitat impacted by EAHCP implementation activities
Riffle Beetle	5% Surface Habitat impacted by EAHCP implementation activities
Peck's Cave Amphipod	5% Surface Habitat impacted by EAHCP implementation activities
Comal Springs Dryopid Beetle	5% Surface Habitat impacted by EAHCP implementation activities

Maintaining surface habitat losses below allowable limits will also allow Permittees to remain in compliance with Sections M1a and M2a of the ITP which stipulate that "the Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals... to no more than 10% of the occupied habitat on an annual basis when implementing EAHCP measures."

5.1 Estimation of Annual Take

To determine incidental take levels in 2013, the EAA contracted with BIO-WEST, who discussed their preferred methodologies for determining take with the USFWS prior to developing their final report.

A summary of incidental take that occurred in 2013 by species is included in Table 5-1. For a more detailed description of the methodologies employed and further species by species analysis, please *see* Appendix NN.

Table 5-1. ITP Take Summary

COVERED SPECIES PER SYSTEM	IMPACTED HABITAT (m^2)		HABITAT 2013 TOTAL (m^2)	INCIDENTAL TAKE		2013 INCIDENTAL TAKE TOTAL	ITP Permit Amount	ITP Permit Remaining
	EAHCP Mitigation / Restoration	EAHCP Measures / Drought		EAHCP Mitigation / Restoration	EAHCP Measures / Drought			
COMAL SYSTEM								
Fountain Darter	4,181	2,807	**6,988**	6,272	4,211	**10,482**	797,000	786,518
Comal Springs Riffle Beetle	0	103	**103**	0	681	**681**	11,179	10,498
Comal Springs Dryopid Beetle	0	134	**134**	0	13	**13**	1,543	1,530
Peck's Cave Amphipod	0	78	**78**	0	81	**81**	18,224	18,143
SAN MARCOS SYSTEM								
Fountain Darter	3,236	7,896	**11,132**	4,854	11,844	**16,698**	549,129	532,431
San Marcos Salamander	15	336	**351**	45	1,008	**1,053**	263,857	262,804
Texas Blind Salamander	0	0	**0**	0	0	**0**	10	10
Comal Springs Riffle Beetle	0	0	**0**	0	0	**0**	n/a	n/a

5.2 EVALUATION OF EFFECTS ON THE PLAN AREA

Conditions M(1)(a) and M(2)(a) of the ITP address impacts related to implementation of the minimization and mitigation activities associated with the EAHCP.

- Condition M(1)(a): Comal Springs, Landa Lake, and the Comal River: The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the Comal Springs, Landa Lake, and Comal River to no more than 10% of the occupied habitat on an annual basis when implementing EAHCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;
- Condition M(2)(a): San Marcos Springs, Spring Lake, and the San Marcos River: The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the San Marcos Springs, Spring Lake, and the San Marcos River to no more than 10% of the occupied habitat on an annual basis when implementing EAHCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;

The Texas cave diving beetle, Texas troglobitic water slater, Comal Spring salamander, San Marcos gambusia, and Texas wild-rice are not considered in the net disturbance calculation as they are either exempt through other provisions in the ITP, or incidental take is not regulated by the ITP. Cumulative disturbance levels by species are included in Table XX. For a detailed analysis of how disturbance was determined, *see* Appendix NN.

Table 5-2. Net Disturbance Area and Percentage of Total Per Species Per System

COVERED SPECIES	Total Occupied Habitat (m^2)	Net Disturbance	
		Impact Area (m^2)	% of Total
City of New Braunfels			
Fountain Darter	73,410	4,181	5.7%
Comal Springs riffle beetle	1,383	0	0
Comal Springs dryopid beetle	350[A]	0	0
Peck's Cave Amphipod	1,470[A]	0	0
City of San Marcos / Texas State University			
Fountain Darter	113,179	3,236	2.9%
San Marcos salamander	2,165	14.8	0.7%
Texas blind salamander	[B]		
Comal Springs riffle beetle	11	0	0

[A] Although a minimal amount of surface habitat was documented for the baseline and comparison purposes, this species is subterranean and utilizes subsurface habitat.

[B] No surface habitat documented for this species.

6.0 RECOMMENDATIONS

Given that 2013 is the first year of program implementation and many elements of the EAHCP are currently in the process of achieving full implementation, the Permittees have not developed recommendations for major modifications to program implementation or the Habitat Conservation Plan itself for 2014. As discussed in Section 3.0 above for each Permittee (subsections entitled "Challenges Observed and Identified Solutions"), numerous detailed action items have been identified to address specific logistical issues associated with implementation of mitigation obligations. Some of these actions have already been initiated in 2013, while others will be tested in 2014 and re-evaluated at the end of this year. Regular monitoring of program implementation will continue throughout 2014, and the Permittees will continue to communicate with the USFWS and EAHCP Stakeholders on any subjects of interest as anticipated by the program documents.

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7.0 RELEVANT PUBLICATIONS

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