Edwards Aquifer

Habitat Conservation Plan

2019 Annual Report

Prepared for

The U.S. Fish & Wildlife Service

On behalf of

The Edwards Aquifer Habitat Conservation Plan and Permittees

Prepared by

Blanton & Associates, Inc.

March 27, 2020

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EXECUTIVE SUMMARY

Edwards Aquifer Habitat Conservation Plan

The Edwards Aquifer Habitat Conservation Plan (EAHCP) is the primary document that establishes the cooperative effort to protect the water of the Southern Segment of the Edwards Aquifer ("Edwards" or "Aquifer") both for people in the region and the threatened and endangered species that inhabit the Aquifer, and aquatic spring environments whose water largely emanates from the Aquifer. This effort began when regional stakeholders and the U.S. Fish & Wildlife Service (USFWS) initiated the Edwards Aquifer Recovery Implementation Program (EARIP) in 2006. The Texas Legislature mandated participation in the process by the Edwards Aquifer Authority (EAA), Texas Commission on Environmental Quality, Texas Department of Agriculture, Texas Parks & Wildlife Department (TPWD), and Texas Water Development Board (TWDB). The EARIP planning group led to the creation of the process known as the EAHCP Program, which has now been fully transitioned from the EARIP. The EAHCP was completed in November 2012 and led to the approval of an Incidental Take Permit (ITP) under the federal Endangered Species Act of 1973 (ESA) issued in February 2013 by the USFWS to be effective in March 2013. The ITP has been amended once. This Annual Report has been prepared for submittal to the USFWS, as required by the ITP. Because of EAHCP implementation efforts, there have been various amendments and clarifications made to the EAHCP, or its supporting documents, since the issuance of the ITP.

The Permittees under the ITP are the EAA, the City of New Braunfels (CONB), the City of San Marcos (COSM), Texas State University (Texas State), and the City of San Antonio acting by and through its San Antonio Water System (SAWS) Board of Trustees.

Covered Species Protected by the EAHCP

The EAHCP addresses the conservation needs of seven endangered species, one threatened species, and three species that have been petitioned for listing, as shown below in **Table ES-1**. Under the EAHCP, the Covered Species are protected by the ITP issued by the USFWS. The ITP authorizes "take" of the Covered Species listed in **Table ES-1**, as that term is defined in the ESA.[1]

[1] "Take," as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." "Harm" is also defined in the implementing regulations as "an act which actually kills or injures wildlife; such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly interfering with essential behavioral patterns including breeding, feeding and sheltering" (50 CFR 17.3). Plants (e.g., Texas wild-rice) are treated differently under the ESA and are not subject to the take rules.

Table ES-1. Covered Species Under the EAHCP ITP

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

* Also known as the "Edwards Aquifer Diving Beetle."

The Texas Cave Diving Beetle, Comal Springs Salamander, and Texas Troglobitic Water Slater are "petitioned" species and are not yet subject to the "take" prohibition in the ESA.

Geographic Area Covered by the EAHCP

As shown in **Figure ES-1**, the ITP provides incidental take coverage for authorized activities in all or parts of Uvalde, Medina, Atascosa, Bexar, Comal, Guadalupe, Hays and Caldwell counties, Texas that are within the EAA's jurisdictional boundary. This region is the Plan Area in which pumping from the Edwards Aquifer is regulated by the EAA and affects the springs and spring ecosystems inhabited by the Covered Species. The Plan Area also includes the recreational areas associated with the Comal Springs and the San Marcos Springs that are managed under the EAHCP by the CONB, and the COSM and Texas State, respectively. As shown in **Figure ES-1,** the Contributing Zone is part of the Edwards Aquifer *system* but is not technically a part of the Edwards Aquifer itself.

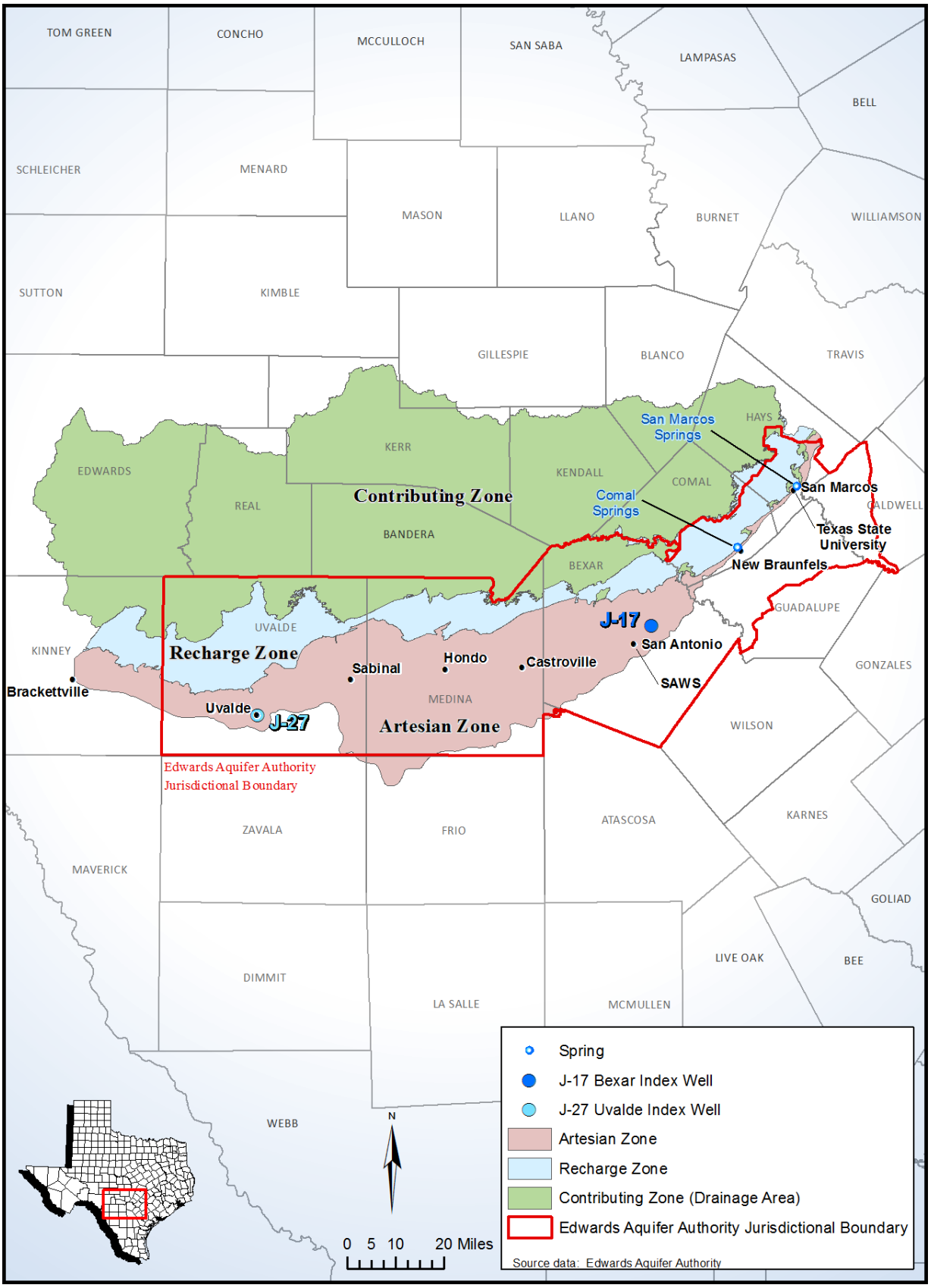

Figure ES-1. Incidental Take Coverage Area for ITP No. TE-63663A-1 (EAA Jurisdictional Boundary).

2019 Edwards Aquifer Conditions, Management, and Notable Conditions

Fall rain in 2018 and spring 2019 sustained aquifer and springflow conditions above historic averages through much of 2019. The Uvalde Pool, Well J-27, remained near 880 feet mean sea level (ft msl) from January through July before water levels began to fall. Water levels at Well J-27 ended 2019 near 879 ft msl. The San Antonio Pool, Well J-17, fluctuated through 2019 and began the year around 685 ft msl and ended 2019 near 672 ft msl. While drought conditions across the region began to intensify in the summer of 2019, groundwater conditions remained well above critical period triggers.

Surface water levels in both the Comal and San Marcos rivers responded to reduced rainfall in the summer with reduced water levels. Surface water levels remained at or above average in the first half of 2019, with surface water levels beginning to drop in July 2019. No major flooding was observed in 2019, though rainfall did cause high peak flows at times.

Effects on Covered Species in 2019

The ITP authorizes incidental take (Condition H) and limits occupied habitat disturbance (Condition M). Both incidental take and net disturbance are evaluated on an annual basis to report to the USFWS (Table ES-2). Condition H of the ITP explicitly defines the amount of incidental take authorized over the permit term. Condition M (1a and 2a) addresses EAHCP minimization and mitigation activities that contribute to recovery. Condition M stipulates that over the course of any given year no more than 10% of a covered species occupied habitat can be affected by EAHCP minimization and mitigation activities. Incidental take associated with implementation of all other applicable EAHCP Covered Activities was characterized and quantified to the degree practical and added to the portion of incidental take calculated from disturbed areas.

Table ES-2. Summary of Impacted Habitat and Net Disturbance and Incidental Take for EAHCP Covered Species Compared Against ITP Maximum Permit Amounts

Covered Species Per System	EAHCP Mitigation/Restoration		EAHCP Measures/ Drought	Combined Impacted Habitat 2019 TOTAL (m^2)	Incidental Take		2019 Incidental Take Total	ITP Maximum Permit Amount	ITP Permit Maximum Minus (Combined First Seven Years)
	Impacted Habitat (m^2)	Net Disturbance % Of Total Occupied Habitat	Impacted Habitat (m^2)		EAHCP Mitigation/ Restoration	EAHCP Measures/ Drought			
COMAL SYSTEM									
Fountain Darter	498	0.5%	0	**498**	747	0	**747**	797,000	735,587
Comal Springs Riffle Beetle	0	0%	0	**0**	0	0	**0**	11,179	8,887
Comal Springs Dryopid Beetle	0	0%	0	**0**	0	0	**0**	1,543	1,527
Peck's Cave Amphipod	0	0%	0	**0**	0	0	**0**	18,224	18,057
SAN MARCOS SYSTEM									
Fountain Darter	8,119	8.6%	331	**8,450**	12,179	497	**12,675**	549,129	461,349
San Marcos Salamander	0	0%	0	**0**	0	0	**0**	263,857	261,183
Texas Blind Salamander	0	0%	0	**0**	0	0	**0**	10	10
Comal Springs Riffle Beetle	0	0%	0	**0**	0	0	**0**	N/A	N/A
Comal Springs Dryopid Beetle	0	0%	0	**0**	0	0	**0**	N/A	N/A

EAHCP 2019 Budget and Expenditures

The EAA Board-approved/amended 2019 Program Funding Applications totaling $19,456,802. The 2019 actual expenses were $17,609,403. Unspent funds in Biological Monitoring, Decaying Vegetation Restoration, LID/BMP Management, Capital (Comal and San Marcos Springs), Applied Environment Research – USFWS NFHTC, and NFHTC Refugia budgets account for most of the difference between total approved budget and actual expenses.

The EAHCP actual revenue for 2019 was $15,402,267 compared to the budgeted revenue of $15,016,336, which is a variance of $385,931. Approximately 90 percent of the actual revenue comes from Edwards Aquifer Authority Aquifer Management Fees. The reserve balance for the EAHCP was $28,744,181 at the end of 2019, which includes unspent funds accumulated since the inception of the EAHCP.

2019 Nonroutine Adaptive Management Process Decisions

Consistent with Funding and Management Agreement (FMA) § 7.12, the Implementing Committee (IC) approved the Nonroutine (Adaptive Management Process) AMP Proposal to increase the Voluntary Irrigation Suspension Program Option (VISPO) Conservation Measure volume goal by 1,795 acre-feet (ac-ft) of Edwards Aquifer water on May 23, 2019. This approval followed development of a Scientific Evaluation Report by the Adaptive Management Science Committee (SC), review by the Adaptive Management Stakeholder Committee (SH), and development of an SH Report. The Nonroutine AMP increasing the VISPO volume goal was approved by the USFWS in June 2019. Increasing the VISPO volume goal to 41,795 ac-ft ensures a modeled 30 cfs daily average minimum springflow in the Comal Springs system during a repeat of drought-of-record scenario.

The SH identified concerns that pulse-flows described by the EAHCP had not been addressed. The SH Report presents the SH's concerns and their final recommendations. Their recommendations and approval of the VISPO Nonroutine AMP Proposal were agreed upon by the IC. A Work Group to will be developed in 2020 in response to the SH recommendations.

2019 Strategic Adaptive Management Process Activities

FMA Article 7 outlines the procedural steps and responsibilities of the Permittees for making AMP decisions – Routine, Nonroutine, and Strategic Adaptive Management Process (SAMP) decisions. SAMP decisions are those that relate to the selection of Phase II Conservation Measures to be implemented by the Permittees for Phase II of the EAHCP (Years 2020 – 2028). The EAHCP concluded discussions and activities through the SAMP that did not result in any SAMP decisions as defined in FMA § 7.13.7.

EAHCP Activities Completed in 2019

As stated above, the five Permittees under the ITP are the EAA, CONB, COSM, Texas State, and SAWS. Under the Implementing Agreement, the TPWD is an additional cooperating agency. These are the agencies working to implement the EAHCP. The Permittees are each tasked with certain responsibilities for implementation of the EAHCP, as directed by the ITP. During Phase I of implementing the EAHCP,

the Permittees are undertaking 38 Conservation Measures for springflow protection, habitat protection, and other measures identified in the EAHCP.

The ITP requires an annual report be submitted to the USFWS to show progress towards permit implementation. This 2019 Annual Report describes actions by the Permittees and the TPWD. In Year 2019, work on the EAHCP built upon work and research accomplished over the six years, along with regional stakeholder guidance and recommendations from the National Academy of Sciences. Highlights of major EAHCP accomplishments for 2019 are summarized below.

Springflow Protection Measures –

With regard to the four EAHCP springflow protection elements (the VISPO, the Regional Water Conservation Program [RWCP], the Critical Period Management Program [CPMP] – Stage V, and the SAWS Aquifer Storage and Recovery [ASR] program), the EAHCP continues to make headway to complete all four of these elements prior to Year 2023, which is the tenth year of the ITP and five years in advance of the Year 2028.

a. *VISPO* – In 2019, conditions were not triggered and forebearance was not required.

b. *RWCP* – SAWS reported a total of 6,859 acre-feet (ac-ft) of water saved through increased leak repair.

c. *CPMP – Stage V* – CPMP – Stage V was not triggered in 2019

d. *SAWS ASR Program* – Drought conditions that require the use of ASR were not triggered in 2019. The EAA contributed 16,667 ac-ft as defined by the Interlocal Contract. SAWS recharged through injection and stored 13,597 ac-ft of EAHCP Groundwater into the SAWS ASR Project for a total storage of 10,448 ac-ft. The EAA acquired and maintained groundwater withdrawal rights totaling about 35,458 ac-ft, of which about 16,891 ac-ft were leased groundwater withdrawal rights and about 18,567 ac-ft were ASR springflow protection forbearance agreements.

Habitat Restoration: Comal and San Marcos Spring Systems –

a. *Comal Springs System* –
Submerged Aquatic Vegetation Restoration in the Comal River (Old Channel and New Channel), Landa Lake, and Upper Spring Run – Aquatic vegetation restoration activities in 2019 included removal of non-native aquatic vegetation and planting of target native aquatic plants as well as monitoring, mapping, and maintenance of restored areas. A summary of 2019 restoration results follows.

   i. *Old Channel* – In 2019, a total of 1,136 native aquatic plants were planted within three new restoration plots in the Old Channel LTBG Reach. The plantings encompassed an area of 242 m^2. Only isolated patches and fragments of *Hygrophila* were identified during the baseline aquatic vegetation mapping that occurred in February 2019.

ii. *New Channel* – In 2019, a total of 96 Ludwigia plants were planted in the Upper New Channel LTBG Reach within a single restoration plot comprising 18 m^2.

iii. *Landa Lake* – In 2019, a total of 4,009 native aquatic plants were planted in the Landa Lake LTBG Reach. An area of 423 m^2 was planted in five restoration plots.

iv. *Upper Spring Run* – In 2019, a total of 240 *Ludwigia* plants were planted in the Upper Spring Run LTBG Reach within two restoration plots comprising 69 m^2.

Non-Native Aquatic Vegetation Management – Except for the Upper New Channel Restoration Reach where significant Hygrophila coverage exists, total Hygrophila coverage from Blieders Creek through Landa Lake, and to the end of the Old Channel LTBG Reach, was less than 20 m2. Efforts were undertaken in 2019 to remove all reemergent non-native vegetation that was identified.

Riparian Restoration – The CONB performed riparian restoration activities along the banks of the Old Channel of the Comal River and in Landa Lake that included removal of non-native vegetation and planting of native plants and grasses.

Control of Harmful Non-Native Animal Species – In 2019, approximately 5,109 pounds (lbs.) of invasive species biomass was removed from Landa Lake, that consisted of vermiculated sailfin catfish, tilapia, and nutria.

b. *San Marcos Springs System* –
Texas wild-rice Enhancement and Restoration – In 2019, 70 m^2 of Texas wild-rice was planted in two reaches – City Park and Upper Interstate Highway -35. Existing stands of Texas wild-rice were maintained by removal of non-native vegetation in and around stands of Texas wild-rice. Texas wild-rice was not planted in Spring Lake due to construction work on Spring Lake Dam.

Significant progress was made towards restoration and enhancement of Texas wild-rice in the San Marcos River. The estimated total coverage of Texas wild-rice was 10,488 m^2, which is a total increase of 5,837 m^2, or 125 percent from 2013 coverage of 5,095 m^2.

Riparian Restoration – The COSM removed and treated invasive regrowth from Sewell Park to Capes Dam and portions of San Marcos River tributaries.

Control of Harmful Non-Native and Predator Species – In 2019, Tilapia were eliminated by bowfishing and sprearfishing in Spring Lake. The COSM also hosted bi-annual polespear tournaments in spring and fall. Three sailfin catfish were removed with pole spears during a night dive. Red-rimmed and giant ramshorn snails were hand-collected in areas of large concentrations primarily below Spring Lake dam. Snails were also included in the bi-annual spearfishing tournament. From 2015 – 2019, COSM staff reported that 1,806 lbs. of invasive species biomass have been removed through spearfishing tournaments.

Supporting Measures –

a. *Refugia* **–** Construction was completed in 2019. The Covered Species were collected throughout the year at the USFWS San Marcos Aquatic Research Center in San Marcos, Texas and the USFWS Uvalde National Fish Hatchery in Uvalde, Texas. Research activities included: 1)

Environmental influences of CSRB pupation; 2) CSRB nutrition supplementation; 3) Long-term marking success of salamanders; and 4) San Marcos salamander reproductive dysfunction.

b. *Applied Research* – The Applied Research Program in 2019 primarily focused on two studies. Applied research on the Sessom Creek Sediment Export Study, and Aquatic Plant Bloom Assessment in Spring Lake; both completed in 2019.

   The Sessom Creek Sediment Export Study established a sediment loading curve for Sessom Creek, comprised of a fitted relationship between flow and entrained constituent concentration, and to assess what factors are contributing to the sediment exports in the San Marcos River and sediment deposition on Texas wild-rice as a recurring issue.

   The Aquatic Plant Bloom Assessment in Spring Lake evaluated the feasibility of using aquatic plant booms for capturing floating vegetation within Spring Lake, and the effectiveness of aquatic plant booms to minimize vegetation mat ccumulation downstream in the San Marcos River.

EAHCP Program Activities –

The EAHCP completed another active year. EAHCP staff managed and facilitated the SAMP activities, one Nonroutine AMP resulting in an amendment to the EAHCP. EAHCP program staff also facilitated various public meetings that included regular and/or joint meetings of the IC, SC, and SH, topical based Work Groups to inform program decisions. Program activities were communicated to the public through the EAHCP website, *EAHCP Steward* Newsletter, EAA *News Drop* Magazine, and *EAHCP Conserve* Newsletter. Additionally, all IC and SH meetings were made available to view online through the EAA Granicus System.

Table of Contents

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

List of Tables (Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

ac-ft	acre-foot/acre-feet
AMF	Aquifer Management Fee(s)
AMP(s)	Adaptive Management Process(es)
ASR	Aquifer Storage and Recovery
BIO-WEST	BIO-WEST, Inc.
CCWRD	Comal County Water Recreation District #1
cfs	cubic feet per second
cm	centimeter(s)
COI(s)	Certificate(s) of Inclusion
CONB	City of New Braunfels
COSM	City of San Marcos
CPMP	Critical Period Management Program
CSRB	Comal Springs riffle beetle
DO	dissolved oxygen
DOR	drought of record
EAA	Edwards Aquifer Authority
EAHCP	Edwards Aquifer Habitat Conservation Plan
EARIP	Edwards Aquifer Recovery Implementation Program
EcoModel	Ecological Model
ESA	federal Endangered Species Act of 1973
FMA	Funding and Management Agreement
ft	foot/feet
ft^2	square feet
GBRA	Guadalupe-Blanco River Authority
HAZMAT	Hazardous Materials
HCP	Habitat Conservation Plan
HHW	Household Hazardous Waste
IA	Implementing Agreement
IC	Implementing Committee
IH	Interstate Highway
ILC	Interlocal Contract
IPMP	Integrated Pest Management Plan
ITP	Incidental Take Permit
LTBG(s)	Long-Term Biological Goal(s)
m	meter(s)
m^2	square meters
MCWE	Meadows Center for Water and the Environment
mg/L	milligram(s) per liter
msl	mean sea level
NAS	National Academy of Sciences
NAS *Report 3*	*National Academy of Sciences – Review of the Edwards Aquifer Habitat Conservation Plan: Report 3*
NBU	New Braunfels Utilities
No.	Number
PAH(s)	non-polycyclic or polycyclic aromatic hydrocarbon compound(s)
PCB(s)	Polychlorinated Biphenyl(s)
Phase II Work Group	Comprehensive Phase II Work Plan Work Group
POCIS	polar organic chemical integrative samples

List of Acronyms and Abbreviations (Continued)

PPCP(s)	Pharmaceutical and personal care product(s)
RCMC	Regional Conservation Monitoring Committee
RWCP	Regional Water Conservation Program
SAMP	Strategic Adaptive Management Process
SAV	submerged aquatic vegetation
SAV Report	Submerged Aquatic Vegetation Analysis and Recommendations Report
SAWS	San Antonio Water System
SC	Adaptive Management Science Committee
SCUBA	Self Contained Underwater Breathing Apparatus
SER	Scientific Evaluation Report
SH	Adaptive Management Stakeholder Committee
SMARC	San Marcos Aquatic Research Center
sp./spp.	species (singular)/species (plural)
SRP	Science Review Panel
SSA	State Scientific Area
SVOC(s)	Semi-volatile Organic Compound(s)
TAC	Texas Administrative Code
Texas State	Texas State University
TPWD	Texas Parks & Wildlife
TTU	Texas Tech University
TWR	Texas wild-rice
UNFH	Uvalde National Fish Hatchery
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
VISPO	Voluntary Irrigation Suspension Program Option
WRIP	Water Resources Integration Program
yd^3	cubic yards

1.0 BACKGROUND AND AQUIFER CONDITIONS

The Edwards Aquifer Habitat Conservation Plan (EAHCP)[2] was approved by the U.S. Fish & Wildlife Service (USFWS) as a regional plan to protect the federally-listed species and certain other non-listed species (known as Covered Species)[3] associated with the Edwards Aquifer while helping to ensure stability of the Edwards Aquifer as a water supply for the region (RECON Environmental, Inc. [RECON] et al. 2012). After approval of the EAHCP, the USFWS issued an Incidental Take Permit (ITP) under the federal Endangered Species Act of 1973 (ESA), with an effective date of March 18, 2013.

The permit is ITP Number (No.) TE-63663A-1 (as amended January 21, 2015), and was issued to five cooperating Permittees: the Edwards Aquifer Authority (EAA); the City of New Braunfels (CONB); the City of San Marcos (COSM); Texas State University (Texas State); and the City of San Antonio acting by and through its San Antonio Water System (SAWS) Board of Trustees. The permit authorizes certain "Covered Activities" (EAHCP Chapter 2.0), under circumstances where the activities may incidentally cause "take" of a Covered Species.

The ITP has been amended once since it was issued by the USFWS. A copy of the amended ITP is contained in **Appendix A1** of this report. Because of EAHCP implementation efforts, there have been various amendments or clarifications made to the EAHCP, or its supporting documents, since the issuance of the ITP. **Appendix A2** is a table summarizing the amendments or clarifications from November 2012 through December 2019.

The ITP provides incidental take coverage for Covered Activities in Uvalde, Medina, Atascosa, Bexar, Comal, Guadalupe, Hays, and Caldwell counties, Texas, within the EAA's jurisdictional boundary, which is the area in which pumping from the Edwards Aquifer is regulated by the EAA (**Figure 1.0-1**). As shown in **Figure 1.0-1,** the Contributing Zone is part of the Edwards Aquifer system but is not technically a part of the Edwards Aquifer itself.

The species covered under the EAHCP are listed in Table 1.0-1.

[2] All acronyms and abbreviations in this Annual Report are defined in the **LIST OF ACRONYMS AND ABBREVIATIONS** located on pages xi – xiii.

[3] All aquatic animal and plant species referenced in this Annual Report are listed in the LIST OF ALL SPECIES OF MANAGEMENT INTEREST REFERENCED located on pages 101 – 102.

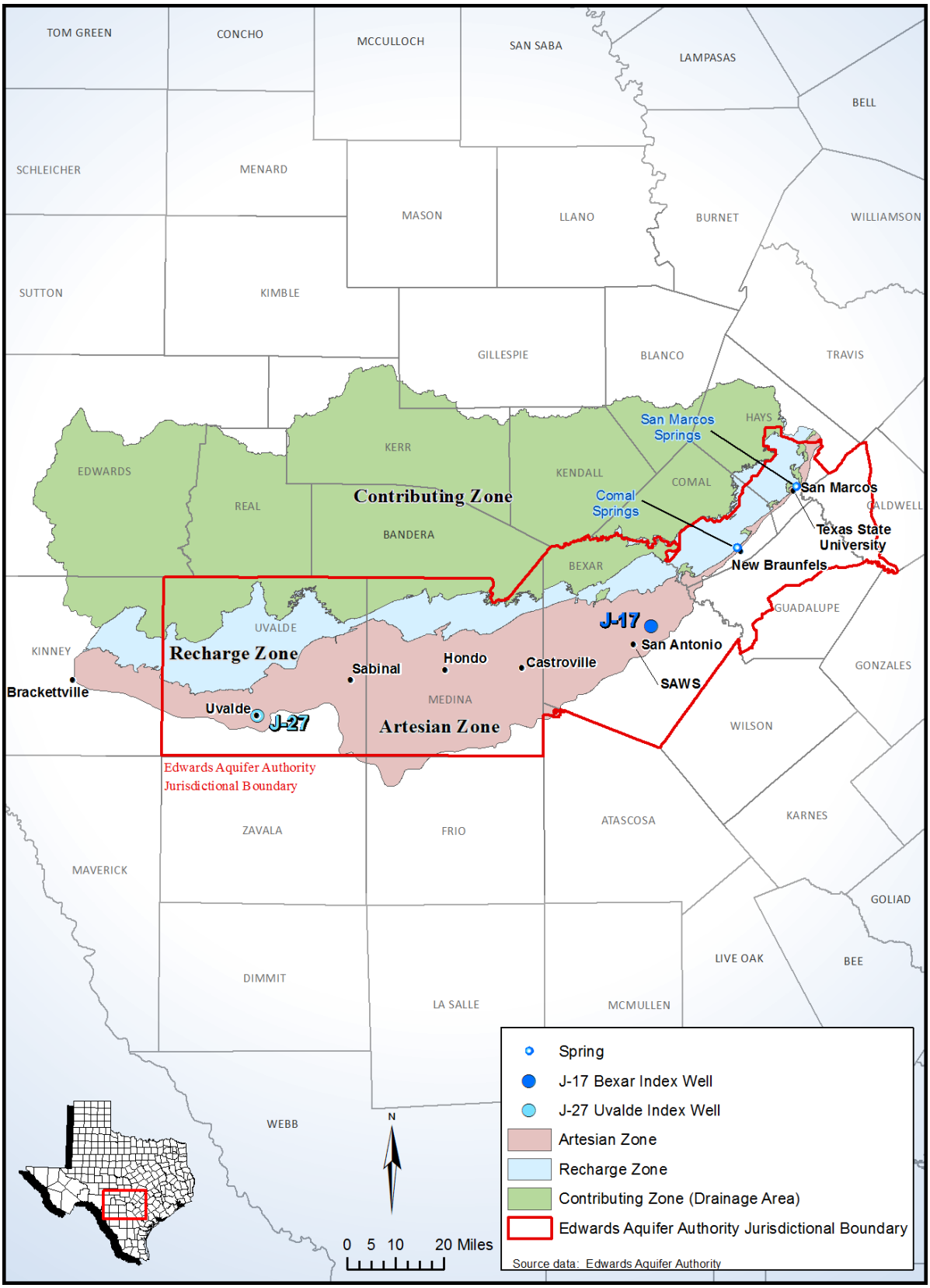

Figure 1.0-1. Incidental Take Coverage Area for ITP No. TE-63663A-1 (EAA Jurisdictional Boundary).

Table 1.0-1. Covered Species Under the EAHCP ITP

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Comal Springs dryopid beetle	*Stygoparnus comalensis*	Endangered	Comal
Comal Springs riffle beetle	*Heterelmis comalensis*	Endangered	Comal & San Marcos
Peck's cave amphipod	*Stygobromus pecki*	Endangered	Comal & San Marcos
Texas wild-rice	*Zizania texana*	Endangered	San Marcos
Texas blind salamander	*Eurycea (=Typhlomolge) rathbuni*	Endangered	San Marcos
San Marcos salamander	*Eurycea nana*	Threatened	San Marcos
Texas cave diving beetle*	*Haideoporus texanus*	Petitioned	Comal & San Marcos
Comal Springs salamander	*Eurycea sp.*	Petitioned	Comal & San Marcos
Texas troglobitic water slater	*Lirceolus smithii*	Petitioned	San Marcos

* Also known as the "Edwards Aquifer Diving Beetle."

1.1 Incidental Take Permit Requirements

The ITP lists many requirements and conditions, among which are the elements to be included in the Annual Reports. The ITP requires an Annual Report be submitted to the USFWS Austin Ecological Services Office and to the USFWS Albuquerque Region 2 Office by March 31 of each year, for the preceding calendar year. As specified by Condition U of the ITP (see **Appendix A1**), "The report will document the Permittees' activities and permit compliance for the previous year, thus documenting progress toward the goals and objectives of the Edwards Aquifer Recovery Implementation Program (EARIP) Habitat Conservation Plan (HCP) and demonstrating compliance with the terms and conditions of this incidental take permit."

The Annual Report must include

a. EAA permitted withdrawals
b. Reference well levels
c. Springflows at Comal and San Marcos springs
d. Aquifer recharge
e. Aquifer discharge from wells and springflow
f. Critical period management reductions
g. Water quality data
h. Location of sampling sites
i. Methods for data collection and variables measured
j. Frequency, timing, and duration of sampling for these variables
k. Description of the data analysis and who conducted the analysis

The Annual Report must also document the following EAHCP Management activities

a. Adaptive management undertaken during the year
b. Expenditures by the EAA on implementation activities
c. Proposed activities for the next year
d. Report on the status of implementation of minimization and mitigation measures and their effectiveness
e. Interim updates and final copies of any research, thesis or dissertation, or published studies accomplished in association with the EARIP or EAHCP
f. Description of species-specific research and management actions undertaken with specific reference to the biological goals and objectives identified for each species
g. Any changes to the Biological Goals and Key Management and Flow-related Objectives of the EAHCP and the reasons for such changes
h. Any changes to the objectives for the monitoring program
i. Effects on the Covered Species or Permit Area
j. Evaluation of progress towards achieving the Biological Goals and Objectives
k. Any recommendations regarding actions to be taken

Table 1.1-1 identifies each condition of the ITP as it is stated in the ITP and provides a reference for the EAHCP Permittees' efforts in 2019 as documented in this Annual Report to comply with these conditions.

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
D.		Acceptance of the permit serves as evidence that the Permittees agree to abide by all conditions stated. Terms and conditions or the permit are inclusive. Any activity not specifically permitted is prohibited. Please read through these conditions carefully as violations of permit terms and conditions could result in your permit being suspended or revoked. Violations of your permit terms and conditions that contribute to a violation of the Endangered Species Act (ESA) could also subject Permittees to criminal or civil penalties.	**1.0**
E.		The authorization granted by this Permit will be subject to full and complete compliance with and implementation of the EARIP HCP and all specific conditions contained herein. The Permit terms and conditions shall supersede and take precedence over any inconsistent provisions in the HCP or other program documents.	**1.0**
F.		This permit does not include incidental take coverage for any federal facility which withdraws groundwater from the Edwards Aquifer.	**1.0**
G.		COVERED SPECIES: This permit only authorizes incidental take of animal species, or impacts to plant species of the following 11 species: 1) Fountain Darter, 2) San Marcos Gambusia, 3) Comal Springs Dryopid Beetle, 4) Comal Springs Riffle Beetle, 5) Peck's Cave Amphipod, 6) Texas Wild Rice, 7) Texas Blind Salamander, 8) San Marcos Salamander, 9) Texas cave diving beetle, 10) Comal Springs Salamander, 11) Texas Troglobitic Water Slater	**1.0 (Table 1.0-1)**
H.		INCIDENTAL TAKE AUTHORIZATION: The following amount of incidental take is authorized by this permit over the 15 year permit term.	**3.0 (Table 3.0-1)**
	1.	No more than 797,000 fountain darters in Comal Springs, Landa Lake and the Comal River, and no more than 549,129 fountain darters in the San Marcos Springs, Spring Lake, and San Marcos River.	**3.0 (Table 3.0-1)**
	2.	No more than 11,179 Comal Springs riffle beetles.	**3.0 (Table 3.0-1)**
	3.	No more than 1,543 Comal Springs dryopid beetles.	**3.0 (Table 3.0-1)**
	4.	No more than 18,224 Peck's cave amphipod.	**3.0 (Table 3.0-1)**
	5.	No more than 10 Texas Blind salamanders.	**3.0 (Table 3.0-1)**
	6.	No more than 263,857 San Marcos salamanders.	**3.0 (Table 3.0-1)**

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
	7.	Incidental take of the Texas cave diving beetle will be provided for individuals of the species killed, harmed, or harassed by springflows with monthly averages above 50.5 cfs (1.43 cms) during HCP Phase I; and by springflows with monthly averages above 51.2 cfs (1.45 cms) during Phase II at San Marcos Springs, if and when this species is listed as threatened or endangered and as long as the HCP is fully implemented. Take limits will be exceeded if these minimum flow rates are not met.	Not applicable as species not listed during report period.
	8.	Incidental take of the Texas troglobitic water slater will be provided for individuals of the species killed, harmed, or harassed by springflows with monthly averages above 50.5 cfs (1.43 cms) during HCP Phase I; and by springflows with monthly averages above 51.2 cfs (1.45 cms) during Phase II at San Marcos Springs, if and when this species is listed as threatened or endangered and as long as the HCP is fully implemented. Take limits will be exceeded if these minimum flow rates are not met.	Not applicable as species not listed during report period.
	9.	Incidental take of the Comal Springs salamander will be provided for individuals of the species killed, harmed, or harassed by springflows with monthly averages above 27 cfs (0.76 cms) during HCP Phase I and by continuous springflows to 45 cfs (1.27 cms) during Phase II at Comal Springs if and when this species is listed as threatened or endangered, as long as the HCP is fully implemented. Take limits will be exceeded if these minimum flow rates are not met.	Not applicable as species not listed during report period.
I.		The endangered San Marcos gambusia has not been collected since 1982 and may no longer exist in the wild, but the Service will provide incidental take coverage for individuals of this species resulting from the covered activities if the species is located or becomes established within the Permit Area, as long as the HCP is fully implemented.	Not applicable as species neither located nor established during report period.
J.		COVERED AREA: This permit only authorizes incidental take of covered species within all of Bexar, Medina, and Uvalde counties, and parts of Atascosa, Comal, Caldwell, Hays, and Guadalupe counties (Permit Area).	**1.0 (Figure 1.0-1)**

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
K.		The EAA will support and coordinate with the U.S. Fish and Wildlife Service (Service) on the work relating to the San Marcos Aquatic Resource Center's operation and maintenance of a series of off-site refugia at the Service's San Marcos, Uvalde, and Inks Dam facilities (Section 6.4 of the HCP). 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. The use of this support will be limited to the Covered Species in the EARIP HCP.	**6.1.2 (Table 6.1-1)**
L.		COVERED ACTIVITIES FOR WHICH THE INCIDENTAL TAKE IS AUTHORIZED - BY PERMITTEE	**1.0**
	1.	Edwards Aquifer Authority	**6.1**
	2.	City of New Braunfels	**6.2**
	3.	City of San Marcos	**6.3**
	4.	Texas State University	**6.4**
	5.	San Antonio Water System	**6.5**
M.		The Permittees are jointly responsible for the following measures that specifically contribute to recovery and for which incidental take is authorized:	**6.0**
	1.	Comal Springs, Landa Lake, and the Comal River:	**6.2**
	2.	San Marcos Springs, Spring Lake, and the San Marcos River:	**6.3** and **6.4**
N.		Upon locating a dead, injured, or sick individual of the covered species, or any other endangered or threatened species, the Permittee is required to contact the Service's Law Enforcement Office in Austin, Texas, (512) 490-0948 for care and disposition instructions. Extreme care should be taken in handling sick or injured individuals to ensure effective and proper treatment. Care should also be taken in handling dead specimens to preserve biological materials in the best possible state for analysis of cause of death. In conjunction with the care of sick or injured endangered/threatened species, or preservation of biological materials from a dead specimen, the Permittee and any contractor/subcontractor has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.	No events meeting this description were reported for 2019.

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
O.		Conditions of the permit shall be binding on, and for the benefit of, the Permittees and any successors and/or assignees. If the permit requires an amendment because of change of ownership, the Service will process it in accordance with regulations (50 CFR 13.23). Any new Permittee must meet issuance criteria per regulations at 50 CFR 13.25. The covered activities proposed or in progress under the original permit may not be interrupted, provided the conditions of the permit are being followed.	No changes in ownership, or interruptions in Covered Activities, to report.
P.		If, during the tenure of the permit, the project design and/or the extent of the habitat impacts is altered, such that there may be an increase in the anticipated take of covered species, the Permittees are required to contact the Service's Austin Ecological Services Office and obtain an amendment to this permit before commencing any construction or other activities that might result in take beyond that authorized by this permit. If authorized take is exceeded, all activities that are shown to cause take must immediately cease and any take above that authorized shall be reported to the Austin Ecological Services Field Office (505) 490-0057) within 48 hours.	No increases in anticipated take, or exceedance of authorized take, to report.
Q.		If actions associated with implementation of the EARIP HCP are shown to result in incidental take of listed species not covered by this permit, those activities that are shown to cause take must immediately cease and any take that has occurred shall be reported to the Austin Ecological Services Field Office (505) 490-0057) within 48 hours.	No events meeting this description were reported for 2019.
R.		CHANGED CIRCUMSTANCES	**5.0,** and **Appendices I1** through **I3**
T.		MONITORING REQUIREMENTS	**1.0**
	1.	The Permittees will monitor compliance with the HCP and provide an annual report as described below.	**1.1**
	2.	The Permittees will develop a monitoring program to determine whether progress is being made toward meeting the long-term biological goals and objectives.	**6.1**
	3.	The Permittees will develop and oversee a monitoring program to identify and assess potential impacts, including incidental take, from Covered Activities and provide a better understanding and knowledge of the species' life cycles and desirable water quality- and springflow-related habitat requirements of the Covered Species (Section 6.3 of the HCP).	**6.1.6**
U.		Annual Reporting:	See discussion below

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
	1.	The EARIP Applicants will provide an annual report, due on March 31 of each year	**1.1**
	2.	The report will document the Permittees' activities and permit compliance for the previous year, thus documenting progress toward the goals and objectives of the EARIP HCP and demonstrating compliance with the terms and conditions of this incidental take permit. The annual report will include:	See discussion below
	a.	EAA Permitted withdrawals	**Appendix D**
	b.	Reference well levels	**Appendix C**
	c.	Springflows at Comal and San Marcos Springs	**Appendix C**
	d.	Aquifer recharge	**Appendix C**
	e.	Aquifer discharge from wells and springflow	**Appendix C**
	f.	Critical period management reductions	**6.1.5 (Table 6.1.1)**
	g.	Water quality data	**Appendix K**
	h.	Location of sampling sites	**Appendix K**
	i.	Methods for data collection and variables measured	**Appendix K**
	j.	Frequency, timing, and duration of sampling for the variables	**Appendix K**
	k.	Description of the data analysis and who conducted the analysis	**Appendix K**
	3.	The report will document HCP Management activities, including:	See discussion below
	a.	Adaptive management activities undertaken during the year	**5.0**
	b.	Expenditures by the EAA on implementation activities	**4.4**
	c.	Proposed activities for the next year	**Appendices J4** through **J6**
	d.	Report on the status of implementation of minimization and mitigation measures and their effectiveness	**1.0** and **6.0**
	e.	Interim updates and final copies of any research, thesis or dissertation, or published studies accomplished in association with the EARIP or HCP	**6.1.1, 6.1.2** and **8.0**
	f.	Description of species-specific research and management actions undertaken with specific reference to the biological goals and objectives identified for each species	**4.1.2, 4.1.3**, **6.0**, and **Appendix K3**

Table 1.1-1. ITP Conditions and EAHCP 2019 Annual Report References Documenting Permittee Compliance Efforts

ITP Condition	ITP Condition Subsection	ITP Condition Title	Annual Report Chapter, Section, Subsection, or Appendix Reference
	g.	Any changes to the Biological Goals and Key Management and Flow-related Objectives of the HCP and the reasons for such changes	No changes during report period.
	h.	Any changes to the objectives for the monitoring program	No changes during report period.
	i.	Effects on the Covered Species or Permit Area	No changes during report period.
	j.	Evaluation of progress toward achieving the Biological Goals and Objectives.	**2.0**, **4.1.1**, **4.1.2**, **5.0**, **6.0**, and **Appendices K7** and **K8**
	k.	Any recommendations regarding actions to be taken	**7.0**
	4.	Information provided in the annual report will be used to determine what, if any, adaptive management strategies should be implemented to most effectively implement the conservation program outlined in the EARIP HCP and to ensure that management changes in response to new, appropriate data are implemented in a timely fashion.	**7.0**

This document serves as the Annual Report for the calendar year 2019. The comments received on earlier drafts of the 2019 Annual Report are included in **Appendix B**.

1.2 2019 Edwards Aquifer Conditions, Management, Notable Conditions, and Springflows

Rain in fall 2018 and spring 2019 sustained aquifer and springflow conditions above historic averages through much of 2019. Rainfall and recharge data for 2018 are included in the 2018 Hydrological Report (**Appendix C**). The Uvalde Pool, Well J-27, remained near 880 feet mean sea level (ft msl) from January through July before water levels began to fall. Water levels at Well J-27 ended 2019 near 879 ft msl. Reduced rainfall in the summer had a great effect on water levels in the San Antonio Pool. The San Antonio Pool, Well J-17, fluctuated through 2019. J-17 began the year around 685 ft msl and ended 2019 near 672 ft msl. No critical period triggers were realized, and aquifer management of withdrawal permits remained normal throughout the year. **Appendix D** contains a listing of all EAA groundwater withdrawal permits.

Drought conditions across the region began to intensify in the summer of 2019. **Figure 1.2-1** compares Texas drought conditions January 1, 2019 with conditions at December 31, 2019. The *U.S. Seasonal Drought Outlook* through 2019 expects drought conditions to persist (National Oceanic and Atmospheric Administration (NOAA) National Weather Service Climate Prediction Center 2019).

Surface water levels in both the Comal and San Marcos rivers responded to reduced rainfall in the summer with reduced water levels. Surface water levels, like groundwater levels, remained at or above average in the first half of 2019 at U.S. Geological Survey (USGS) stations in the Comal River (USGS 08169000) and San Marcos River (USGS 08170500). While surface water levels began to drop in July, 2019 groundwater conditions remained well above critical period triggers. No major flooding was observed in 2019, though rainfall did cause high peak flows at times.

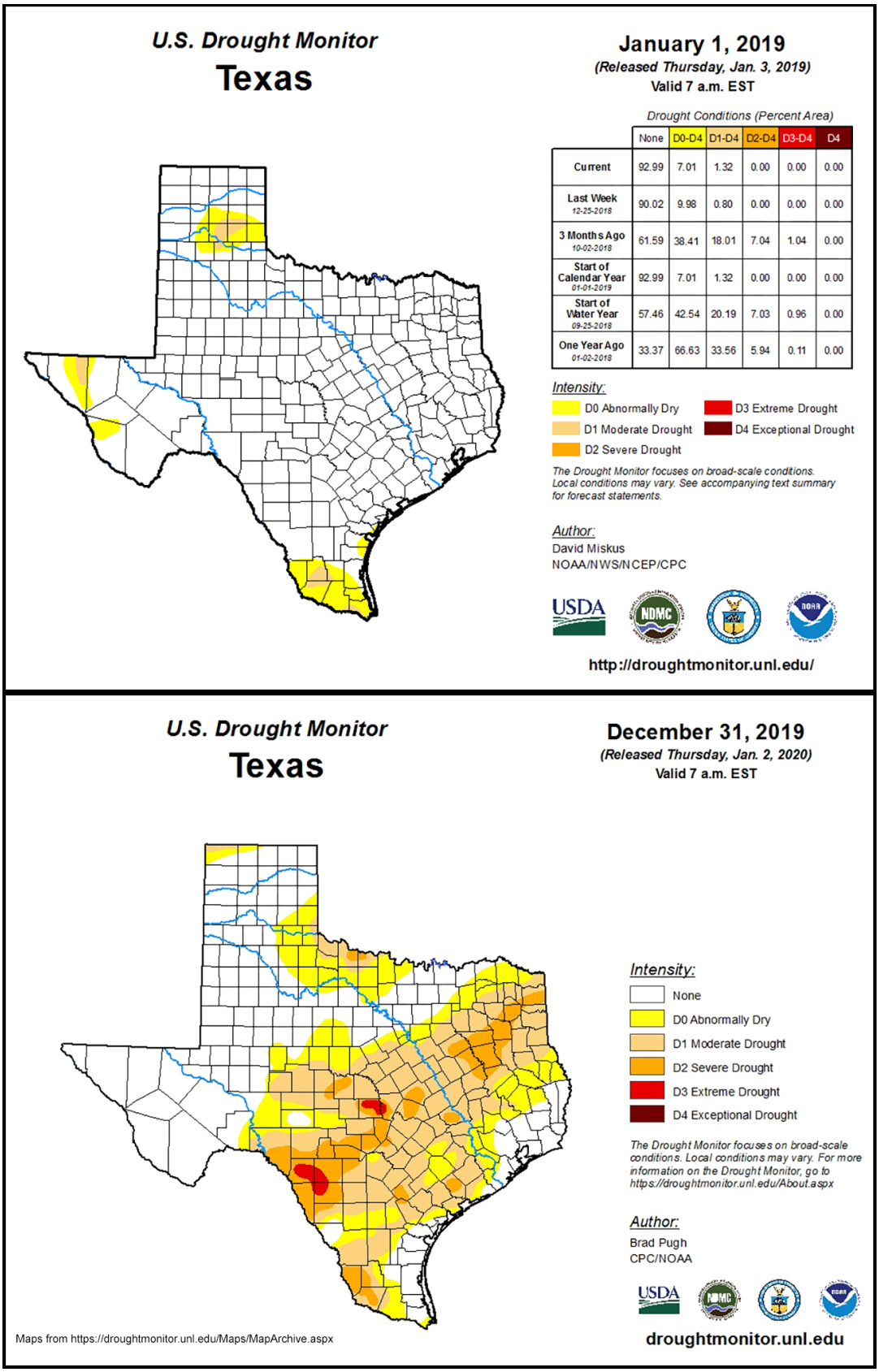

Figure 1.2-1. Texas drought conditions in January 2019 versus December 2019.

2.0 BIOLOGICAL GOALS AND OBJECTIVES FOR COVERED SPECIES

The Biological Goals and Objectives of the EAHCP were initially described in Section 4.1 of the EAHCP and are summarized below in **Table 2.0-1** through **Table 2.0-5**[4]. The identification of Biological Goals and Biological Objectives is one of five components in the "5-Point Policy" outlined in the HCP Handbook Addendum (USFWS and NMFS 2000) and identified in the current HCP Plan Handbook (USFWS and NMFS 2016). Long-Term Biological Goals (LTBGs) are the rationale behind the minimization and mitigation strategies. Conversely, minimization and mitigation measures are the means for achieving the LTBGs and objectives.

Section 4.1 of the EAHCP includes details for all Covered Species in sections covering the LTBGs, key management objectives, flow-related objectives, historical and present-day perspective, and methods and discussion. The LTBGs, key management objectives, and flow-related objectives are subject to change under limited circumstances set out in the Funding and Management Agreement (FMA), and they are summarized in **Table 2.0-1** through **Table 2.0-5**. The EAHCP Biological Goals and Objectives summarized in **Table 2.0-1** through **Table 2.0-5** reflect the clarifications of, and/or amendments made to, the EAHCP through 2019.

[4] The Biological Goals and Objectives have been modified from those in Section 4.0 of the EAHCP by several clarifications and minor amendments regarding fountain darter habitat and populations in the Comal and San Marcos rivers, as submitted by the EAHCP to the USFWS in correspondence dated September 20, 2016, which were subsequently approved by the USFWS in correspondence dated October 24, 2016 (included in the EAHCP 2016 Annual Report, Appendix A).

Table 2.0-1. Comal Springs Long-Term Biological Goals

FOUNTAIN DARTER

- **Long-Term Biological Goals:** Areal coverage of aquatic vegetation (habitat) within four representative reaches of the Comal system (Upper Spring run [upstream most portion of the system to Spring Island], Landa Lake [Spring Island to the outflow to Old and New channels], Old Channel, and New Channel) and fountain darter density (population measurement) per aquatic vegetation type (See Figure 4-1 of the EAHCP).

- **Habitat-Based and Population Measurement Goals (including proposed aquatic vegetation restoration efforts):**

Fountain Darter Habitat (Aquatic Vegetation) Goal in Meters Squared (m^2)						
Study Reach	**Bryophytes**	***Potamogeton***	***Ludwigia***	***Cabomba***	***Sagittaria***	***Vallisneria***
Upper Spring Run	1,750	0	25	25	850	0
Landa Lake	3,950	25	900	500	2,250	12,500
Old Channel	550	0	425	180	450	0
New Channel	150	0	100	2,500	0	0
TOTALS	**6,400**	**25**	**1,450**	**3,205**	**3,550**	**12,500**

Fountain Darter Median Density Goal (number/m^2)					
Bryophytes	***Potamogeton***	***Ludwigia***	***Cabomba***	***Sagittaria***	***Vallisneria***
20	3.3	7	7	1	1

- **Population Measurement Goal:** Maintain the median densities of fountain darters observed per aquatic vegetation type per system at a level greater than or equal to that observed from 2002 – 2012 in the EAA Variable Flow Study monitoring.

COMAL SPRINGS RIFFLE BEETLE

- **Habitat-Based Goal:** Maintain silt-free habitat conditions via continued springflow, riparian zone protection, and recreation control throughout each of three sample reaches: Spring Run 3; Western shoreline; and Spring Island area (See Figure 4-2 of the EAHCP).

- **Population Measurement Goal:** Maintain greater than or equal to the median densities observed from 2006 – 2012 in the EAA Variable Flow Study monitoring.

- **Long-Term Biological Goals:**

Three Sample Reach	**Spring Run 3**	**Western Shoreline**	**Spring Island Area**
Habitat	Silt-free gravel and cobble substrate ≥ 90% of each study area		
Density (# of Species/Lure)	≥ 20	≥ 15	≥ 15

COMAL SPRINGS DRYOPID BEETLE AND PECK'S CAVE AMPHIPOD

- **Long-Term Biological Goal:** Water quality not to exceed 10% deviation (daily average) from historically recorded water quality conditions (long-term average) within the Edwards Aquifer as measured issuing from the spring openings at Comal Springs, including all water quality constituents currently measured in the EAA Variable Flow Study.

Table 2.0-2. Comal Springs Key Management Objectives (Listed in No Particular Order)

FOUNTAIN DARTER

- Implement active native vegetation restoration and protection in Landa Lake and Old Channel and extend restoration activities beyond study reaches in equal proportion to effort expended per study area in relation to total area of Landa Lake and Old Channel.
  - By establishing known "restoration reaches" with current study reaches, aquatic vegetation includes majority of key fountain darter habitat in areas upstream and downstream of Landa Lake study reach and entire stretch of the Old Channel study reach from Landa Lake Dam to existing Old Channel study reach.
  - **Fountain Darter Habitat (Aquatic Vegetation) in Meters Squared and Median Density (Number/M² Per Habitat Type) to Define "Restoration Reaches" in Comal River:**

Fountain Darter Habitat (Aquatic Vegetation) Goal in Meters Squared (m^2)							
Study Reach	**Bryophytes**	***Potamogeton***	***Ludwigia***	***Cabomba***	***Sagittaria***	***Vallisneria***	**TOTALS**
Landa Lake UP[A]	5,500	0	25	250	250	0	6,025
Landa Lake DOWN[B]	500	0	50	125	100	22,500	23,275
Old Channel UP[C]	1,250	100	850	200	750	750	3,900
TOTALS	**7,250**	**100**	**925**	**575**	**1,100**	**23,250**	**33,200**

Fountain Darter Median Density Goal (number/m^2)							
	Bryophytes	***Potamogeton***	***Ludwigia***	***Cabomba***	***Sagittaria***	***Vallisneria***	
	20	3.3	7	7	1	1	**TOTALS**
# darters * veg total	145,000	330	6,475	4,025	1,100	23,250	180,180

[A] Landa Lake Long-Term Biological Goal reach to downstream boundary of Spring Island.
[B] Landa Lake Long-Term Biological Goal reach to weir across from City of New Braunfels Park Office.
[C] Old Channel from Long-Term Biological Goal reach upstream to Landa Lake Dam.

- Surface water quality within Comal River not to exceed a 10% deviation (daily average) from historically recorded water quality conditions (long-term average) measured at 15 EAA Variable Flow Study water quality monitoring locations (See Figure 4-1 of the EAHCP for monitoring locations), including water quality constituents measured in the EAA Variable Flow Study except water temperature and dissolved oxygen.
  - Monitor and evaluate water temperatures on instantaneous basis within four representative study reaches so they are maintained at < 25° C throughout the Comal system.
  - Monitor and evaluate dissolved oxygen concentrations on instantaneous basis within four representative study reaches so they are maintained at > 4.0 mg/L throughout fountain darter habitat.

COMAL SPRINGS RIFFLE BEETLE

- Edwards Aquifer water quality not to exceed 10% deviation (daily average) from historically recorded water quality conditions (long-term average) as measured issuing from spring openings at Comal Springs, including water quality constituents measured in the EAA Variable Flow Study.
- Implement active riparian habitat restoration adjacent to spring openings (Spring Run 3 and Western Shoreline) to limit sedimentation experienced following rainfall events.

COMAL SPRINGS DRYOPID BEETLE AND PECK'S CAVE AMPHIPOD

- No discussion in the EAHCP for Key Management Objectives for these two species.

Table 2.0-3. San Marcos Springs Long-Term Biological Goals

TEXAS WILD-RICE

- **Long-Term Biological Goals:**

River Segment	Areal Coverage (m^2)	Reach Percentage of Total Areal Coverage
Spring Lake	1,000 – 1,500	N/A
Spring Lake Dam to Rio Vista Dam	5,810 – 9,245	83 – 66
Rio Vista Dam to IH-35	910 – 1,650	13 – 12
Downstream of IH-35	280 – 3,055	4 – 22
TOTALS	**8,000 – 15,450**	**100**

FOUNTAIN DARTER

- **Long-Term Biological Goals:** Areal coverage of habitat within three representative river reaches of the San Marcos system (See Figure 4-3 of the EAHCP) and fountain darter density (population measurement) per aquatic vegetation type.
- **Habitat-Based and Population Measurement Goals:**

Fountain Darter Habitat (Aquatic Vegetation) in Meters Squared (m^2)						
Study Reach	***Ludwigia***	***Cabomba***	***Potamogeton***	***Sagittaria***	***Hydrocotyle***	***Zizania***
Spring Lake Dam	100	50	200	200	50	700-
City Park	150	90	1,450	300	10	1,750
IH-35	50	50	250	150	50	600
TOTALS	**300**	**190**	**1,900**	**650**	**110**	**3,050**

Fountain Darter Median Density Goal (number/m^2)					
Ludwigia	***Cabomba***	***Potamogeton***	***Sagittaria***	***Hydrocotyle***	***Zizania***
7	7	5	1	4	5

- **Population Measurement Goal:** Maintain greater than or equal to the median densities observed per aquatic vegetation type per system from 2002 – 2012 in the EAA Variable Flow Study monitoring.

SAN MARCOS SALAMANDER

- **Habitat-Based Goal:** Maintain silt-free habitat conditions via continued springflow, riparian zone protection, and recreation control throughout each of the following three sample reaches: Hotel area; Riverbed area; and eastern spillway below Spring Lake Dam (See Figures 4-3 and 4-4 of the EAHCP).
- **Population Measurement Goal:** Maintain greater than or equal to the median densities observed during monitoring from 2002 – 2012.
- **Long-Term Biological Goals:**

Three Representative Reaches	Hotel Area (Spring Lake)	Riverbed Area (Spring Lake)	Eastern Spillway Below Spring Lake Dam
Habitat	Silt-free gravel and cobble substrate ≥ 90% of each study area		
Density (# of Species/m^2)	≥ 15	≥ 10	≥ 5

TEXAS BLIND SALAMANDER

- **Long-Term Biological Goals:** Water quality not to exceed 10% deviation (daily average) from historically recorded water quality conditions (long-term average) within the Edwards Aquifer as measured issuing from the spring openings in Spring Lake, including water quality constituents currently measured in the EAA Variable Flow Study.

Table 2.0-4. San Marcos Springs Key Management Objectives (Listed in No Particular Order)

TEXAS WILD-RICE

- Minimum Texas wild-rice Coverage Per River Segment During Drought of Record-Like Conditions:

River Segment	Areal Coverage (m^2)	Reach Percentage of Total Areal Coverage
Spring Lake	500	N/A
Spring Lake Dam to Rio Vista Dam	2,490	83
Rio Vista Dam to IH-35	390	13
Downstream of IH-35	120	4
TOTALS	**3,550**	**100**

- Active restoration and Texas wild-rice expansion efforts and long-term monitoring focused on high-quality habitat areas.
- Recreation awareness throughout river system at all flows, with designated controls implemented in the following high-quality habitat areas (combined river segments) when total San Marcos discharge is below 100 cfs:

Combined River Segment	Texas Parks & Wildlife Dept. Individual Segments
Spring Lake Dam to Rio Vista Dam	B, C
Rio Vista Dam to IH-35	F
Downstream of IH-35	K

FOUNTAIN DARTER

- Implement active native vegetation restoration and protection in all three representative reaches, and restoration activities to extend efforts beyond study reaches in equal proportion to effort expended per study area in relation to total river segment.
  - By establishing known "restoration reaches" with current study reaches, aquatic vegetation includes majority of key fountain darter habitat in areas upstream and downstream of the City Park study reach and entire stretch of the river from downstream of the IH-35 study reach to the IH-35 bridge.
  - **Fountain Darter Habitat (Aquatic Vegetation) in Meters Squared and Median Density (Number/M^2 Per Habitat Type) to Define "Restoration Reaches" in San Marcos River:**

Fountain Darter Habitat (Aquatic Vegetation) Goal in Meters Squared (m^2)							
Study Reach	***Ludwigia***	***Cabomba***	***Potamogeton***	***Sagittaria***	***Hydrocotyle***	***Zizania***	**TOTALS**
Sewell Park	25	25	150	25	10	1,100	1,335
Below Sewell to City Park[A]	50	50	500	700	20	2,300	3,620
Hopkins Street – Snake Island	50	50	475	750	10	950	2,285
Cypress Island – Rio Vista	50	50	150	50	0	350	650
IH-35 Expanded[B]	50	100	250	450	50	450	1,350
TOTALS	**225**	**275**	**1,525**	**1,975**	**90**	**5,150**	**9,240**

Fountain Darter Median Density Goal (number/m^2)							
	Ludwigia	***Cabomba***	***Potamogeton***	***Sagittaria***	***Hydrocotyle***	***Zizania***	
	7	7	5	1	4	5	**TOTALS**
# darters * veg total	1,575	1,925	7,625	1,975	360	25,750	39,210

[A] Sewell Park to upstream Boundary of City Park Long-Term Biological Goal reach.
[B] Immediately downstream of established IH-35 Long-Term Biological Goal reach to IH-35.

- Surface water quality within San Marcos River not to exceed a 10% deviation (daily average) from historically recorded water quality conditions (long-term average) measured at EAA Variable Flow Study water quality monitoring stations (See Figure 4-3 of the EAHCP), including water quality constituents currently measured in the EAA Variable Flow Study, excluding temperature and dissolved oxygen.
  - Monitor and evaluate water temperatures on instantaneous basis within three representative study reaches so they are maintained at < 25 °C throughout the San Marcos system.
  - Monitor and evaluate dissolved oxygen concentrations on an instantaneous basis within three representative study reaches so concentrations are maintained at > 4.0 mg/L throughout fountain darter habitat.

SAN MARCOS SALAMANDER

- Continue aquatic gardening for Riverbed Area similar to what has occurred from 2002 – 2012 in Spring Lake.
- Implement recreation control in Eastern Spillway below Spring Lake Dam, particularly at total San Marcos discharge of < 100 cfs.

TEXAS BLIND SALAMANDER

- No discussion in the EAHCP for Key Management Objectives for this species.

Table 2.0-5. Flow Related Objectives for All Covered Species – Comal and San Marcos Springs

Flow Objectives	Comal Springs	San Marcos Springs
Long-term average flow	Daily average of 225 cubic feet per second (cfs) total Comal discharge.	Daily average of 140 cfs total San Marcos discharge.
Minimum flow	Daily average of 30 cfs total Comal discharge not to exceed a period of six months followed by average daily flows of 80 cfs for three months.	Daily average of 45 cfs total San Marcos discharge not to exceed a period of six months followed by average daily flows of 80 cfs for three months.

3.0 2019 ANNUAL TAKE AND NET DISTURBANCE ESTIMATES

The EAHCP ITP (**Appendix A1**) authorizes incidental take (Condition H) and limits occupied habitat disturbance (Condition M). Both incidental take and net disturbance are evaluated on an annual basis to report to the USFWS (**Table 3.0-1**). Condition H of the ITP explicitly defines the amount of incidental take authorized over the permit term. Condition M (1a and 2a) addresses EAHCP minimization and mitigation activities that contribute to recovery. Condition M stipulates that over the course of any given year no more than 10% of a covered species occupied habitat can be affected by EAHCP minimization and mitigation activities. Incidental take associated with implementation of all other applicable EAHCP Covered Activities was characterized and quantified to the degree practical and added to the portion of incidental take calculated from disturbed areas**. Appendix E** offers a more detailed description of methodologies and species-specific results of the 2019 incidental take and net disturbance assessments. **Table 3.0-2** provides an estimate of the accumulated take totals so far in the implementation of the EAHCP.

Table 3.0-1. Summary of Impacted Habitat and Net Disturbance and Incidental Take for EAHCP Covered Species Compared Against ITP Maximum Permit Amounts

Covered Species Per System	EAHCP Mitigation/Restoration		EAHCP Measures/ Drought	Combined Impacted Habitat 2019 TOTAL (m^2)	Incidental Take		2019 Incidental Take Total	ITP Maximum Permit Amount	ITP Permit Maximum Minus (Combined First Seven Years)
	Impacted Habitat (m^2)	Net Disturbance % Of Total Occupied Habitat	Impacted Habitat (m^2)		EAHCP Mitigation/ Restoration	EAHCP Measures/ Drought			
COMAL SYSTEM									
Fountain Darter	498	0.5%	0	**498**	747	0	**747**	797,000	735,587
Comal Springs Riffle Beetle	0	0%	0	**0**	0	0	**0**	11,179	8,887
Comal Springs Dryopid Beetle	0	0%	0	**0**	0	0	**0**	1,543	1,527
Peck's Cave Amphipod	0	0%	0	**0**	0	0	**0**	18,224	18,057
SAN MARCOS SYSTEM									
Fountain Darter	8,119	8.6%	331	**8,450**	12,179	497	**12,675**	549,129	461,349
San Marcos Salamander	0	0%	0	**0**	0	0	**0**	263,857	261,183
Texas Blind Salamander	0	0%	0	**0**	0	0	**0**	10	10
Comal Springs Riffle Beetle	0	0%	0	**0**	0	0	**0**	N/A	N/A
Comal Springs Dryopid Beetle	0	0%	0	**0**	0	0	**0**	N/A	N/A

Table 3.0-2. Incidental Take Summary (2013-2019)

Spring System	Species (Common Name)	ITP Take Limit	2013 Take	2014 Take	2015 Take	2016 Take	2017 Take	2018 Take	2019 Take	TOTAL Take	Remaining ITP Take*
Comal	Fountain Darter	797,000	10,482	23,060	5,115	9,959	4,620	7,432	747	**61,415**	735,585
	Comal Springs Riffle Beetle	11,179	681	1,564	0	0	46	0	0	**2,291**	8,888
	Comal Springs Dryopid Beetle	1,543	13	2	0	**0**	1	0	0	**16**	1,527
	Peck's Cave Amphipod	18,224	81	82	0	0	3	0	0	**166**	18,058
San Marcos	Fountain Darter	549,129	16,698	11,909	13,295	11,023	10,239	11,927	12,675	**87,766**	461,363
	San Marcos Salamander	263,857	1,053	482	1,059	0	36	45	0	**2,675**	261,182
	Texas Blind Salamander	10	0	0	0	0	0	0	0	**0**	10
	Comal Springs Riffle Beetle	N/A	0	0	0	0	0	0	0	**0**	N/A
	Comal Springs Dryopid Beetle	N/A	0	0	0	0	0	0	0	**0**	N/A

* The accumulation of annual totals from previous take report numbers show a difference by one or two individuals. Calculation discrepancies are due to rounding to the whole number. The discrepancy found in the San Marcos fountain darters occurs due to a change that happened after the 2013 ITP was created. In early 2014, the San Marcos fountain darter numbers were recalculated to account for Texas wild-rice, increasing the 2013 take by 14 fountain darters.

4.0 2019 EAHCP COMMITTEE ACTIVITIES, FINANCIAL REPORT, AND PROGRAM MANAGEMENT

EAHCP staff successfully facilitated five Implementing Committee (IC) meetings, three Adaptive Management Science Committee (SC) meetings, and four Adaptive Management Stakeholder Committee (SH) meetings; of these three were joint meetings of the SH and IC meeting and one was a joint committee meeting of the IC, SH, and SC. Additionally, EAHCP staff organized the meetings of four Work Groups. Article Seven of the FMA establishes the roles of four committees for the EAHCP: the IC; the SH; the SC; and the Science Review Panel/National Academy of Sciences (SRP/NAS) (EAA et. al 2012). The SRP/NAS completed their activities in 2018[5]. Committee and Work Group activities are described in the following sections.

Public accountability and the transparency of the EAHCP process are important guiding principles for EAHCP program management. Thus, EAHCP staff responsibilities for meeting facilitation include ensuring that committee meetings are conducted in accordance with the FMA, using the *Operational Procedures of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan* (November 2013), the *Parliamentary Rules of Conduct of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan* (November 2013), the *Program Operational Rules for EAHCP Program Adaptive Management Stakeholder Committee Members and Participants* (May 2014), and the *Operational Procedures of the Science Committee of the Edwards Aquifer Habitat Conservation Plan* (April 2014), as may be appropriate, as a guide to best practices for providing notice, holding open meeting sessions, and providing records of meetings. Agendas and notices for all meetings were posted a minimum of one week in advance of the meeting date. Meetings were held in public with opportunities for the public to provide comment and minutes were posted on the EAHCP website following EAHCP Committee approval. In an effort to improve transparency and public accessibility, all IC and SH meetings in 2019 were made available to view and livestream through the EAA Granicus System available on the EAA website (EAA 2020). Additionally, a monthly report of EAHCP activities was sent to EAHCP Committee members every month starting in October 2019.

4.1 Implementing Committee Activities

The IC supervises implementation of the EAHCP and ensures compliance with documents such as the ITP, EAHCP, and FMA. There are five voting members of the IC who represent the five Permittees, and one representative of the Guadalupe-Blanco River Authority (GBRA) who serves as a non-voting member. **Table 4.1-1** lists the members of the IC for 2019. The IC met five times in 2019. The agendas and minutes for those meetings are provided in **Appendix F1**.

[5] Section 5.1.3 of the EAHCP establishes the role and responsibilities of the Regional Conservation Monitoring Committee (RCMC) (RECON et al. 2012). The activities of this committee are not covered in this Annual Report as the RCMC authorized the EAHCP Program Manager to submit a "Statement of Program Finalization" to the IC as the obligations of the Regional Water Conservation Program (RWCP) and the RCMC under the EAHCP were fulfilled in 2016.

Table 4.1-1. Members of the Implementing Committee for 2019

Member	Entity	Alternate
Mark Enders*	CONB	Phillip Quast
Roland Ruiz**	EAA	Brock Curry
Robert Mace, Ph.D.***	Meadows Center for Water and the Environment (MCWE) – Texas State	Kimberly Meitzen, Ph.D.
Tom Taggart	COSM	Melani Howard
Darren Thompson	SAWS	Donovan Burton
Nathan Pence	GBRA	Mike Urrutia

* Committee Chair
** Committee Vice Chair
*** Committee Secretary

Highlights of the IC meetings are listed below.

- January 24, 2019:
  - Report on the draft Comprehensive Phase II Work Plan.
  - Approval of extending the FMA Strategic Adaptive Management Process (SAMP) proposal and Comprehensive Phase II Work Plan due dates to May 23, 2019.
- March 21, 2019:
  - Report on draft EAHCP Resolution No. 05-19-001 and final draft of the Comprehensive Phase II Work Plan.
  - Approval of the 2018 EAHCP Annual Report submittal to the USFWS.
  - Approval of amendments to the 2019 COSM Work Plan and 2019 EAA Work Plan.
  - Approval of amendments to the 2019 EAA Funding Application.
- May 23, 2019:
  - Report from EAA on the 2018 authorized pumping withdrawals from the Edwards Aquifer.
  - Report on Joint Base San Antonio's use of the Edwards Aquifer and impact on the EAHCP.
  - Approval of the EAHCP Comprehensive Phase II Work Plan and Resolution No. 05-19-001.
  - Approval of the Nonroutine Adaptive Management Process (AMP) Proposal to amend the EAHCP Voluntary Irrigation Suspension Program Option (VISPO) Conservation Measure.
  - Approval of the 2020 CONB, COSM, and EAA Work Plans.
- October 3, 2019:
  - Report on the 2019 EAHCP Budget Work Group, 2019 Annual Report timeline, and USFWS proposed amendments to the Recovery Plan.
  - Approval of amendments to the 2020 CONB, COSM, and EAA Funding Application and Work Plans.
  - Approval of an amendment to the 2019 COSM Work Plan.
- December 19, 2019:
  - Joint meeting of the IC, SH, and SC.
  - Report on the 2019 National HCP Coalition Annual Meeting held in Shepherdstown, West Virginia.
  - Approval of amendments to the 2019 CONB Funding Application and Work Plan.
  - Approval of amendments to the 2020 EAA Work Plan.
  - Approval of 2020 officers.

4.1.1 Comprehensive Phase II Work Plan Work Group

In accordance to FMA Section 4.3, the IC was required to develop and approve a Comprehensive Phase II Work Plan. The Comprehensive Phase II Work Plan Work Group (Phase II Work Group) was formed at the request of the EAHCP Program Manager to review and provide comments on a draft Comprehensive Phase II Work Plan. The members of the Phase II Work Group were Cindy Loeffler (Texas Parks & Wildlife Department [TPWD]), Mark Enders (CONB), Patrick Shriver (SAWS), Julia Carrillo (EAA), Nathan Pence (GBRA), and Melani Howard (COSM). Ms. Loeffler and Mr. Enders served as the co-chairs of the Phase II Work Group.

The charge of the Phase II Work Group was to review, provide comments on, and approve the draft Comprehensive Phase II Work Plan. A *Phase II Work Group Report* summarizing the Work Group's comments and recommendations was presented to the IC and SH on January 24, 2019. The *2018 Phase II Work Group Report* is provided in **Appendix F2**.

4.1.2 Comal Springs Riffle Beetle Work Group

The Comal Springs Riffle Beetle (CSRB) Work Group's charge is to review and provide input on monitoring the CSRB as part of the implementation of the EAHCP. The members of the CSRB Work Group for 2019 were Conrad Lamon (SC), Chad Norris (SC and TPWD), Floyd Weckerly (SC), Ken Ostrand (USFWS), and Tom Arsuffi (SC).

The Work Group convened five times in 2019 to discuss cotton lure methodology, CSRB collection routines, and LTBGs of the CSRB. The *Comal Springs Riffle Beetle Work Group Report* and supporting materials are provided in **Appendix F3**.

4.1.3 EAHCP Budget Work Group

The Budget Work Group's charge from the IC is to "collaborate with and inform the EAA Budget Process, as it relates to the EAHCP, EAHCP reserve and EAHCP [Aquifer Management Fee] AMF, and address fiscal issues as they arise and are referred by the IC." Also, as approved by the IC, the Budget Work Group will be in existence for the duration of the ITP.

The members of the Budget Work Group for 2019 were Tom Taggart (IC), Brock Curry (EAA designee), Steve Raabe (SH), Myron Hess (SH), Mary Bailey (SAWS designee), and Adam Yablonski (Medina County Farm Bureau). The Work Group met on September 18, 2019, to review and discuss the EAA 2020 budget process to monitor the management of EAHCP revenue and expenses. The Work Group's report titled *Edward Aquifer Habitat Conservation Plan Report of the 2019 Budget Work Group* was submitted to the IC. Copies of the Budget Work Group's meeting agenda and minutes, and final report can be found in **Appendix F4.**

4.2 Adaptive Management Stakeholder Committee Activities

Table 4.2-1 lists the 27 SH representatives, their affiliations, the interests they represent, and their alternates as of the end of 2019.

Table 4.2-1. Members of the Adaptive Management Stakeholder Committee in 2019

Member	Affiliation	Representing	Alternate
Myron Hess*	Texas Living Waters Project	Environmental Interest from the Texas Living Waters Project	Annie Kellough
Doris Cooksey**	City Public Service Energy (CPS Energy)	CPS Energy	Emily Speed
Patrick Shriver***	SAWS	SAWS	Brandon Payne
Carl Adkins	Texas BASS Federation Nation	Recreational interest in the Guadalupe River Basin	Tim Cook
Chuck Ahrens	EAA	EAA	Javier Hernandez
Bruce Alexander	East Medina County Special Utility District	Holder of an initial regular permit issued by the EAA for a retail public utility located west of Bexar County	Tim Kelly, Mayor – City of Castroville
Buck Benson	Alamo Cement/Pulman Law	Holder of an initial regular permit issued by the EAA for industrial purposes	Shanna Castro/Paul Hunt
Roger Biggers	New Braunfels Utilities (NBU)	Retail public utility in whose service area the Comal Springs or San Marcos Springs is located	Ryan Kelso
Jim Bower	City of Garden Ridge	Holder of an EAA initial regular permit issued to a small municipality (population under 50,000) located east of San Antonio	David R. Heier
James Dodson	City of Victoria	Holder of a municipal surface water right in the Guadalupe River Basin	No alternate named
Rader Gilleland	Gilleland Farms	Holder of an initial regular permit issued by the EAA for irrigation	Adam Yablonski
Renee Green	Bexar County	Bexar County	Kerim Jacaman
Cindy Hooper	Texas Commission on Environmental Quality (TCEQ)	TCEQ	Cary Betz
Melani Howard	COSM	COSM	Laurie Moyer
Dan Hunter	Texas Department of Agriculture (TDA)	TDA	David Villarreal
Cindy Loeffler	TPWD	TPWD	Colette Barron
Glenn Lord	DOW Chemical	Holder of an industrial surface water right in the Guadalupe River Basin	Dwaine Schoppe
Mark Enders	CONB	CONB	Phillip Quast
Kimberly Meitzen, Ph.D.	Texas State	Texas State	Robert Mace, Ph.D.

Table 4.2-1. Members of the Adaptive Management Stakeholder Committee in 2019

Member	Affiliation	Representing	Alternate
Gary Middleton	South Central Texas Water Advisory Committee (SCTWAC)	SCTWAC	No alternate named
John Byrum	Nueces River Authority (NRA)	NRA	Sky Lewey
Carol Patterson	Regional Clean Air and Water	Edwards Aquifer Region municipal ratepayers/general public	Kirk Patterson
Nathan Pence	GBRA	GBRA	Mike Urrutia
Ray Joy Pfannstiel	Guadalupe County Farm Bureau	Agricultural producer from the Edwards Aquifer Region	Gary Schlather
Steve Raabe	San Antonio River Authority (SARA)	SARA	Allison Elder
Humberto Ramos	Guadalupe Basin Coalition	Guadalupe River Basin municipal ratepayers/general public	Mike Dussere
Rachel Sanborn	San Marcos River Foundation (SMRF)	Conservation organization	Virginia Condie

* Committee Chair
** Committee Vice Chair
*** Committee Secretary

The SH met four times in 2019. The agendas and minutes for these SH meetings and for the joint EAHCP Committee meetings, and the SH Report recommending the IC approve and adopt the Nonrountine AMP Proposal to amend the EAHCP VISPO Conservation Measure are included in **Appendix F5**.

Highlights of the SH meetings are noted below.

- January 24, 2019:
  - Report on 2018 Biological Monitoring activities and Net Disturbance and Incidental Take in the San Marcos and Comal Spring systems.
  - Report on the 2018 Water Quality Monitoring activities conducted in the San Marcos and Comal Spring systems.
- May 23, 2019:
  - Approval of the EAHCP Nonroutine AMP Proposal.
  - Approval of the Nonroutine AMP Stakeholder Report and its submission to the IC.
- October 3, 2019:
  - Report from Tanya Sommer, USFWS, and Scott Storment, EAHCP Program Manager, on the proposed amendments to the 1996 Recovery Plan.
  - Report on the general activities occurring within the EAHCP program.
  - Report on the EAHCP Work Plans.
- December 19, 2019:
  - Joint meeting of the IC, SH, and SC.
  - Report from Tanya Sommer, USFWS, on Species Status Assessments.
  - Report on the EAHCP Addendum and SAMP Report.
  - Report on the Comal Springs Riffle Beetle and Research Work Groups.
  - Recommendations and approval of 2020 officers.

4.3 Adaptive Management Science Committee Activities

The SC consists of eleven experts who have technical expertise in one or more of the following areas: (a) the Edwards Aquifer or its management; (b) the Comal Springs and River; (c) the San Marcos Springs and River; (d) the Covered Species; or (e) experimental design and data. The SC serves as an independent scientific panel to advise, consult, and provide recommendations to the SH and IC. The SC members for 2019 are listed in **Table 4.3-1**.

The SC met in March and June 2019 and participated in a joint meeting with the IC and SH in December. The agendas and minutes for the SC meetings and the joint meeting are included in **Appendix F6**.

Table 4.3-1. Members of the Adaptive Management Science Committee in 2019

Member	Affiliation	Expertise	Nominating Entity
Chad Norris, M.S.*	TPWD	Aquatic Biology Aquatic Invertebrate Specialist	SH
Jacquelyn Duke, Ph.D.**	Baylor University	Stream Ecology Riparian Ecohydrology	IC
Floyd Weckerly, Ph.D.	Texas State	Population Ecology Experimental Design	SH
Tom Arsuffi, Ph.D.	Texas Tech University (TTU)	Aquatic Biology Stream Ecology	IC
Janis Bush, Ph.D.	University of Texas at San Antonio	Plant Ecology Experimental Design	SH
Charlie Kreitler, Ph.D.	LBG-Guyton Associates (Retired)	Hydrogeology Groundwater Science	IC
Conrad Lamon, Ph.D.	Statistical Ecology Associates LLC	Ecological Modeling	IC
Glenn Longley, Ph.D.	Edwards Aquifer Research and Data Center (Retired)	Biologist Edwards Aquifer Specialist	SH
Jack Sharp, Ph.D.	University of Texas at Austin	Hydrology Hydrogeology	Joint IC and SH
Doyle Mosier, M.S.	TPWD (Retired)	Instream Flows Aquatic Habitats	IC
Jackie Poole, M.A.	TPWD (Retired)	Botany/Taxonomy Texas wild-rice Specialist	SH

* Committee Chair
** Committee Vice Chair

Highlights of the SC meetings are listed below.

- March 27, 2019:
  - Report on EAHCP Nonroutine AMP Proposal.
  - Approval to allow Committee Chairs to submit the EAHCP Nonroutine AMP Scientific Evaluation Report (SER) to the SH.
  - Report on 2020 Work Plans for the EAA, CONB, and COSM.
  - Report on proposed Applied Research to install aquatic plant booms in Spring Lake to catch floating vegetation.
- June 27, 2019:
  - Report on aquatic plant boom assessment of Spring Lake.

- Report on catch per unit effort of non-native suckermouth catfish in the upper San Marcos River from 2014 – 2018.

- December 19, 2019
  - Joint meeting of the IC, SH, and SC.

4.3.1 Research Work Group

The Research Work Group is charged with, while operating on a consensus-basis, suggesting specific Applied Research projects to be conducted during 2018 and 2019 as part of the Applied Research Program, and suggesting refinements to the methodology proposed for Refugia research projects. The Work Group meets on an as-needed basis and is expected to be in existence for the duration of the ITP. The Work Group members are derived from the SC membership. The Work Group members are Chad Norris (TPWD), Tom Arsuffi (TTU), Floyd Weckerly (Texas State), and Conrad Lamon (Statistical Ecology Associates, LLC). Nathan Bendik (City of Austin) also participated as a salamander expert.

The Research Work Group met on December 11, 2019, and discussed the continuation of the following research:

- Factors affecting pupation in the endangered CSRB
- Identifying conditions affecting pupation rates in the endangered CSRB
- Captive population nutrition and longevity of the CSRB
- Reproductive dysfunction of San Marcos salamanders

Copies of the Research Work Group's meeting agenda and minutes can be found in **Appendix F7**.

4.4 2019 Financial Report

As specified in Section 4.6 of the Funding and Management Agreement (FMA), each year the EAA Board of Directors approves each Permittee's Program Funding Application budget. The Program Funding Applications are the mechanism by which the Permittees request funding to implement the Conservation Measures or other EAHCP Program-related activities. The EAA Board of Directors approved the 2019 Program Funding Applications for each of the Permittees at their meeting on October 18, 2018.

Two amendments to the EAHCP Program Funding Applications were approved by the EAA Board of Directors in 2019. Specifically, amendments were made to the LID/BMP Management and NFHTC Refugia program budgets. Other transfers between various accounts for reclassification of expenditure needs had a net impact of $0 on the budget and did not require EAA Board of Directors approval. The amendments and transfers are identified in the EAHCP Expense Report located in **Appendix G** of this Annual Report.

The EAHCP Expense Report shows Table 7.1 of the EAHCP funding amounts for 2019 totaling $17,967,597. These amounts can be compared to the EAA Board-approved/amended 2019 Program Funding Applications totaling $19,456,802. **Figure 4.4-1** reflects the 2019 EAA Board-approved/amended 2019 Program Funding Applications, by budget and EAHCP activity.

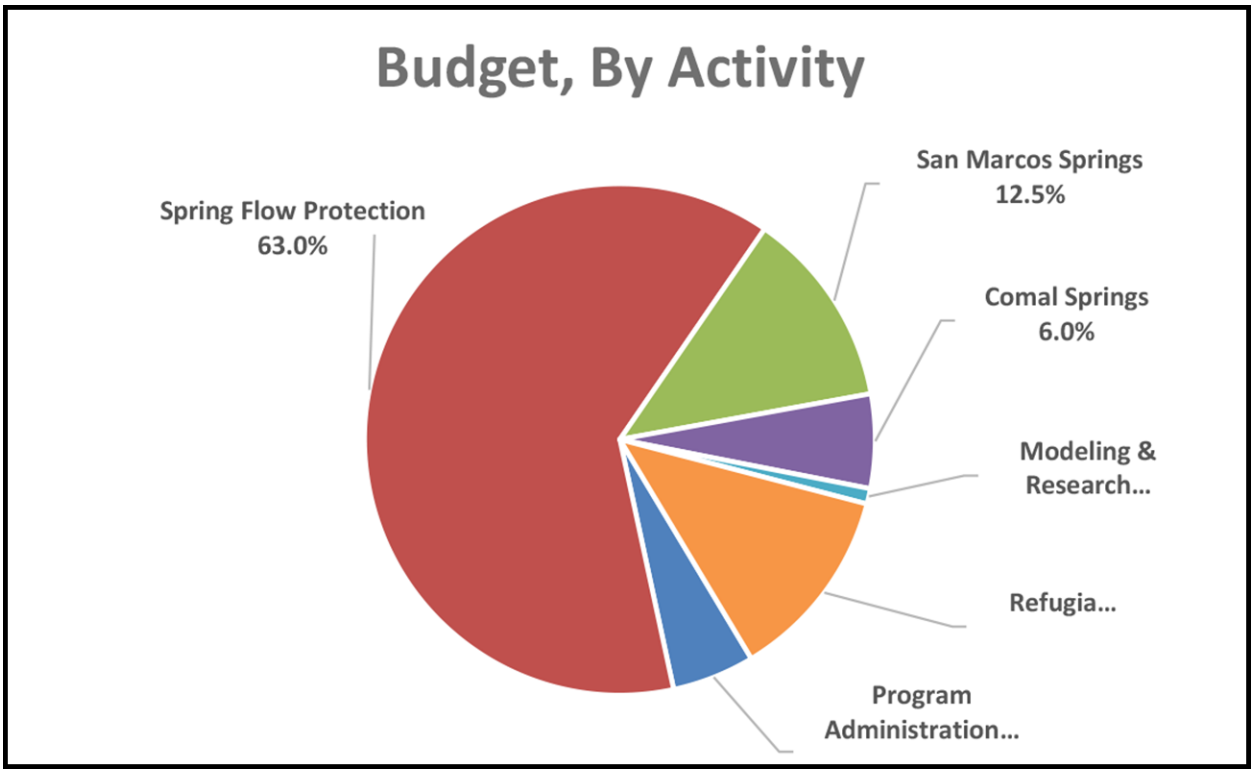

Figure 4.4-1. 2019 EAA Board-approved/amended 2019 Program Fund Applications, by budget and EAHCP activity.

The 2019 actual expenses were $17,609,403. Unspent funds in Biological Monitoring, Decaying Vegetation Restoration, LID/BMP Management, Capital (Comal and San Marcos Springs), Applied Environment Research – USFWS NFHTC, and NFHTC Refugia budgets account for most of the difference between total approved budget and actual expenses. **Figure 4.4-2** shows the 2019 actual expenses by each EAHCP activity.

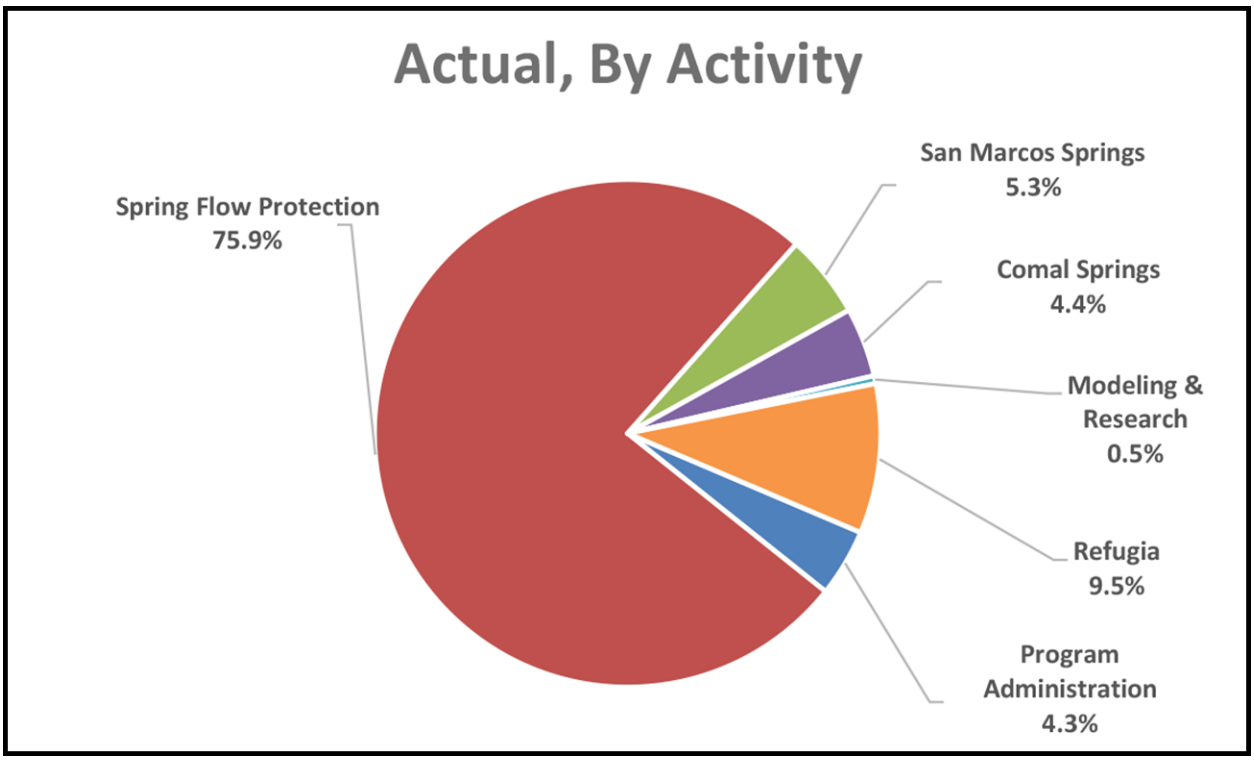

Figure 4.4-2. 2019 actual expenses by EAHCP activity.

The EAHCP Expense Report also breaks down the adopted budget, Program Funding Applications budget, and actual expenses. By the end of 2019, the reserve balance for the EAHCP was $28,744,181, which includes unspent funds accumulated since the inception of the EAHCP (**Figure 4.4-3**).

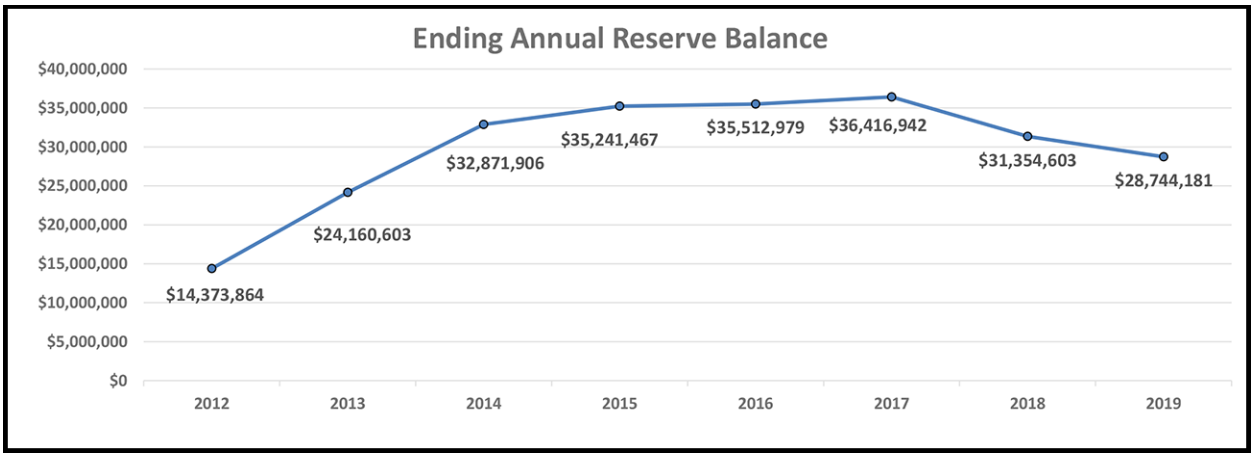

Figure 4.4-3. Reserve balances for EAHCP since program inception.

The actual revenue for 2019 was $15,402,267 compared to the budgeted revenue of $15,016,336, which is a variance of $385,931. Approximately 90 percent of the actual revenue comes from Edwards Aquifer Authority AMFs.

4.5 Program Management

General management and oversight of the EAHCP is administered through the EAA pursuant to Section 2.2 of the FMA. Part of the EAA's responsibility includes facilitating the employment of the Program Manager, who is responsible for managing the EAHCP Program, and ensuring compliance with all relevant program documents. Although referred to in the FMA as the "Program Manager," the title for this position under the EAA organizational structure is also referred to "Senior Director – Threatened and Endangered Species." Section 5.6.5 of the FMA allows for use of EAHCP monies to fund EAA administrative costs and employee salaries, so long as all incurred costs, including salaries, are with certain exceptions, not used for the costs of non-EAA Permittees' employees or administrative costs relative to the EAHCP.

In 2019, EAHCP staff included seven positions (the Program Manager [or Senior Director], Chief Science Officer [an EAA-funded position], Habitat Conservation Manager, Contract Administrator, Environmental Scientist [an EAA-funded position], and two HCP Program Coordinators). The EAA also sponsored an intern during the fall 2019 semester. Two EAHCP staff positions, a Senior Project Coordinator and an Administrative Assistant, remained unfilled in 2019.

Program management activities performed in 2019 included coordination with Permittees in accordance with the ITP, Implementing Agreement (IA), EAHCP, FMA, and other program documents. EAHCP staff coordinated Committee and Work Group activities described in **Sections 4.1**, **4.2**, and **4.3** above. Program activities were communicated to the public through the EAHCP website, *EAHCP Steward* Newsletter, EAA *News Drop* Magazine, and *EAHCP Conserve* Newsletter as described in **Section 4.5.1** below. The goal of these activities is to ensure transparency with the public and EAHCP Committees. Additionally, all IC and SH meetings were made available to view online through the EAA Granicus System. EAHCP staff also completed tasks consistent with program guidance to perform and/or coordinate activities described throughout **Section 6.0** later in this Annual Report.

Additional special projects occurred in 2019 through professional contracting services. These activities included an Addendum Project to summarize the adaptive management efforts approved by the USFWS from 2012 through 2018 and a summary of the transition from Phase I to Phase II of the ITP through the SAMP. The SAMP Report will provide a single document describing program changes during Phase I of the EAHCP and include presentations and correspondence supporting those changes. The document summarizing the SAMP will be finalized in March 2020 (see discussion under **Section 5.5** of this Annual Report).

Staff also developed EAHCP Resolution No. 05-19-001 and an associated Technical Memo in association with the Phase II Work Plan. The Phase II Work Plan, described in **Sections 4.1.1**, defines how the program will implement Conservation Measures in Phase II. The EAHCP Resolution No. 05-19-001 defines the purpose of the Phase II Work Plan and is consistent with language from FMA § 7.13.7.d. The associated Technical Memo offers additional administrative detail realitive to the SRP *NAS 3 Report,* FMA § 7.13.7.d, and the Phase II Work Plan.

The EAHCP Program Coordinators also performed site visits with contractors working for the CONB and the COSM to implement habitat protection Conservation Measures. The intent of these site visits was to better understand the work being performed and how communication occurred between contractors. These activities fit into a larger effort to increase our public outreach efforts and improve communication with stakeholders using geographic information systems (GIS) technology.

Finally, the EAHCP Program Manager and EAHCP staff also coordinated with the USFWS Ecological Services regarding program activities. The EAHCP Program Manager met with the USFWS Ecological Services Austin Habitat Conservation Planning Branch Chief, Tanya Sommer, on several occasions and held several phone calls.

4.5.1 Newsletters and Outreach

4.5.1.1 Newsletters

The *EAHCP Steward* Newsletter (**Appendix H1**) is a monthly newsletter highlighting the collaborative efforts to protect the threatened and endangered species that inhabit the Edwards Aquifer and the Comal and San Marcos springs systems. Each newsletter features a story about a conservation activity, contractor, volunteer organization, or dedicated individual working to support and/or implement EAHCP Conservation Measures or protect the Edwards Aquifer. In 2019, one newsletter and accompanying podcast was published each month (12 newsletters total). Newsletter topics, for example, ranged from new EAHCP staff hires to the history of the Aquifer Storage and Recovery (ASR) program. In addition to the *EAHCP Steward* Newsletter, the EAA publishes a quarterly magazine called the *News Drop* (**Appendix H2**) and an *EAHCP Conserve* Newsletter **(Appendix H3**). Each *News Drop* Magazine publication included three to four EAHCP feature articles. The six *EAHCP Conserve* Newsletters distributed in 2019 were intended to increase Permittee participation in the ASR and VISPO Conservation Measures.

4.5.1.2 Outreach

In 2019, EAHCP staff participated in the following community outreach events:

- Great Texas River Clean Up
- COSM Sustainability Fair and Native Plant Sale
- MCWE 2019 Earth Day
- Capital One/Junior Achievement Finance Park
- Lion's Club San Marcos River Education and Awareness Event
- Mermaid Society – River Guardianship Symposium Event

4.5.2 Permit Oversight

EAHCP staff are committed to maintaining all regulatory permits necessary for the implementation of projects in the San Marcos and Comal springs systems to ensure compliance with the ITP. This does not include permits required for contractors to perform their contractual scopes of work. The purpose of the permit oversight effort is to ensure current compliance with all federal, state, and local regulatory permits

needed for current and future projects. A permit tracking matrix was maintained to assist EAHCP staff and Permittees in identifying additional permits needed.

Staff received technical assistance from two consulting firms in developing permit applications for various state and federal agencies that included the TPWD, TCEQ, Texas Historical Commission and the U.S. Army Corps of Engineers. In 2019, EAHCP staff assisted the CONB, COSM, and Texas State in completing and submitting all permit applications and coordination letters appropriate for full compliance. Permit oversight included reviewing the Impervious Cover and Water Quality Protection Plan designs, reviewing riparian restoration plans, coordinating with the COSM on Sessom Creek site visits, Sessom Creek Cultural Resources Surveys for Antiquities Permit Applications, and attending meetings upon request.

4.5.3 Work Plans and Funding Applications

EAHCP staff work with the Permittees and Partners throughout the year to implement EAHCP activities defined in annual work plans. Work Plans, along with their associated budgets as funding applications, are amended through the IC throughout the year as documented in meeting agendas (see discussions under **Section 4.1** and **Section 6.0** of this Annual Report).

5.0 ADAPTIVE MANAGEMENT ACTIVITIES FOR 2019 AND USFWS CORRESPONDENCE

Article 7 of the FMA outlines the procedural steps and responsibilities of the Permittees for making AMP decisions. It also identifies three different AMP decisions the Permittees may make – Routine, Nonroutine, and SAMP decisions. Routine decisions are decisions involving ongoing, day-to-day matters related to the management and administration of existing Conservation Measures and Phase II Conservation Measures implemented through the SAMP that do not require an amendment to the ITP. Nonroutine AMP decisions are decisions related to existing Conservation Measures, which are not Routine AMP decisions. SAMP decisions are decisions that relate to the selection of Phase II Conservation Measures that are to be implemented by the Permittees from 2020 through the end of the ITP (2028).

5.1 Routine Decisions

There were no Routine AMP decisions made in 2019.

5.2 Nonroutine Decisions

Consistent with Section 7.12 of the FMA, a Nonroutine AMP Proposal to increase the VISPO Conservation Measure (EAHCP §5.1.2) volume goal was distributed to the SC in March 2019. The proposal for an additional 1,795 acre-feet (ac-ft) of Edwards Aquifer water in VISPO was approved by the IC on May 23rd following development of a SER by the SC, review by the SH, and development of the SH Report. The Nonroutine AMP increasing the VISPO volume goal from 40,000 ac-ft to 41,795 ac-ft was approved by the USFWS in June 2019.

Increasing the VISPO volume goal to 41,795 ac-ft ensures a modeled 30 cfs daily average minimum springflow in the Comal Springs system during a repeat of drought-of-record (DOR) scenario. MODFLOW groundwater modeling completed in 2018 indicated that full implementation of all EAHCP Conservation Measures with modified SAWS ASR forbearance and VISPO enrollment of 40,921 ac-ft would result in 29.6 cfs of springflow at the Comal Springs. This Nonroutine AMP fulfills the springflow shortfall according to MODFLOW simulations.

The SH identified concerns that pulse-flows described by the EAHCP had not been addressed. The SH Report in **Appendix F5** presents the SH's concerns and their final recommendations. Their recommendations and approval of the VISPO Nonroutine AMP Proposal were agreed upon by the IC. A Work Group to will be developed in 2020 in response to the SH recommendations. Details of the proposed 2020 Work Group activities are presented in **Section 7.0** of this Annual Report.

5.3 Strategic Adaptive Management Process Decisions

There were no SAMP decisions made in 2019.

5.4 Other USFWS Correspondence

Adaptive management decisions, as well as other clarifications to the EAHCP, IA, FMA, or ITP may be necessary to address issues that arise during implementation pursuant to Section 9.2.1 of the EAHCP. The Program Manager submitted the VISPO Nonroutine AMP decision to the USFWS on June 7, 2019 (**Appendix I1**). The USFWS responded to this correspondence via formal letter on June 26 (**Appendix I2**). The Program Manager also submitted the Comprehensive Phase II Work Plan and Resolution 05-19-001 as an informational memorandum to the USFWS on June 5 (**Appendix I3**).

The USFWS proposed Recovery Plan revisions for 21 plans including 25 species in 15 states were published on August 6, 2019. The proposal included amendments to the 1996 Recovery Plan for Texas wild-rice, fountain darter, and Texas blind salamander. The amendments were finalized in December 2019 after updates were made to incorporate comments received from the August proposed changes.. The final amendments to the 1996 Recovery Plan for Texas wild-rice, fountain darter, and Texas blind salamander are in **Appendix I4**.

5.5 2019 Strategic Adaptive Management Process Activities

The EAHCP SAMP represents the transition between implementation of Phase I and Phase II of the ITP. This transition would encapsulate selection of Phase II Conservation Measures. The final *National Academy of Sciences – Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* (NAS *Report 3*) reviewed the effectiveness of the Phase I (2012 – 2019) Conservation Measures at meeting the Biological Objectives and the likelihood that the Biological Objectives would meet LTBGs during Phase II (2020 – 2027). The NAS *Report 3* determined that: (1) Phase I Conservation Measures and activities are achieving the Biological Goals; and (2) they were unable to reach a determination on the effectiveness of the Conservation Measures related to the CSRB. These results highlighted the success of the EAHCP Conservation Measures and prompted the creation of a Phase II Work Group and a CSRB Work Group in 2018.

Activities of both the Phase II and CSRB work groups continued into 2019. The activities of these work groups are described in **Sections 4.1.1** and **4.1.2** of this Annual Report, respectively. The transition from Phase I to Phase II was documented through 2019 and a report summarizing EAHCP activities during this transition will be finalized in March 2020.

6.0 PLAN IMPLEMENTATION IN 2019

Section 6.0 of this Annual Report discusses the progress achieved in 2019 towards meeting the Conservation Measures outlined in the EAHCP to comply with the ITP requirements. Section 10(a)(2)(A) of the ESA requires that any application for an ITP be accompanied by an HCP. HCPs must describe the measures the applicant will undertake to monitor, minimize, and mitigate the impacts of the taking of listed species (USFWS and NMFS 1996, 2016). This section describes actions by each of the Permittees and the TPWD.

All efforts to implement the EAHCP Conservation Measures were carried out according to the reviewed and approved 2019 Work Plans. The 2019 Work Plans approved by the IC on June 21,2018, and as amended, are included in this Annual Report in **Appendix J1** through **Appendix J3**.

6.1 Edwards Aquifer Authority

The EAA is responsible for implementation of the measures under the EAHCP listed in **Table 6.1-1.** Work Plans and Funding Applications for 2019 program activities and 2020 proposed program activities are included as **Appendix J1** and **Appendix J4**, respectively.

Table 6.1-1. Edwards Aquifer Authority 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Applied Research (EAHCP § 6.3.4)	Intended to enhance understanding of the ecology of aquatic ecosystems, provide scientifically-rigorous information needed to meet the Biological Goals and Objectives, and provide improved data and information to support refugia operations.	Applied research on the (1) Sessom Creek Sediment Export Study, and (2) Spring Lake vegetative boom was completed in 2019.	Applied research developed from the CSRB Work Group will be proposed and contracted in 2020. Additional applied research may be developed based on recommendations from a new work group to be created in 2020 to address the May 22nd SH discussion document.	**Section 6.1.1**, **Appendix K1,** and **Appendix K2**
Refugia (EAHCP §§ 5.1.1, 6.4.2, 6.4.3, and 6.4.4)	Operation and maintenance of two off-site refugia to house and protect adequate populations of Covered Species and expand knowledge of their biology, life histories, and effective reintroduction techniques.	Construction was completed in 2019. Species collections began, and research activities included: 1) Environmental influences of CSRB pupation; 2) CSRB nutrition supplementation; 3) Long-term marking success of salamanders; 4) San Marcos salamander reproductive dysfunction.	Continued day-to-day operations and maintenance of refugia; species collections and 2019 research activities will continue in 2020.	**Section 6.1.2** and **Appendix K3**
VISPO (EAHCP § 5.1.2)	Compensates irrigation permit holders for not pumping (a total combined volume goal of 41,795 ac-ft) from the Edwards Aquifer during certain drought conditions when the water level at the J-17 Index Well is at or below 635 feet mean sea level (ft msl) on October 1st.	Conditions were not triggered, and forbearance was not required.	Conditions were not triggered in 2019, and forbearance will not be required in 2020. VISPO agreements totaling 39,645.943 ac-ft will be held moving into 2020, and 15,812.121 ac-ft will expire in 2020. EAA staff will solicit permit holders to reach the volume goal.	**Section 6.1.3**
RWCP (EAHCP § 5.1.3)	Conserve 20,000 ac-ft of permitted or exempt Edwards Aquifer water where 10,000 ac-ft will be held by the EAA to remain un-pumped for the term of the ITP and the other 10,000 ac-ft will remain available for withdrawal by the participating entity.	SAWS reported a total of 6,859 ac-ft of water saved through increased leak repair capabilities for 2019.	Contracts to conserve 20,000 ac-ft will continue and this Conservation Measure will remain fulfilled through the ITP. Payments to SAWS for their leak repairs will also be finalized in 2020.	**Section 6.1.4** and **Appendix K4**
Critical Period Management Program (CPMP) – Stage V (EAHCP § 5.1.4)	Mandates a 44 percent reduction in the authorized groundwater withdrawal amount of EAA-issued groundwater withdrawal permits triggered when the 10-day average Aquifer level at the J-17 Index Well drops below 625 ft msl, or if the springflows at Comal Springs decline below 45 cfs based on a 10-day rolling average,	CPMP – Stage V was not triggered in 2019.	CPMP – Stage V will be enforced if triggered in 2020.	**Section 6.1.5**

Table 6.1-1. Edwards Aquifer Authority 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
	or below 40 cfs based on a three-day rolling average, or when the J-27 Index Well Aquifer level drops below 840 ft msl.			
Expanded Water Quality Monitoring (EAHCP § 5.7.2)	Continued historical groundwater and surface water quality monitoring along with expanded water quality monitoring efforts to include stormwater and additional groundwater and surface water sampling as necessary around Landa Lake, the Comal River, Spring Lake, and the San Marcos River.	Expanded water quality monitoring occurred in 2019.	Water quality monitoring requirements outlined in the EAHCP will continue. A new scope of work will be developed and contracted consistent with the EAHCP for future water quality monitoring activities.	**Section 6.1.6, Appendix K5,** and **Appendix K6**
Biological Monitoring (EAHCP §§ 6.3.1, 6.4.3, and 6.4.4)	To monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities, to collect data that can be used in the applied research studies, and to provide data and information for Ecological Model (EcoModel) development.	Biological monitoring occurred as outlined in the EAHCP.	Biological monitoring will continue as completed in previous years with the vegetation mapping only occurring among the representative reaches.	**Section 6.1.7, Appendix K7,** and **Appendix K8**
Groundwater Modeling (EAHCP § 6.3.2)	Improve MODFLOW model to reduce uncertainty in the results for use during the AMP and to provide assurance/confirmation that modeling results for the Edwards Aquifer and springflows are more reliable and defensible.	The EAHCP obligations to reduce uncertainty in the MODFLOW model and develop a new finite-element model by December 31, 2014 have been met.	Finalize the MODFLOW uncertainty analysis currently being conducted by the USGS under a joint funding agreement with EAA.	**Section 6.1.8**
Ecological Modeling (EAHCP § 6.3.3)	Develop a predictive ecological model to evaluate, and quantify the magnitude of, potential adverse ecological effects from Covered Activities to develop alternative approaches or mitigation strategies.	The EcoModel and modeling requirements were completed in 2017.	No EcoModel activities are proposed.	Section 3.1.9 and Appendix K5 of the EAHCP 2018 Annual Report
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6)	EAA will put together materials regarding the value of a ban on the use of coal tar sealants and work with local governments to explore and encourage their consideration of such a ban.	Work on this Conservation Measure was completed in 2015.	The EAA serves as a resource for any local government that concludes future regulatory action is necessary. Additionally, the EAA will continue to enforce its coal tar rules.	Section 3.1.11 of the EAHCP 2015 Annual Report

Table 6.1-1. Edwards Aquifer Authority 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
EAA ASR Springflow Protection (EAHCP § 5.5.1)	The EAHCP requires the EAA acquire a total of 16,667 ac-ft of Edwards Aquifer permitted water through leases and maintain such leases on an annual basis for use in the SAWS ASR Program. The EAA will also acquire a total of 33,333 ac-ft of forbearance agreements for springflow protection related to EAA permitted Edwards Aquifer water and maintain such agreements on an annual basis.	The EAA contributed 16,667 ac-ft as defined by the Interlocal Contract (ILC) with SAWS. SAWS recharged through injection and stored 13,597 ac-ft of EAHCP Groundwater into the SAWS ASR Project; the difference between what EAA contributed and what was stored was credited to EAHCP Groundwater from SAWS consistent with the ILC. EAA only paid operations and maintanence costs for the total stored amount, 13,597 ac-ft. The EAA acquired and maintained groundwater withdrawal rights totaling about 35,458 ac-ft of which about 16,891 ac-ft were leased groundwater withdrawal rights and about 18,567 ac-ft were ASR springflow protection forbearance agreements.	The EAA will continue to acquire leases and forbearance agreements for the ASR consistent with the ILC. The EAA will contribute 9,957.439 ac-ft to fulfill their commitment to store 126,000 ac-ft of Edwards Aquifer permitted water in the SAWS ASR Program.	**Section 6.5**

6.1.1 Applied Research (EAHCP § 6.3.4)

The initial stage of the Applied Research Program conducted studies prescribed in the EAHCP to fill critical gaps in data regarding the species and their habitat. As the new data were acquired, additional applied research questions were developed by the SC to better inform management of the systems support and compliance with the EAHCP's requirements. The studies conducted in 2019 are summarized below.

1) *Sessom Creek Sediment/Constituent Export Loading Curves and Analysis Study*
   Rationale and role of this study in the EAHCP process: The purpose of this study is for the development of Sessom Creek sediment/constituent export loading curves and analysis of the development of factors contributing to sediment exports from the watershed. Twelve storm events and more than 300 stormwater samples were collected in 2018. The results of stormwater samples were analyzed in combination with continuous turbidity and discharge data to develop continuous discharge-constituent rating curves for total suspended sediments (TSS) and total phosphorus (TP). The USGS Load Estimator (LOADEST) software was used to build regression models to develop loading curves. These loading curves can be used to estimate TSS in the future in combination with ongoing continuous turbidity and discharge data from the watershed. Further analysis of hysteresis patterns suggest that sediments transported during small storm events and during first-flush may be largely derived from impervious surfaces.

   The final report for the Sessom Creek Sediment/Constituent Export Loading Curves and Analysis Study can be found in **Appendix K1**.

2) *Aquatic Plant Boom Assessment in Spring Lake*
   Rationale and role of this study in the EAHCP process: The primary purpose of this project was to assess the feasibility of using aquatic plant booms for capturing floating vegetation within Spring Lake, and the effectiveness of aquatic plant booms to minimize vegetation mat accumulation downstream in the San Marcos River. The project was designed to determine if aquatic plant booms could be a complement to current vegetation management activities occurring in Spring Lake and be integrated into the minimization and mitigation measure for vegetation mats in the San Marcos River. Objectives for this project were three-fold: 1) Quantify floating aquatic vegetation volume captured by aquatic plant booms; 2) Assess the use of the harvester boat to clear vegetation captured by the aquatic plant booms; and 3) Qualitatively monitoring the accumulation of vegetation mats downstream prior to and after the deployment of the aquatic plant booms.

   The aquatic plant booms successfully captured floating vegetation. However, no clear correlation between the amount of vegetation collected from the booms and the amount transported downstream could be established. Details of the study results are in the final report for this project in **Appendix K2**.

6.1.2 Refugia (EAHCP §§ 5.1.1, 6.4.2, 6.4.3, and 6.4.4)

Refugia operations were established to provide protection for the Covered Species included in the ITP in accordance with the EAHCP, and to allow research on those species. Establishing off-site refugia for the Covered Species is necessary to provide back-up populations that can be used to re-establish endemic populations in case of extirpation from the wild. The Covered Species were planned for collection throughout the year at the USFWS San Marcos Aquatic Research Center (SMARC) in San Marcos, Texas, and the USFWS Uvalde National Fish Hatchery (UNFH) in Uvalde, Texas in accordance with their 2019 Work Plan (**Appendix J1**). The species census for December 2019 is shown in **Table 6.1-2.** Interim species research reports detailing 2019 activities can be found in **Appendix K3**.

Table 6.1-2. Number of Organisms Incorporated in Refugia, and Total Census as of December 2019, of Edwards Aquifer Organisms Taken to Facilities (by Species and Facility)

Species	Incorporated into Refugia SMARC[1]	Incorporated into Refugia UNFH	SMARC Dec 31 Census[2]	UNFH Dec 31 Census	SMARC Survival Rate	UNFH Survival Rate[3]
Fountain darter-San Marcos *Etheostoma fonticola*	245	488	622	533	62.1%	57.6%
Fountain darter-Comal *Etheostoma fonticola*	181	5	213	36	52.7%	67.9%
Comal Springs riffle beetle *Heterelmis comalensis*	346	133	63 (30)	32	14.7%	21.8%
Comal Springs dryopid beetle *Stygoparnus comalensis*	15	4	12	1	66.7%	25.0%
Peck's Cave amphipod *Stygobromus pecki*	220	229	206 (80)	157	48.1%	54.7%
Edwards Aquifer diving beetle *Haideoporus texanus*	0	0	0	0	--	--
Texas troglobitic water slater *Lirceolus smithii*	*	0	*	0	*	--
Texas blind salamander *Eurycea rathbuni*	204	38	264	31	91.0%	81.6%
San Marcos salamander *Eurycea nana*	269	177	343	305	77.1%	74.6%
Comal Springs salamander *Eurycea* sp.	25	47	88	55	90.7%	84.6%
Texas wild rice plants *Zizania texana*	35	80	211 (10)	157 (14)	85.1%	98.1%

1 Incorporated refers to organisms that have passed their 30-day quarantine period where they have been evaluated for health and suitability for inclusion into refugia populations; also, they have been cleared by USFWS Fish Health Unit where applicable.

2 End of year census number is of those incorporated; the number in parenthesis are those in quarantine period.

3 Survival rate does not include any organisms during quarantine period or those sacrificed for research or Fish Health diagnostics.

6.1.3 Voluntary Irrigation Suspension Program Option (EAHCP § 5.1.2)

On October 1, 2018, the Aquifer level at the J-17 Index Well was recorded at 677.04 ft msl and therefore did not trigger VISPO forbearance by permit holders in 2019. All VISPO participants were paid only the standby amount in 2019, with combined total VISPO payments amounting to $2,328,821 as presented by county in **Table 6.1-3**.

Table 6.1-3. VISPO Total Enrollment (in ac-ft) and Payments (in dollars), by County

Enrollment Option	Atascosa	Bexar	Comal	Hays	Medina	Uvalde	TOTALS
5-Year Base	654.400	769.000	0.000	0.000	3,053.556	13,470.935	**17,947.891**
5-Year Unrestricted	0.000	119.700	0.000	0.000	941.530	5,174.383	**6,235.613**
Subtotal	654.400	888.700	0.000	0.000	3,995.086	18,645.318	**24,183.504**
10-Year Base	0.000	1,450.926	0.000	0.000	6,151.918	4,183.493	**11,786.337**
10-Year Unrestricted	0.000	122.000	0.000	0.000	1,800.783	1,910.949	**3,833.732**
Subtotal	0.000	1,572.926	0.000	0.000	7,952.701	6,094.442	**15,620.069**
TOTALS	**654.400**	**2,461.626**	**0.000**	**0.000**	**11,947.787**	**24,739.760**	**39,803.573**
PAYMENTS	**$35,004.46**	**$157,519.09**	**$0.00**	**$0.00**	**$765,983.59**	**$1,370,313.54**	**$2,328,820.69**

6.1.4 Regional Water Conservation Program (EAHCP § 5.1.3)

The EAA maintains contracts with three communities to conserve water under the RWCP through 2028 as outlined in agreements with the EAA. The City of Uvalde began implementing its toilet replacement program in 2013 to conserve 57.450 ac-ft of water. In 2014, the City of Universal City began implementing its leak detection program to conserve 163.684 ac-ft of water and in 2016, SAWS began implementing a five-year Leak Detection and Repair Program. The SAWS Leak Detection and Repair Program satisfies the total remaining RWCP goal for water committed into the EAA Groundwater Trust for the remainder of the ITP. The estimated savings are shown in **Table 6.1-4** with a total savings of 20,053 ac-ft of conserved water from all three communities. One-half of the conserved water (10,027.13 ac-ft) has been, or will be, placed in the Groundwater Trust through the RWCP to remain un-pumped through 2028.

Table 6.1-4. Estimated Savings (in ac-ft) of Conserved Water through Regional Water Conservation Program Agreements

Water	2013	2014	2015	2016	2017	2018	2019	2020	TOTALS
Estimated Savings (ac-ft)	114.0	327.0	0	4,745.00	4,745.00	4,745.00	4,745.00	632.00	**20,053.00**
Groundwater Trust (ac-ft)	57.450	163.684	0	2,372.50	2,372.50	2,372.50	2,372.50	316.00	**10,027.13**

SAWS reported a total of 6,859 ac-ft of water saved through increased leak repair capabilities for 2019. This information can be found in more detail in **Appendix K4**.

6.1.5 Critical Period Management Program – Stage V (EAHCP § 5.1.4)

Stage V was not triggered in 2019 and no other critical period stages were triggered in 2019. **Table 6.1-5** and **Table 6.1-6** list the requirements for all CPMP stages for the San Antonio and Uvalde pools, respectively.

Table 6.1-5. CPMP 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**
J-17 Index Well 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 Poolis 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 Index Well, 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 exiting from Stage I for the San Antonio 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 Index Well, as applicable, are all above the same stage trigger level.

** In order to enter Critical Period Stage V, the applicable springflow trigger is either less than 45 cfs based on a 10-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 10-day rolling average of 45 cfs or greater.

Table 6.1-6. CPMP 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
J-27 Index Well 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 II for the Uvalde Pool, is triggered if the 10-day average of daily aquifer levels at the J-27 Index Well, 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 exiting from Stage II for the Uvalde Pool, is triggered only when the 10-day average of daily aquifer levels at the J-27 Index Well is above the same stage trigger level.

6.1.6 Expanded Water Quality Monitoring (EAHCP § 5.7.2)

The Expanded Water Quality Monitoring Program (EAHCP § 5.7.2) continued in 2019 as an effort to detect early signs of water quality impairment to the Comal and San Marcos systems. The following discussion and **Table 6.1-7** summarize these activities in 2019. A more detailed discussion of monitoring and sample results are presented in **Appendix K5** and **Appendix K6**.

Table 6.1-7. Summary of Data Types and Water Quality Sampling Events for 2019

San Marcos River	Sample Dates
Passive Diffusion Samplers	2/19, 4/19, 6/19, 8/19, 10/19, 12/19
Polar Organic Chemical Integrative Sampler (only at HSM 470*)	2/19, 4/19, 6/19, 8/19, 10/19, 12/19
Fish tissue	Multiple days from April through June
Comal River	**Sample Dates**
Stormwater (only at HCS210 and 240)	4/18/19
Passive Diffusion Samplers	2/19, 4/19, 6/19, 8/19, 10/19, 12/19
Polar Organic Chemical Integrative Sampler (only at HCS 460)	2/19, 4/19, 6/19, 8/19, 10/19, 12/19
Fish tissue	Multiple days from April through June

* For an explanation of the sampling location codes referenced in this table (e.g. HSM 470), please refer to the following:

- HSM = San Marcos; and HCS = Comal
- The number following the abbreviation is either 1, 2 or 3 to indicate whether location is:
  - 1 = surface water sampling
  - 2 = stormwater sampling
  - 3 = sediment sampling
  - 4 = passive diffusion sampling
- The last two digits correspond to a specific sample location

The EAA collected stormwater samples from the Comal system above and below the Landa Lake Golf Course in April 2019. In odd numbered years, stormwater samples are not collected for the San Marcos system. Stormwater samples were analyzed for Integrated Pest Management Plan (IPMP) compounds. The EAA also collected passive diffusion samples and polar organic chemical integrative samples (POCIS) from the Comal and San Marcos systems. In odd numbered years, the EAA analyzes fish tissue samples from both systems as part of the expanded water quality monitoring effort to assess the ecological water quality. The fish samples were collected and tested for semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), metals, and pharmaceutical and personal care products (PPCPs). The final 2019 Expanded Water Quality Monitoring Report, including water quality analysis reports, is included in **Appendix K5**. The EAA also monitored the Real Time Instrumentation (RTI) that measures changes in dissolved oxygen (DO), pH, conductivity, turbidity (Sessom Creek only), and temperature at 15-minute intervals (**Appendix K6**).

Stormwater Samples

Stormwater samples from the Comal system included one upstream of Landa Park Golf Course (HCS210) and one adjacent to and downstream of most of the golf course (HCS240). These two stormwater sample locations were intended to assess the possible presence of IPMP constituents plus atrazine that are potentially related to the Landa Park Golf Course. The EAA collected five samples from each sample

location during an April 2019 storm event. Three samples were collected on the rising limb of the storm hydrograph, one sample collected at the peak, and one sample collected at the tail end. No pesticides were detected from the upstream sample location, HCS210. The pesticide, chlorothalonil, was detected in two water samples collected during the rising limb of the hydrograph during this storm event. The herbicide, prodiamine, was detected in four water samples collected during the rising limb and peak of the hydrograph. No pesticides were detected during the falling limb (recovery period) of the storm hydrograph. The detections were well below the ecological risks for freshwater fish, freshwater invertebrates, and freshwater vascular plants.

Passive Diffusion Samplers

Passive diffusion samplers were deployed at five sample locations in the Comal system, from the upstream end of Landa Lake (where Blieders Creek empties into the headwaters of Landa Lake) to the south end of the Comal River, upstream of the confluence with the Guadalupe River. The San Marcos system has seven sample locations, beginning at Sink Creek upstream of the headwaters of Spring Lake on the north end of the system and ending downstream of Capes Dam on the south end of the system. Passive diffusion samplers were deployed in each spring system for two-week periods, six times every other month during the year.

Passive diffusion samplers regularly detected two analytes, total petroleum hydrocarbons and tetrachloroethene, in various locations throughout the Comal and San Marcos systems. The concentrations of these analytes did not exceed the TCEQ surface water standards for contact recreation and ecological health.

Polar Organic Chemical Integrative Samplers

The EAA deployed POCIS, which are passive diffusion samplers used for PPCPs testing, at the most downstream sample sites (HCS460 and HSM470) in each spring system for one-month periods, six times during the year. Of the 43 PPCP constituents evaluated, 11 constituents were detected in the Comal River, while eight constituents were detected in the San Marcos River. Some of the analytes detected, however, were also detected in the extraction blank analyzed.

Fish Tissue Sampling

The EAA staff collected fish from two locations along the Comal Springs and San Marcos systems, in the far upper reaches of each system, and at the most downstream biomonitoring reach for each system. At each of the four sites, two fish species were collected. The species included a lower trophic species, gambusia (*Gambusia affinis* and *Gambusia geiseri),* and a predator species, largemouth bass (*Micropterus salmoides)*. Fish samples were delivered to a laboratory for compositing and analysis. For each sample, whole body organisms were combined to create a composite sample.

Fish tissue analyses detected one SVOC in the Comal system and three SVOCs in the San Marcos system. None of the compounds detected were PAH compounds. One polychlorinated biphenyl PCB, Aroclor-1260, was detected in fish tissue from both spring systems. Fish tissue analyses detected 21 metals in the Comal system and 20 metals in the San Marcos system. One PPCP, DEET (N-Diethyl-meta-

toluamide), was detected in the Comal system, but none were detected in fish tissue from the San Marcos system. No PBDEs were detected in fish tissue samples from either spring system.

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

Many different sampling components are included in the EAHCP Biological Monitoring Program (BioMP), and several sampling location strategies are employed. The sampling locations selected are designed to cover a representative extent of Covered Species habitats in both systems and are a subset used for ecological interpretation of the systems, while maximizing resources where practical and when applicable. As such, the current design employed the following six basic sampling location strategies for the Comal and/or San Marcos systems, with associated sampling components:

- System-wide sampling
  - Texas wild-rice full-system mapping – annually (San Marcos only)
  - Full system aquatic vegetation mapping – once every five years (will not be performed until 2023)
- Select longitudinal locations
  - Temperature monitoring – thermistors
  - Water quality sampling – during CPMP sampling
  - Fixed-station photography
  - Discharge measurements (Comal system only)
- Reach Sampling (four reaches)
  - Aquatic vegetation mapping
  - Fountain darter drop netting
  - Fountain darter presence/absence dip netting
  - Macroinvertebrate community sampling (San Marcos)
- Springs Sampling
  - Endangered Comal invertebrate sampling
  - Comal Springs salamander sampling
  - San Marcos salamander sampling
- River Section/Segment Sampling
  - Fountain darter timed dip net surveys
  - Macroinvertebrate community sampling (Comal system)
  - Fish community sampling
- Critical Period Sampling
  - Both systems, as applicable if CPMP stages are triggered – this sampling did not occur in 2019

The 2019 Biological Monitoring Reports for both the Comal and San Marcos systems are included in **Appendix K7** and **Appendix K8**, respectively.

6.1.8 Groundwater Modeling (EAHCP § 6.3.2)

The requirements in EAHCP § 6.3.2 to update the MODFLOW groundwater model and to develop a new finite element groundwater model have been met as described in previous annual reports. The updated MODFLOW model was used to repeat a "Bottom-Up" analysis in 2019 to evaluate the amount of additional VISPO forbearance that would be needed to achieve a model result that meets the 30 cfs minimum flow condition at Comal Springs. This modeling effort was used to support the Nonroutine AMP decision to increase the VISPO volume goal from 40,000 ac-ft to 41,795 ac-ft that was approved by the USFWS in June 2019. The model files, applications, and documentation for this analysis were archived along with instructions to aid in any future need to repeat or modify this analysis.

6.2 City of New Braunfels

The CONB is responsible for implementation of the measures under the EAHCP listed in **Table 6.2-1**. Work Plans and Funding Applications for 2019 program activities and 2020 proposed program activities are included as **Appendix J2** and **Appendix J5**, respectively.

Table 6.2-1. City of New Braunfels 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Flow-Split Management in the Old and New Channels (EAHCP § 5.2.1)	Control flow entering the Old and New Channels of the Comal River from Landa Lake to maintain optimal habitat conditions for the Covered Species under varying total flow conditions.	Continued to monitor flow rates in the Old and New Channels of the Comal River. Operated the flow-control gates between Landa Lake and the Old Channel to meet the flow objectives.	Continue to monitor flow rates in the Old and New Channels of the Comal River and operate the flow-control gates to meet the flow objectives defined in annual Work Plans.	**Appendix J2** and **Appendix J5**
Native Aquatic Vegetation Restoration and Maintenance (EAHCP § 5.2.2)	Implement an Aquatic Vegetation Restoration Program (removal of non-native aquatic plant species, planting of target native aquatic plant species, and maintenance of restored areas) within key, sustainable reaches of the Comal River system including Landa Lake, the Upper Spring Run area, and portions of the Old and New Channels to improve habitat conditions for the fountain darter by increasing the amount of usable habitat and by improving the quality of existing habitat.	Planted 5,989 native aquatic plants, primarily *Ludwigia* and *Sagittaria*, in Restoration Reaches (RRs) located throughout the Comal River system. Removed approximately 18 m^2 of non-native *Hygrophila*. Monitored and maintained previously restored native aquatic vegetation stands.	Continue efforts to increase the coverage and density of target aquatic vegetation preferred by fountain darters for habitat. Efforts will be focused in the Old Channel, Landa Lake, New Channel and Upper Spring Run as well as in the Upper and Lower Landa Lake restoration reaches.	**Section 6.2.1** and **Appendix L1**
Management of Public Recreational Use of Comal Springs and River Ecosystems (EAHCP § 5.2.3)	Enforce recreation restrictions on the Comal River to limit recreation on Landa Lake, the spring runs in Landa Park, and the Old Channel of the Comal River along with extending take protection to commercial outfitting businesses that voluntarily participate in the Certificate of Inclusion (COI) Program.	Continued enforcement of City Ordinance Section 142-5, which restricts access to Landa Lake, the Spring Runs (except for the wading pool on Spring Run #2), and portions of the Comal River, including the Old Channel and the "Mill Race" of the New Channel. CONB park rangers routinely patrol Landa Park and enforce the ordinance. Signage is in place along the waterways to inform visitors.	Trained park rangers enforce City Ordinance Section 142-5. The CONB will work with EAHCP Program staff and stakeholders to develop a plan to inform river recreation outfitters on the benefits of the EAHCP COI Program. The CONB will recruit outfitters who operate on the Comal River and voluntarily participate in the COI program.	N/A

Table 6.2-1. City of New Braunfels 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Decaying Vegetation Removal and Dissolved Oxygen Management (EAHCP § 5.2.4)	Monitor DO concentrations and related water quality parameters in Landa Lake and mitigate depressed DO levels (<4 mg/L), regardless of the initiating circumstances.	DO monitoring and mitigation activities did not occur in 2019 due to above average springflow and adequate DO concentrations.	Monitor DO concentrations in prime habitat areas of Landa Lake and the Upper Spring Run if total Comal springflow decreases below 100 cfs. Floating vegetation mats will be managed, and decaying vegetation removed if low-DO levels are realized and it is determined that concentrations are negatively influenced by decaying vegetation.	**Appendix J2** and **Appendix J5**
Control of Harmful Non-Native Animal Species (EAHCP § 5.2.5)	Implement a non-native species control program that targets armored catfish (Loricariidae), tilapia (*Oreochromis sp.),* nutria (*Myocastor coypus*), and giant ramshorn snail (*Marisa cornuarietis*).	Performed routine removal sessions throughout the year to remove non-native fish and animal species from the Comal River system.	Continue the existing program to remove target non-native species, including tilapia, nutria, and armored catfish using proven and effective methods	**Section 6.2.2**
Monitoring and Reduction of Gill Parasites (EAHCP §§ 5.2.6 and 6.3.6)	Monitor gill parasite (*Centrocestus formosanus*), and its intermediate host snail (*Melanoides tuberculate*), and establish a reduction program.	Performed water column cercaria monitoring for the gill parasite and *Haplorchis pumilio* in August 2019.	Continue monitoring free-swimming cercaria, snail parasite larva, in the water column.	**Section 6.2.3** and **Appendix L2**
Prohibition of Hazardous Materials Transport Across the Comal River and its Tributaries (EAHCP § 5.2.7)	Prohibit the transport of hazardous materials (HAZMAT) on routes crossing the Comal River and its tributaries.	Hazardous materials transport prohibitions (CONB City Code § 126-185) remained in effect and notification signs remained in place and in good condition.	Maintain HAZMAT signage installed in 2016 and monitor for the presence of trucks carrying hazardous cargo on routes crossing the Comal River and its tributaries.	N/A
Native Riparian Habitat Restoration (Riffle Beetle) (EAHCP § 5.2.8)	Implement a restoration program by removing non-native vegetation and planting native vegetation to improve the riparian zone along Spring Run #3 and the western shoreline of Landa Lake, and to minimize sedimentation impacts.	Planted more than 800 native plants within riparian buffer area along the southeast side of Spring Run #3 to increase density of riparian vegetation. Monitored and maintained sediment capture structures along the northwest side of Spring Run #3.	Continue to monitor the riparian vegetation and buffer area established along the southeast side of Spring Run #3 and plant native riparian species as needed; monitor and remove reemergent non-native vegetation in the riparian zone along the northwest side of Spring Run #3 and the western shoreline of Landa Lake.	**Section 6.2.4**

Table 6.2-1. City of New Braunfels 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Reduction of Non-Native Species Introduction and Live Bait Prohibition (EAHCP § 5.2.9)	Prohibit the introduction of domestic and non-native aquatic organisms, targeting bait species and aquarium trade species and educate and promote awareness on the adverse impacts of aquarium dumping and use of non-native bait species.	The CONB adopted Ordinance No. 2019-42 that restricts the usage of non-native bait species and prohibits aquarium dumping and release of non-native aquatic species. Included non-native animal species education in the "Making the Most of our Resources" newsletter that was an insert in 10,000 copies of the local newspaper, the *New Braunfels Herald-Zeitung* newspaper.	Educate residents and visitors on the negative impacts of aquarium dumping and usage of specific live bait species. Enforce City Ordinance No. 2019-42.	**Appendix L3**
Litter Collection and Floating Vegetation Management (EAHCP § 5.2.10)	Remove litter and manage floating vegetation to enhance habitat for the Covered Species. This includes dislodging vegetation mats that form on the water surface, particularly during low flows, to allow continued movement downstream, and removal of litter from the littoral zone and stream bottom.	Continued to remove litter and dislodge floating vegetation mats from Landa Lake and portions of the Comal River system where Covered Species habitat is present to minimize shading of restored aquatic vegetation, entrainment of material in the 48-inch culvert screen and control gate to the Old Channel, and oxygen consumption in Landa Lake associated with decaying vegetation.	Continue efforts to remove litter and dislodge floating vegetation mats to prevent negative impacts to flow control structures, aquatic restoration reaches, and Covered Species habitat.	N/A
Management of Golf Course Diversions and Operations (EAHCP § 5.2.11)	Develop and implement a Golf Course Management Plan that will include an IPMP designed to target techniques to protect water quality and minimize potential negative effects to the Covered Species. EAHCP § 2.3.4 also defines Covered Activities for spring-fed pool diversions and operation.	Continued to implement existing IPMP and maintained vegetative buffers between the golf course and Landa Lake and the Old Channel of the Comal River to protect water quality. Continued withdraws from the Old Channel for Golf Course irrigation and filling of the spring-fed pool per TCEQ permit #18-3826 and continued to maintain the Spring-fed pool according to the 2003 Comal Ecosystem Management Plan.	Continue to update the IPMP and maintain a vegetative buffer between the golf course and Landa Lake and the Old Channel of the Comal River. The IPMP will be revised, as needed, to address any operational changes associated with the management of the golf course grounds. Continue withdraws from the Old Channel for Golf Course irrigation and filling of the spring-fed pool per TCEQ permit #18-3826 and continue to maintain the Spring-fed pool according to the 2003 Comal Ecosystem Management Plan.	Appendix L5 of the 2018 Annual Report

Table 6.2-1. City of New Braunfels 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Native Riparian Habitat Restoration (Old Channel Improvements) (EAHCP § 5.7.1)	Initiate a riparian restoration program to enhance the riparian zone along the Old Channel, the golf course, and near Clemens Dam.	• Approximately 100,500 ft^2 of riparian area was addressed in 2019. This includes the removal of non-native vegetation and the introduction native vegetation. • 4,452 non-native plants were treated and/ or removed from the riparian areas. • 1,386 plants were transplanted into the riparian areas; 17,148 ft^2 was seeded with a variety of drought and shade tolerant native grasses and forbs. • All activities were carried out according to the approved CONB 2019 Work Plan.	• Continue efforts to increase the coverage and density of native vegetation by planting transplants and seeding within the riparian zones around Landa Lake and at the NBU Headwaters facility. • Continue to maintain previously restored areas to prevent re-establishment of non-native vegetation and promote native vegetation growth. • Continue to install and maintain sediment control structures along the previously restored streambanks. • Continue efforts to treat and remove non-native riparian vegetation from the banks of Landa Lake and from islands located within Landa Lake.	**Section 6.2.5**
Management of Household Hazardous Wastes (EAHCP § 5.7.5)	Continue to implement a Household Hazardous Waste (HHW) program and enhance the program to generate additional participation by the public.	Held three HHW collection events in February, May, and October 2019. Overall, 1,034 cars/participants were recorded and a total of 90,425 pounds (lbs.) of hazardous waste was collected. Partnered with NBU to hold one unused medication collection and disposal event.	Hold three HHW collection events and partner with New Braunfels Utility on the Operation MedSafe drug recovery and collection program.	N/A
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6)	Expand criteria related to desired impervious cover, provide incentives to reduce existing impervious cover on public and private property in New Braunfels, and implement stormwater runoff best management practices around Landa Lake and the spring runs.	Completed the construction of a bio-retention stormwater filtration basin at North Houston Ave. Performed conceptual design for green stormwater retrofits for the Landa Park Aquatics Center parking lot to be implemented in the future.	Design and construct a bio-retention basin at the Headwaters at the Comal facility. Perform engineering design for green stormwater retrofits at the Landa Park Aquatics Center parking lot.	**Section 6.2.6**

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

In 2019, aquatic vegetation restoration activities occurred within Landa Lake, the Old Channel of the Comal River, the Upper Spring Run and the New Channel of the Comal River. Aquatic vegetation restoration activities conducted in 2019 included; 1) removal of non-native, invasive aquatic vegetation (i.e. *Hygrophila*); 2) planting of native aquatic plants; and 3) monitoring, mapping, and gardening of restored areas. **Figure 6.2-1** illustrates the location of LTBG Reaches (Landa Lake, Upper Spring Run, Old Channel and Upper New Channel), outlined in red, and aquatic vegetation restoration reaches, outlined in green. The following subsections include summaries of 2019 aquatic vegetation restoration activities and results for each individual Restoration Reach.

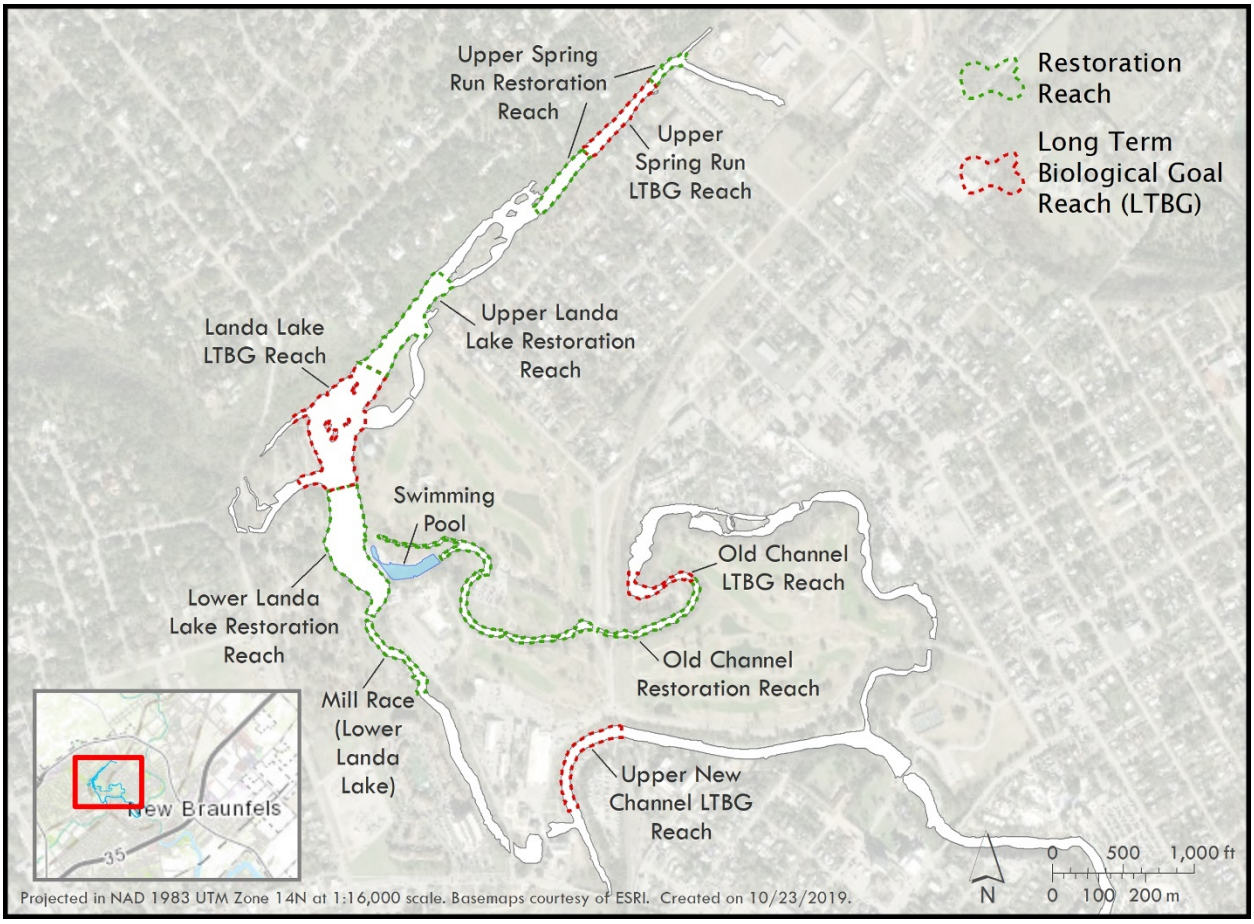

Figure 6.2-1. LTBG reaches and aquatic vegetation restoration reaches within the Comal River system.

6.2.1.1 Old Channel Aquatic Vegetation Restoration Results and Discussion

A total of 1,136 native aquatic plants were planted within three new restoration plots in the Old Channel LTBG Reach in 2019 (**Table 6.2-2**). The plantings encompassed an area of 242 m^2. *Ludwigia* was planted in Plot 19A and *Cabomba* was planted in Plots 19B and 19C (**Figure 6.2-2**). Despite being included as a target species for planting in 2019, *Sagittaria* was not planted to allow for the expansion of *Cabomba* and *Ludwigia*. **Table 6.2-3** presents the total area planted within the Old Channel LTBG Reach and the change in plant coverage between fall 2018 and fall 2019. No aquatic vegetation restoration planting was

scheduled for the Old Channel Restoration Reach in 2019. While no new restoation planting occurred in 2019, the change in plant coverage in this reach between fall 2018 and fall 2019 is presented in **Table 6.2-3**.

Table 6.2-2. Number of Native Plants Planted Within the Comal River System in 2019

Date Planted	Plot	*Ludwigia*	*Sagittaria*	*Cabomba*	*Potamogeton*
2019 Old Channel Restoration Plantings – Old Channel LTBG Reach					
5/22/2019	19A	576	-	-	-
7/18/2019	19B	-	370	-	-
7/26/2019	19C	-	190	-	-
TOTALS		**576**	**560**	-	-
2019 Landa Lake Restoration Plantings – Landa Lake LTBG Reach					
4/10/2019	DD	80	-	-	-
4/11/2019	DD	150	-	-	-
4/26/2019	DD	200	-	-	-
5/13/2019	S	120	-	-	-
5/13/2109	T	120	-	-	-
5/13/2019	A	120	-	-	-
6/4/2019	DD	65	-	-	-
6/6/2019	DD	245	-	-	-
6/7/2019	F	340	-	-	-
6/11/2019	F	50	-	-	-
7/2/2019	19A	288	-	-	-
7/8/2019	19B	300	-	-	-
7/9/2019	19B	288	-	-	-
7/12/2019	19C	192	-	-	-
7/15/2019	19C	200	-	-	-
7/15/2019	19D	-	-	865	-
7/25/2019	19E	240	-	-	-
8/2/2019	19F		-	-	50
8/29/2019	19G	96	-	-	
TOTALS		**3,094**	-	**865**	**50**
2019 Landa Lake Restoration Plantings – Upper Landa Lake Restoration Reach					
7/2/2019	19A	144	-	-	-
7/31/2019	19B	-	-	220	-
TOTALS		**144**	-	**220**	-
2019 Landa Lake Restoration Plantings – Lower Landa Lake Restoration Reach					
7/1/2019	19A	144	-	-	-
TOTAL		**144**	-	-	-
2019 Upper New Channel Restoration Plantings – Upper New Channel LTBG Reach					
8/29/2019	19A	96	-	-	-
TOTAL		**96**	-	-	-
2019 Upper Spring Run Restoration Plantings – Upper Spring Run LTBG Reach					
7/3/2019	19A	144	-	-	-
8/26/2019	19B	96	-	-	-
TOTAL		**240**	-	-	-

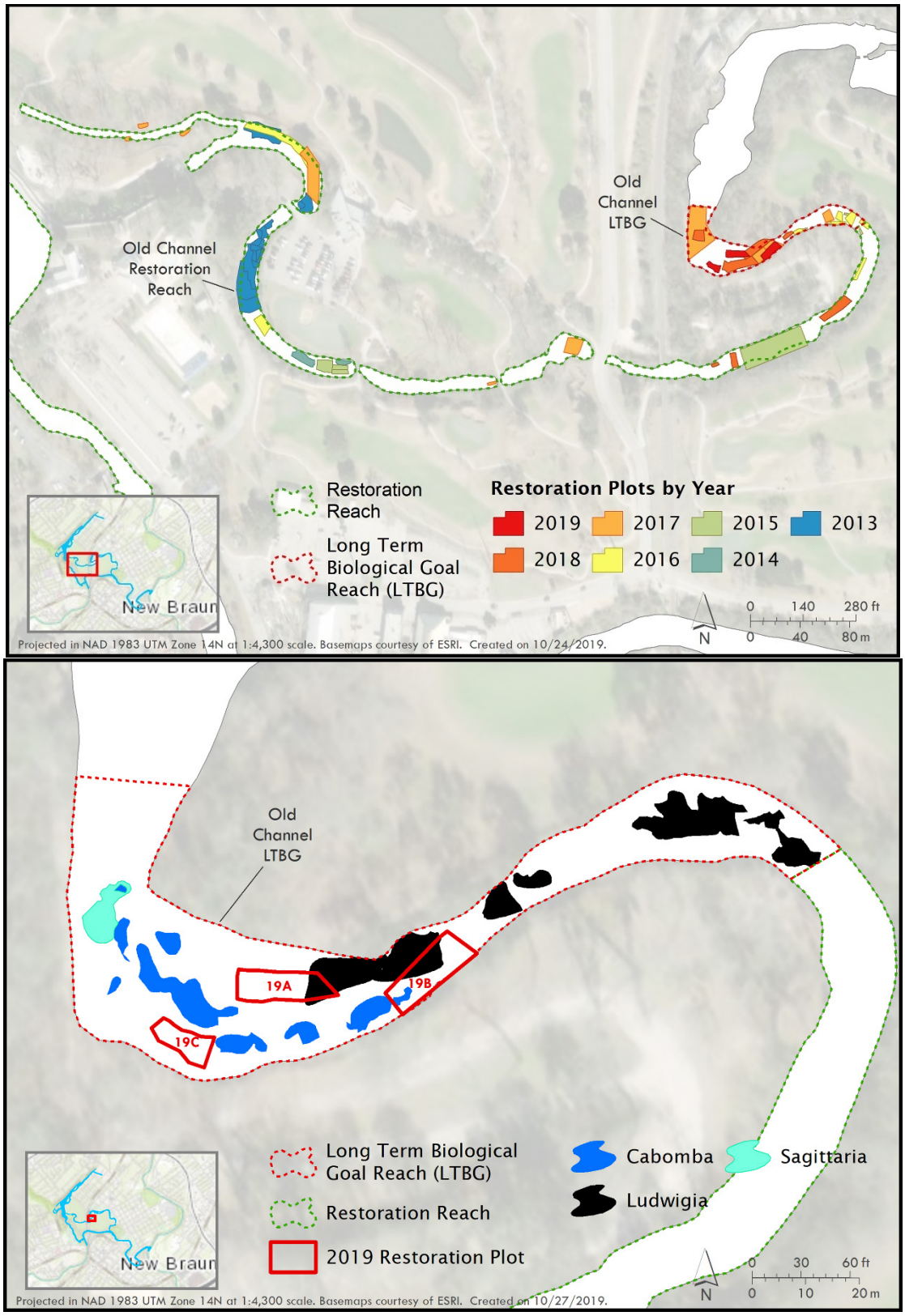

Figure 6.2-2. Aquatic vegetation restoration plots in the Old Channel LTBG and Restoration reaches (upper figure) and 2019 aquatic vegetation restoration plots in Old Channel LTBG Reach (lower figure).

Table 6.2-3. Planted Area and Change in Aquatic Vegetation Coverage in the Comal River System from Fall 2018 to Fall 2019 Mapping Events

Vegetation Type	Total Area Planted in 2019 (m^2)	Plant Coverage Fall 2018 (m^2)	Plant Coverage Fall 2019 (m^2)	Change in Plant Coverage (m^2)
Old Channel LTBG Reach				
Ludwigia	89	239	303	+64
Cabomba	153	112	175	+63
Sagittaria	0	6	30	+24
Old Channel Restoration Reach				
Ludwigia	0	856	622	-234
Cabomba	0	21	15	-6
Sagittaria	0	481	749	+268
Potamogeton	0	570	635	+65
Vallisneria	0	888	905	+17
Landa Lake LTBG Reach				
Ludwigia	316	364	576	+212
Cabomba	100	308	297	-11
Sagittaria	0	2,712	3,733	+1,021
Potamogeton	7	29	24	-5
Vallisneria	0	11,795	12,200	+405
Upper Landa Lake Restoration Reach				
Ludwigia	20	N/A	19	N/A
Cabomba	68	N/A	20	N/A
Sagittaria	0	N/A	473*	N/A
Lower Landa Lake Restoration Reach				
Ludwigia	20	N/A	46	N/A
Cabomba	0	N/A	211	N/A
Sagittaria	0	N/A	21	N/A
Upper New Channel LTBG Reach				
Ludwigia	18	106	133	+27
Cabomba	0	29	30	+1
Upper Spring Run LTBG Reach				
Ludwigia	69	3	16	+13
Cabomba	0	0	0	0
Sagittaria	0	863	1,218	+355

*Coverage exceeds the EAHCP long-term aquatic vegetation coverage goal.
N/A- Aquatic vegetation mapping was not conducted in Upper and Lower Landa Lake Restoration reaches in fall 2018.

6.2.1.2 Landa Lake Aquatic Vegetation Restoration Results and Discussion

A total of 4,009 native aquatic plants were planted in the Landa Lake LTBG Reach in 2019 (**Table 6.2-2**). An area of 423 m^2 was planted in five restoration plots. Of the 4,009 plants planted, 1,490 were planted as supplemental plantings into existing plots and 2,519 plants were planted into new restoration plots (**Figure 6.2-3**). A total of 364 aquatic plants were planted within two restoration plots comprising 88 m^2 in the Upper Landa Lake Restoration Reach (**Table 6.2-2** and **Figure 6.2-4**). A total of 144 aquatic plants were planted in the Lower Landa Lake Restoration Reach within a single restoration plot comprising 20 m^2 (**Table 6.2-2** and **Figure 6.2-5**). **Table 6.2-3** presents the total area planted within the Landa Lake LTBG and Restoration reaches as well as the change in plant coverage between fall 2018 and fall 2019.

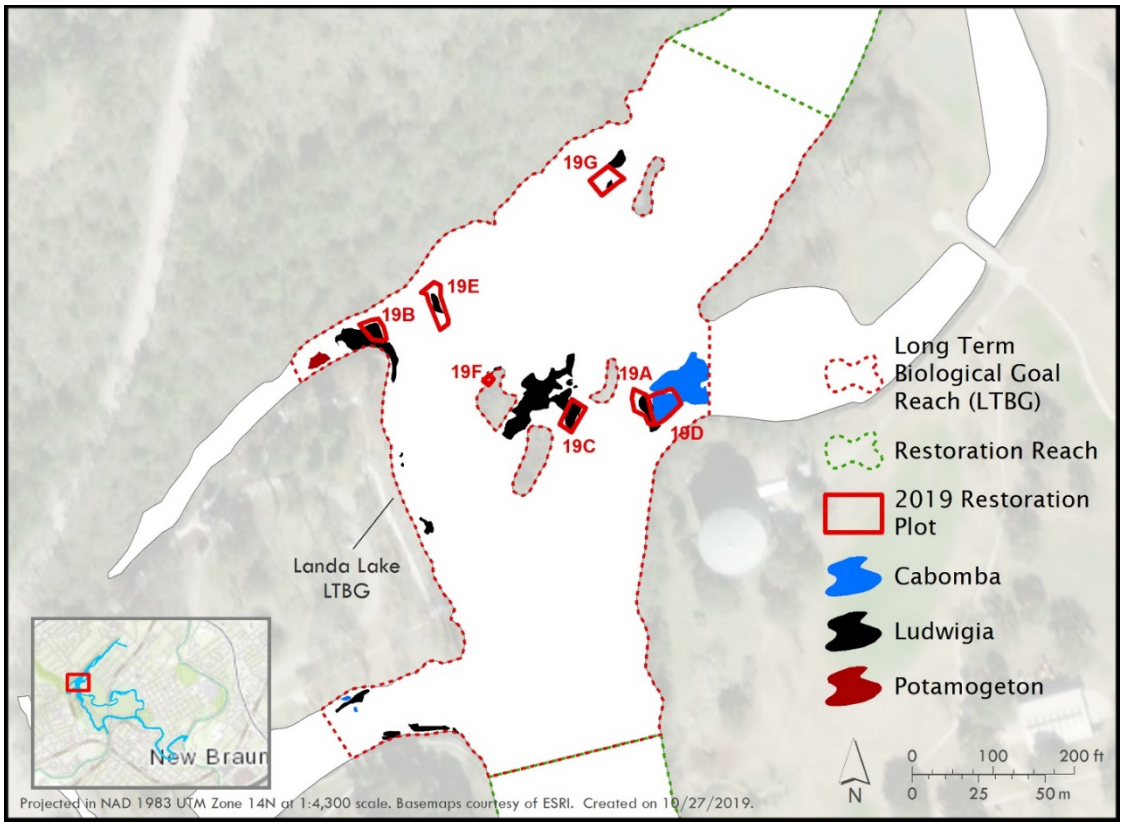

Figure 6.2-3. Map of restoration plots in Landa Lake LTBG Reach.

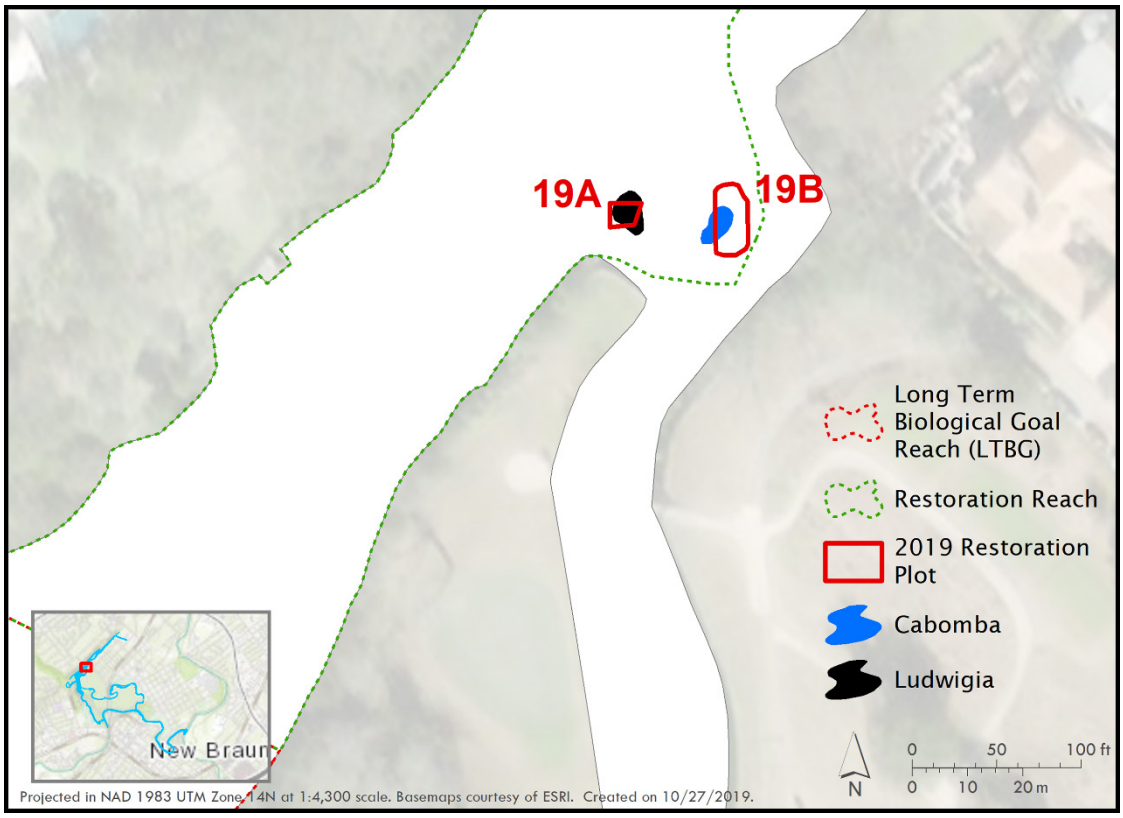

Figure 6.2-4. Map of restoration plots in Upper Landa Lake Restoration Reach.

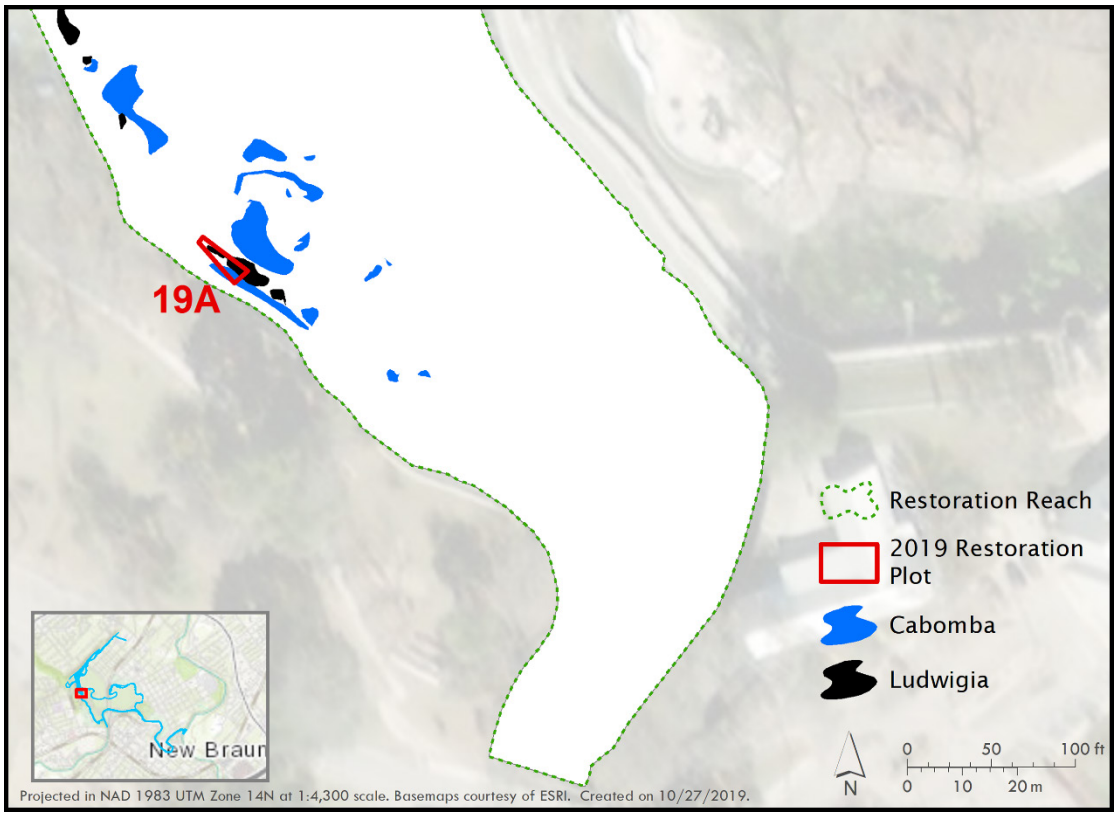

Figure 6.2-5. Map of restoration plots in Lower Landa Lake Restoration Reach.

6.2.1.3 Upper New Channel Aquatic Vegetation Restoration Results and Discussion

A total of 96 *Ludwigia* plants were planted in the Upper New Channel LTBG Reach within a single restoration plot comprising 18 m^2 (**Figure 6.2-6** and **Table 6.2-2**). **Table 6.2-3** presents the total area planted within the Upper New Channel LTBG reach as well as the change in plant coverage between fall 2018 and fall 2019.

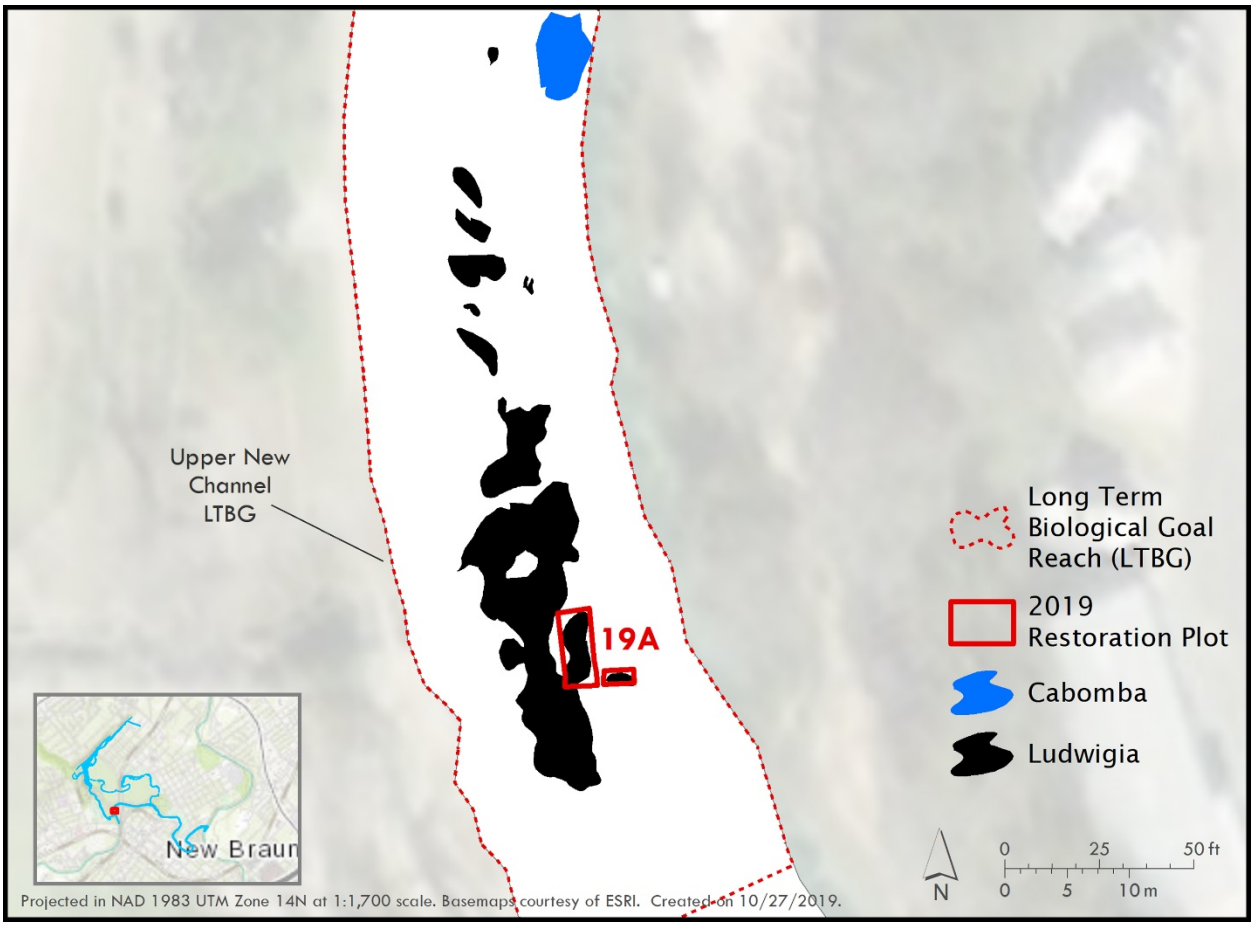

Figure 6.2-6. Map of the restoration plot in Upper New Channel LTBG Reach.

6.2.1.4 Upper Spring Run Aquatic Vegetation Restoration Results and Discussion

A total of 240 *Ludwigia* plants were planted in the Upper Spring Run LTBG Reach within two restoration plots comprising 69 m^2 (**Figure 6.2-7** and **Table 6.2-2**). **Table 6.2-3** presents the total area planted within the Upper Spring Run LTBG reach as well as the change in plant coverage between fall 2018 and fall 2019.

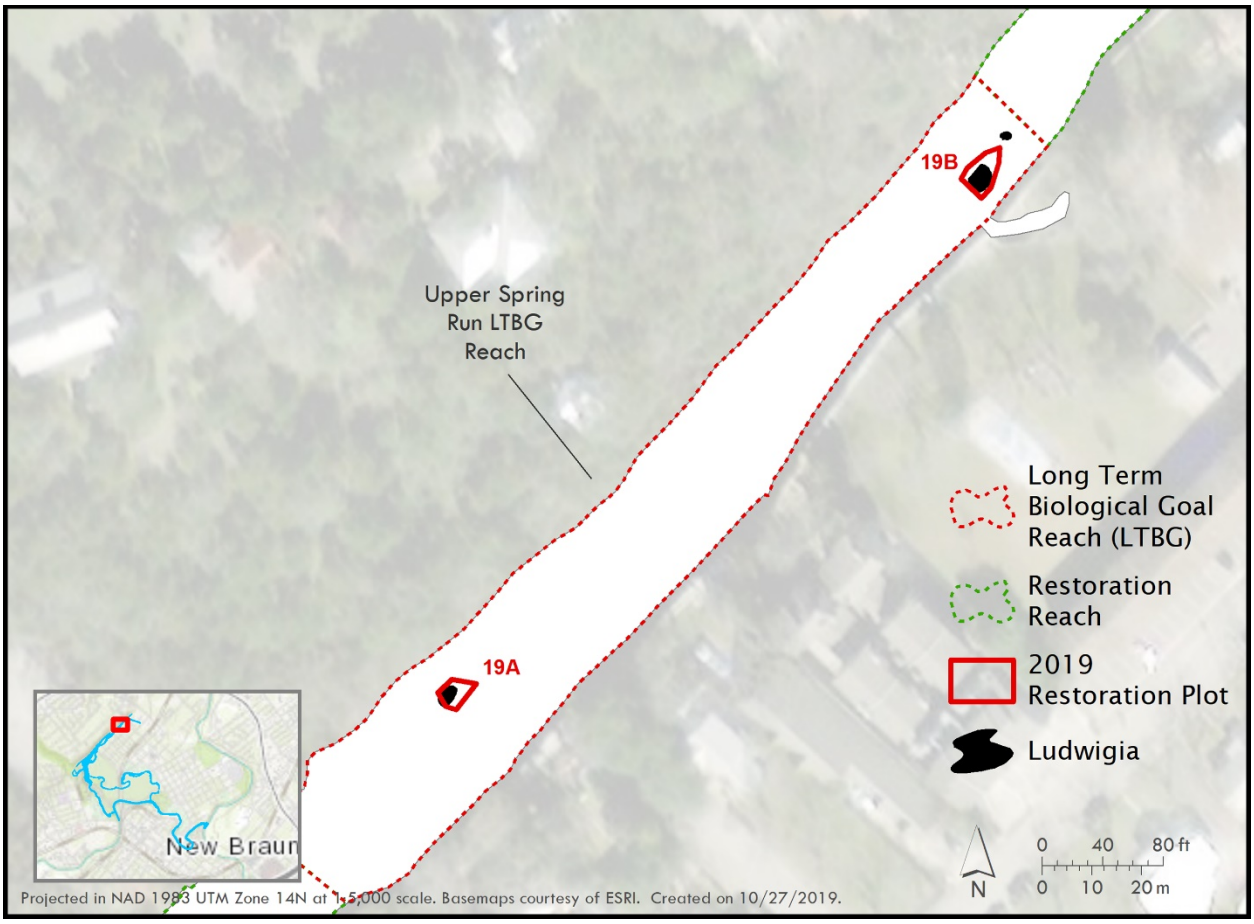

Figure 6.2-7. Map of the restoration plot in Upper Spring Run LTBG Reach.

6.2.1.5 Non-Native Aquatic Vegetation Removal Results and Discussion (Miscellaneous Reaches)

As a result of previous efforts to remove non-native *Hygrophila* from the various LTBG and Restoration reaches, only isolated patches and fragments of *Hygrophila* were identified during the baseline aquatic vegetation mapping that occurred in February 2019 (**Figure 6.2-8**). With the exception of the Upper New Channel Restoration Reach where significant *Hygrophila* coverage exists, total *Hygrophila* coverage from Blieders Creek through Landa Lake, and to the end of the Old Channel LTBG Reach, was less than 20 m^2. Routine inspection and non-native vegetation removal sessions occurred throughout 2019 to remove re-emergent non-native vegetation. All non-native vegetation identified in 2019 in the Old Channel and Upper Spring Run was removed.

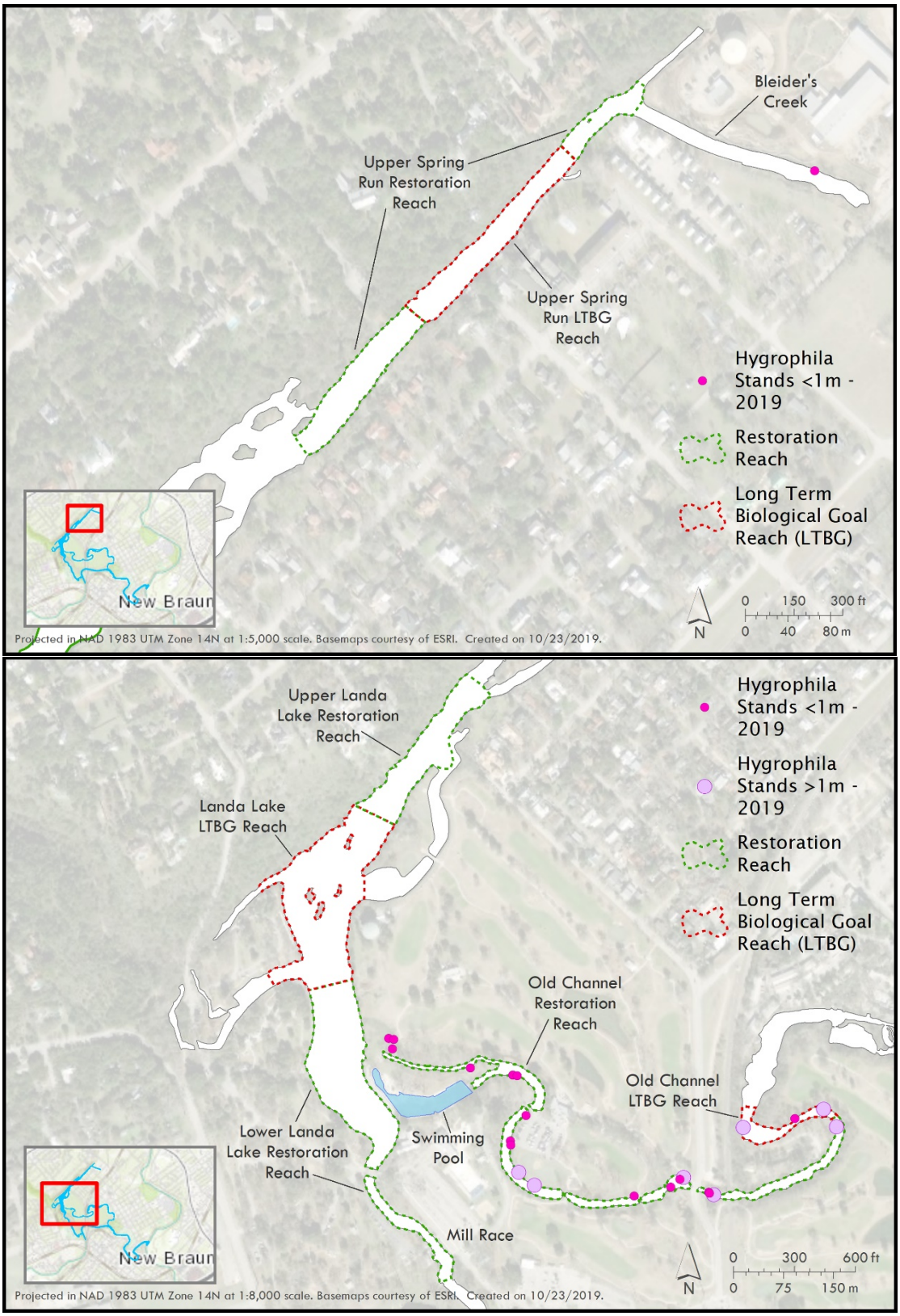

Figure 6.2-8. Map of baseline distribution of *Hygrophila* prior to 2019 removal activities, February 2019.

A full report regarding aquatic plant restoration activities in the Comal River system is included as **Appendix L1** of this Annual Report.

Compliance for this Conservation Measure is based on total coverage of fountain darter habitat in m^2 specified in Table 4-1 of the EAHCP. The overall status of aquatic vegetation coverage and 2019 restoration efforts are summarized in **Table 6.2-4**.

Table 6.2-4. Comal Long-Term Biological Goal and Restoration Reach Fountain Darter Habitat (Aquatic Vegetation) Status in m^2

Reach	Aquatic Vegetation Species	Native Aquatic Vegetation Coverage (m^2)				
		Fall 2018	Fall 2019	Gain / (Loss)	Total Planted Area (2019)	EAHCP Long-Term Program Goal
LTBG Reaches						
Old Channel	*Ludwigia*	239	303	64	89	425
	Cabomba	112	175	63	153	180
	Sagittaria	6	30	24	0	450
Landa Lake	*Ludwigia*	364	576	212	316	900
	Cabomba	308	297	(11)	100	500
	Vallisneria	11,795	12,200	405	0	12,500
	Potamogeton	29	24	(5)	7	25
New Channel	*Ludwigia*	106	133	27	0	100
	Cabomba	29	30	1	0	2,500
Upper Spring Run	*Ludwigia*	3	16	13	69	25
	Cabomba	0	0	0	0	25
	Sagittaria	863	1,218	355	0	850
Restoration Reaches						
Old Channel	*Ludwigia*	856	622	-234	0	850
	Cabomba	21	15	-6	0	200
	Sagittaria	481	749	+268	0	750
	Potamogeton	570	635	+65	0	100
	Vallisneria	888	905	+17	0	750
Landa Lake Upper	*Ludwigia*	N/A*	19	N/A	20	25
	Cabomba	N/A*	20	N/A	68	250
	Sagittaria	N/A*	473	N/A	0	250
Landa Lake Lower	*Ludwigia*	N/A*	46	N/A	20	50
	Cabomba	N/A*	211	N/A	20	125
	Sagittaria	N/A*	21	N/A	0	100

* These sections were not mapped in 2018.

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

The CONB continued to implement a non-native animal species removal program focused on tilapia (*Oreochromis sp.*), nutria (*Myocastor coypus*) and vermiculated sailfin catfish (family Loricariidae). Divers used spears and spearguns to capture fish species. Nutria were captured using baited box traps. **Table 6.2-5** summarizes the number of non-native animal species removed from the Comal River system

in 2019. Tilapia were captured primarily in the main body of Landa Lake while sailfin catfish were captured primarily in the lower portion of Landa Lake. Nutria were captured primarily around Landa Lake, in the Upper Spring Run area and along Blieders Creek.

Table 6.2-5. Summary of Non-Native Animal Species Removal (February – December 2019)

Species	Number Removed	Biomass (lbs.)	Average Biomass (lbs./individual)
Vermiculated Sailfin Catfish	89	222.19	2.50
Tilapia	1,558	4684.04	3.00
Nutria	33	203.6	6.17
TOTALS	**1,680**	**5,109.83**	**-**

6.2.3 Monitoring and Reduction of Gill Parasites (EAHCP §§ 5.2.6 and 6.3.6)

Water-column gill parasite monitoring of free-swimming cercaria concentrations of the gill parasite (*Centrocestus formosanus*) and *Haplorchis pumilio* was conducted in 2019. Monitoring was conducted August 20-21, 2019 at three previously established long-term monitoring transects as well as one new transect. The monitoring sites include Landa Lake outflow (LL), Old Channel at Elizabeth Avenue (OCR), New Channel at Landa RV Park (RVP) and Pecan Island Slough (PI) (**Figure 6.2-9**).

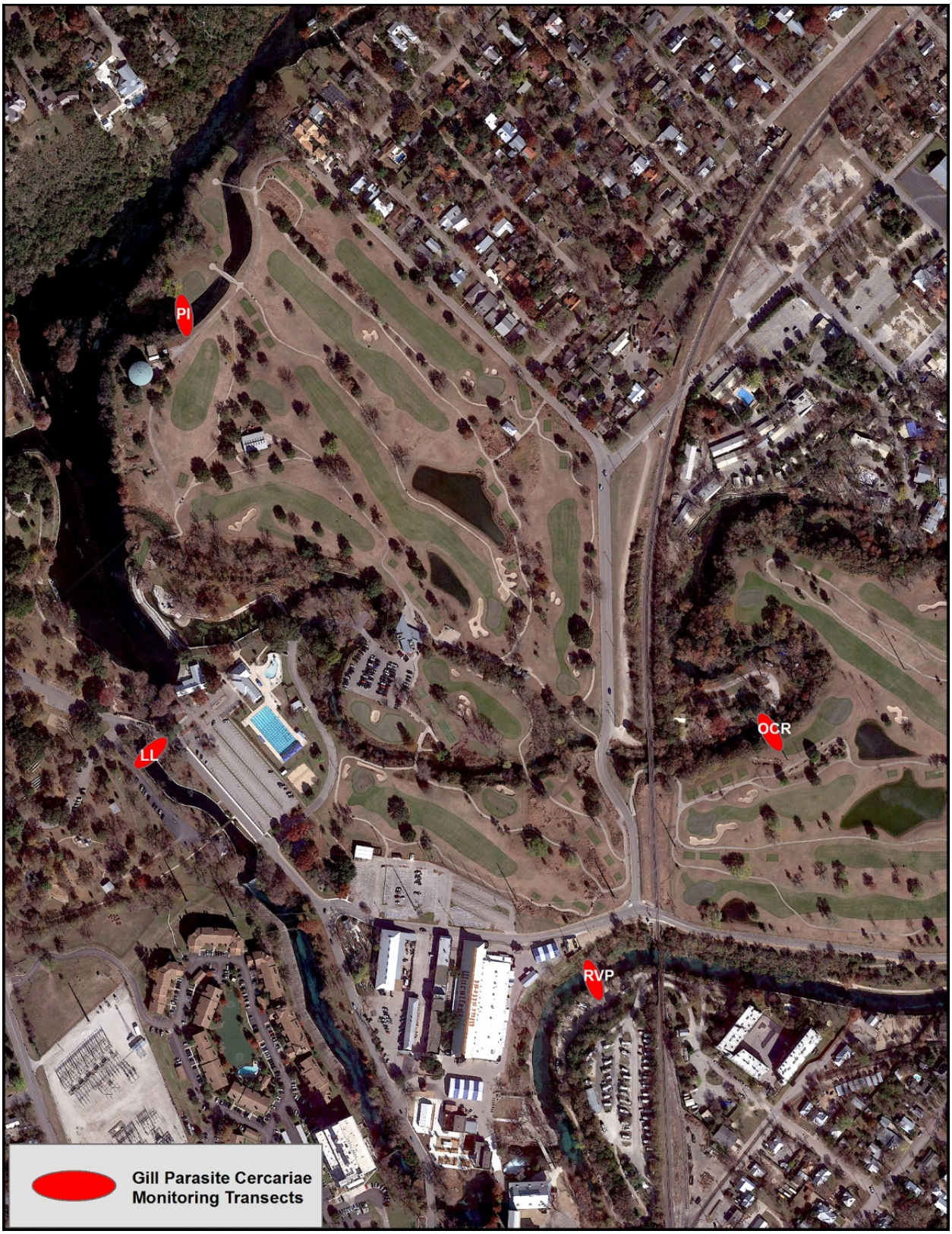

Figure 6.2-9. Location of cross-sections where water column monitoring of free-swimming cercaria occurred in August 2019.

Annual density estimates for *C. formosanus* and *H. pumilio* have generally declined since the inception of cercaria monitoring (**Figure 6.2-10**). No distinct patterns in seasonality are evident based on data collected from multiple seasons during 2014 – 2019. However, there is evidence of a relationship between system discharge and cercariae density with most sites showing a decrease in cercariae density under high flow conditions. Assuming a constant number of cercaria produced, higher springflow volumes logically result in dilution of cercaria concentrations. Other factors may be influencing the number of cercariae produced, and it remains to be seen if cercaria concentrations will return to those observed in 2014 during future low-flow years. Additional monitoring under varying flow conditions is important to determine if long-term decreases in cercariae concentrations are purely flow-driven, or if a reduction in cercaria production has occurred in recent years.

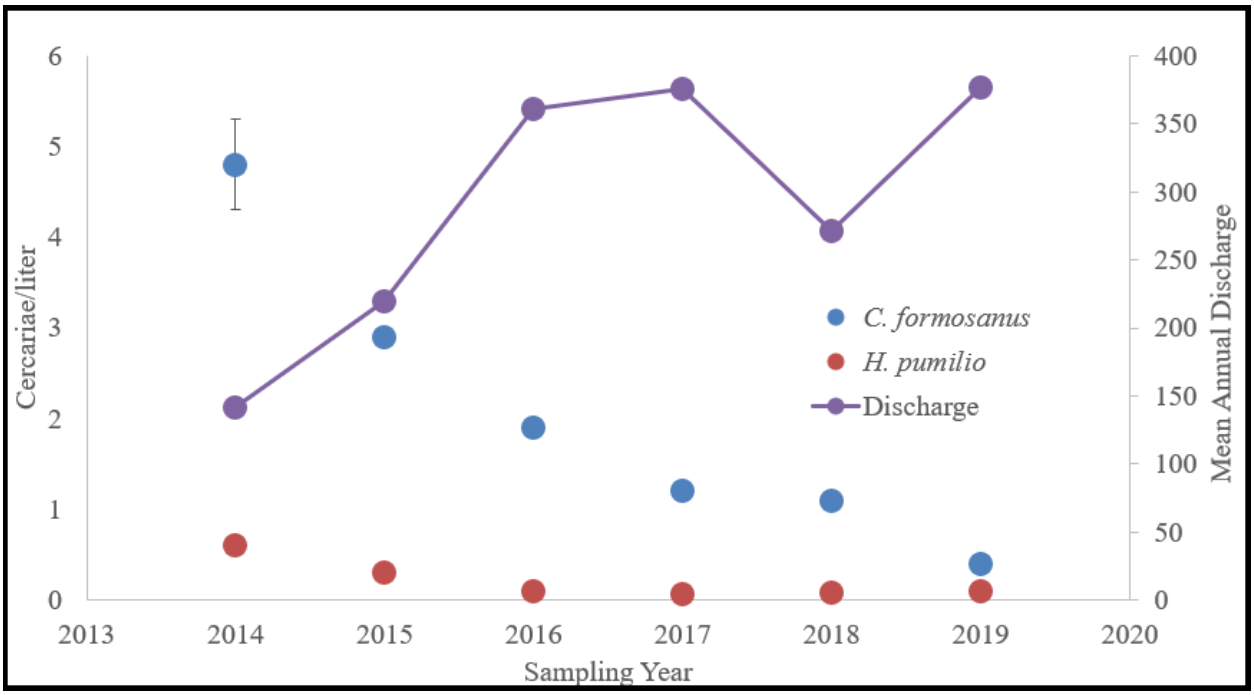

Figure 6.2-10. Overall annual average cercaria density for *C. formosanus* and *H. pumilio* (2014 – 2019).

A technical memorandum summarizing 2019 parasite monitoring results and methods is included as **Appendix L2** of this report.

6.2.4 Native Riparian Habitat Restoration (Riffle Beetle) (EAHCP § 5.2.8)

In 2019, effort was taken to maintain and increase the density of native riparian vegetation within the riparian buffer that was initially established along the southeast side of Spring Run #3 in 2018.

A total of 867 native plants were planted along the length of the riparian buffer area in 2019. A listing of the number and varieties of plantings is included in **Table 6.2-6**. Pre- and post-project photos are included as **Figure 6.2-11** and **Figure 6.2-12**. Native plants appear to be establishing well and will help to stabilize banks and filter stormwater runoff.

Table 6.2-6. Species and Quantities of Native Plants Planted Within the Riparian Buffer Area Along the Southeast Side of Spring Run #3 in 2019

Date Planted	Plant Species	Quantity Planted
4/19/2019	Chile pequin *(Capsicum annuum)*	20
4/19/2019	Coralberry *(Symphoricarpus orbiculatus)*	5
4/19/2019	Fall aster *(Symphyotrichum oblongifolium)*	20
4/19/2019	Inland seaoats *(Chasmanthium latifolium)*	30
4/19/2019	Wax mallow *(Malvaviscus drummondii)*	30
4/19/2019	Buttonbush *(Cephalanthus occidentalis)*	5
4/19/2019	Mealy blue salvia *(Salvia farinacea)*	3
4/19/2019	Golden columbine *(Aquilegia chrysantha)*	20
4/19/2019	Red columbine (*Aquilegia canadensis)*	10
4/19/2019	Yellow bidens *(Bidens laevis)*	30
4/19/2019	Clover fern *(Marsilea macropoda)*	20
4/19/2019	Inland seaoats *(Chasmanthium latifolium)*	30
4/19/2019	Big muhly *(Muhlenbergia lindheimeri)*	30
4/19/2019	Bushy bluestem *(Andropogon glomeratus)*	10
4/19/2019	Wood sedge *(Carex blanda)*	20
4/19/2019	Deer muhly *(Muhlenbergia rigens)*	20
4/19/2019	White topped sedge *(Rynchospora colorata)*	20
10/11/2019	Wax mallow *(Malvaviscus drummondii)*	40
10/11/2019	Fragrant mistflower (*Eupatorium havanensis)*	40
10/11/2019	Frogfruit *(Lippia nodiflora)*	40
10/11/2019	Canadian goldenrod *(Solidago canadensis)*	5
10/11/2019	Emory sedge *(Carex emoryi)*	300
10/11/2019	Inland seaoats *(Chasmanthium latifolium)*	40
10/11/2019	Indian grass *(Sorghastrum nutans)*	5
12/12/2019	Texas lantana (*Lantana urticoides*)	40
12/12/2019	Big muhly (*Muhlenbergia lindheimeri*)	24
12/12/2019	Little bluestem (*Schizachyrium scoparium*)	10
	TOTAL PLANTED	**867**

Figure 6.2-11. Photo of Spring Run #3 area prior to installation of riparian buffer zone.

Figure 6.2-12. Photos taken in October 2019 depicting Spring Run #3 riparian buffer area.

In addition to planting and maintenance of the riparian buffer area along the southeast side of Spring Run #3, erosion control measures along the opposite side of the spring run and along the western shoreline of Landa Lake were maintained and/or installed to capture sediment and minimize sedimentation in the spring run.

6.2.5 Native Riparian Habitat Restoration (Old Channel Improvements) (EAHCP § 5.7.1)

The primary riparian habitat restoration activities that occurred in 2019 included removal and control of non-native riparian vegetation along the Old Channel of the Comal River and the banks of Landa Lake, establishment of native vegetation in areas where non-native vegetation was previously treated/removed and reestablishment of native vegetation in areas where the existing vegetation was damaged due to high traffic from wildlife and pedestrians.

Non-native species targeted in 2019 included elephant ear (*Colocasia* sp.), privet (*Ligustrum* sp.), Chinese tallow (*Triadica sebifera*), giant cane (*Arundo donax*), and chinaberry (*Melia azedarach*). Several areas along the banks of Landa Lake and the segment of the Old Channel from Elizabeth Street through the Old Channel LTBG Reach received varying levels of non-native vegetation treatment and riparian zone restoration as discussed in the CONB 2019 Work Plan (**Appendix J2**).

1) **Restoration Area A – Comal County Water Recreation District and Landa Lake:** The CONB began discussions with the Comal County Water Recreation District #1 (CCWRD) in 2018 to gain permission to perform riparian restoration activities on property owned by the district. The work area for 2019 is part of 9.46 acres owned and managed by the CCWRD, which consists of six to ten feet of the riparian zone along the banks of Landa Lake and the "Island", a one-acre island utilized for recreation by the residents in the neighborhood. Much of the shoreline is covered with elephant ear plants as well as sporadic Ligustrum and Chinese tallows mixed in with the native trees and shrubs. In 2019, the CONB began to address the non-native vegetation in an area at the southernmost end of the CCWRD property. This project site is considered a test plot to showcase for the residents of the adjacent neighborhood what the restoration efforts will look like once non-native vegetation species removal has occurred and native vegetation has been established**.**
2) **Restoration Area B – Landa Park:** Two locations were selected in Landa Park for riparian restoration. The restoration areas were immediately adjacent to Spring Run #1 and Landa Lake. These two areas were selected due to their proximity to the Spring Run and Landa Lake, and the abundance of denuded vegetation caused by high levels of pedestrian and wildlife traffic. Both locations are highly shaded requiring a specific selection of transplants and seed that are shade tolerant. Restoration of these areas included incorporation of soil amendments, tilling, distribution of shade-tolerant native grass seed and planting of native plants. Temporary fencing was also installed to limit pedestrian traffic through the restoration areas. Approximately 17,400 ft^2 was restored in these areas in 2019 (**Figure 6.2-13**).
3) **Restoration Area C – Old Channel Restoration – Elizabeth Street through the Old Channel LTBG Reach:** Non-native vegetation control work in this area began in 2017 and continued through 2018. In late 2018, work began to plant native vegetation in this project area. In 2019, a

major effort was made to complete removal of non-native vegetation, especially in the northernmost section of the project area where a large stand of mature Ligustrum trees were located. The area closest to Elizabeth Street was cleared of a large stand of giant cane and replaced with concentrated plantings of native vegetation and erosion control berms.

The coverage and density of native vegetation was increased in all riparian restoration locations in 2019 via supplemental planting and seeding of native species. The species and the total number of transplants planted are described in **Table 6.2-7**.

In 2020, the coverage and density of native vegetation in the riparian zones along the banks of Landa Lake and the NBU Headwaters facility, located at the confluence of Blieders Creek and the Upper Spring Run, will be increased with continued planting efforts. Non-native vegetation will continue to be removed along the banks of Landa Lake on property owned by the CCRWD. Erosion controls measures will replace these non-native species while native plant species become established.

Figure 6.2-13. Before and after photographs of southern riparian restoration area in Landa Park.

Table 6.2-7. Species and Quantities of Native Plants Planted in Riparian Restoration Areas in 2019

Common Name	Scientific Name	Quantity Planted
Alamo vine	*Merremia dissecta*	2
American beautyberry	*Callicarpa americana*	29
Bear grass	*Nolina lindheimeriana*	7
Bushy bluestem	*Andropogon glomeratus*	8
Buttonbush	*Cephalanthus occidentalis*	7
Carolina buckthorn	*Frangula caroliniana*	8
Coralbean	*Erythrina herbacea*	6
Coralberry	*Symphoricarpos orbiculatus*	6
Eastern redbud	*Cercis canadensis*	12
Eastern red cedar	*Juniperus virginiana*	9
Elderberry	*Sambucus nigra*	58
Emory's sedge	*Carex emoryi*	20
Eve's necklace	*Styphnolobium affine*	2
Fall aster	*Symphyotrichum oblongifolium*	18
False indigo bush	*Amorpha fruticosa*	6
Fragrant mistflower	*Chromolaena odorata*	1
Gray golden-aster	*Heterotheca canescens*	1
Green ash	*Fraxinus pennsylvanica*	7
Heartleaf skullcap	*Scutellaria ovata*	8
Hinckley columbine	*Aquilegia chrysantha var. hinckleyana*	1
Honey locust	*Gleditsia triacanthos*	4
Scouringrush horsetail	*Equisetum hyemale*	320
Inland sea oats	*Chasmanthium latifolium*	117
Lindheimer's marsh fern	*Thelypteris ovata var. lindheimeri*	25
Lindheimer muhly	*Muhlenbergia lindheimeri*	312
Little bluestem	*Schizachyrium scoparium*	50
Lyre leaf sage	*Salvia lyrata*	4
Upright prairie coneflower	*Ratibida columnifera*	4
Orange zexmenia	*Wedelia acapulcensis var. hispida*	56
Palmetto	*Sabal minor*	15
Pigeonberry	*Rivina humilis*	36
Possumhaw	*Ilex decidua*	2
Prairie verbena	*Glandularia bipinnatifida*	6
Purple sage	*Leucophyllum frutescens*	2
Rain lily	*Cooperia drummondii*	3
Red buckeye	*Aesculus pavia*	4
Red yucca	*Hesperaloe parviflora*	1
Roughleaf dogwood	*Cornus drummondii*	3
Straggler daisy	*Calyptocarpus vialis*	1
Sycamore	*Platanus occidentalis*	7
Texas mountain laurel	*Sophora secundiflora*	18
Texas sage	*Salvia texana*	44
Tropical sage	*Salvia coccinea*	5
Turk's cap	*Malvaviscus arboreus*	91
Virginia creeper	*Parthenocissus quinquefolia*	4
American water-willow	*Justicia americana*	12
Woolly stemodia	*Stemodia lanata*	5
Yaupon	*Ilex vomitoria*	1
Yellow bells	*Tecoma stans*	18
TOTAL NUMBER OF PLANTS PLANTED		1,386

Maintenance will continue in areas where non-native riparian vegetation was removed in previous years to prevent re-establishment. CONB staff will continue to monitor and maintain previously planted areas to promote permanent establishment and growth of native vegetation. Maintenance of restored areas in Landa Park will include the installation of permanent fencing, as needed, to prevent disturbance of restored areas by park visitors.

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

A bio-retention basin was constructed at the end of North Houston Avenue to intercept, infiltrate, and filter stormwater runoff from adjacent roadways prior to entering the Upper Spring Run of Landa Lake. The basin was vegetated with grasses and native plants to stabilize the basin and to filter pollutants in stormwater runoff entering the basin. Plantings within the basin are well established and endured a three-month period without rain. **Figure 6.2-14** depicts the bio-retention basin in October 2019.

A conceptual design plan was also developed in order to evaluate the feasibility and costs associated with installation of green stormwater retrofits in the Landa Park Aquatics Center parking lot, a 1.5-acre parking lot immediately adjacent to the Mill Race portion of the Comal River.

Figure 6.2-14. Photos showing bio-retention basin constructed at North Houston Avenue adjacent to Upper Spring Run of Landa Lake.

6.3 City of San Marcos

The COSM is responsible for implementation of the measures under the EAHCP listed in **Table 6.3-1**. Implementation of these measures has been accomplished in partnership with Texas State, as specified in the EAHCP, to maintain consistency implementing these measures that jointly affect the Covered Species and their habitats in the San Marcos River. Work Plans and Funding Applications for 2019 program activities and 2020 proposed program activities are included as **Appendix J3** and **Appendix J6,** respectively.

Table 6.3-1. City of San Marcos 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Texas wild-rice Enhancement and Restoration (EAHCP §§ 5.3.1 and 6.3.5)	Identify areas of optimal habitat for *Zizania texana* (Texas wild-rice) and target those areas for removal of non-native submerged aquatic vegetation (SAV) species, propagation and planting guided by Table 34 of the *Submerged Aquatic Vegetation Analysis and Recommendation Report* (BIO-WEST and Watershed Systems Services 2016)(SAV Report), and continual monitoring of new and existing stands.	753.5 ft^2 (70 m^2) of Texas wild-rice was planted in two reaches – City Park and Upper Interstate Highway (IH)-35. Existing stands of Texas wild-rice were maintained by removal of non-native vegetation in and around stands of Texas wild-rice.	Spring Lake, Cypress Island, IH-35 combined and below IH-35 reaches will be planted according to the annual goals listed in Table 34 of the SAV Report; efforts will focus on monitoring and maintenance in reaches where goals have been achieved.	**Section 6.3.1** and **Appendix M1**
Management of Recreation in Key Areas (EAHCP § 5.3.2)	Continue to implement recreation mitigation measures approved by the City of San Marcos Resolution 2011-21, which include, but are not limited to, implementing buffer zones around designated recreation areas, developing and implementing a robust river education program, addressing the accumulation of silt in the river through watershed controls, reducing recreational impacts that harm the river (such as litter), and issuing COIs to river outfitters to extend the protections of the ITP to those entities.	The Conservation Crew (CC) held 1,101 conversations with river users and removed 3,073 cubic feet (ft^3) of litter from the river and 4,459 ft^3 from the river parks during the recreation season. Public education activities included public service announcements, youth events and conversations with river users. The CC also removed floating plant mats.	In 2020, the COSM will continue implementation of recreational management goals and will continue to educate the public engaged in water-based recreation on sustainable river use that protects the Covered Species and their habitats. To help achieve this goal, a litter-based survey will be developed and implemented to start catching trends and educate the public. The seasonal workers will also conduct continuous litter removal and EAHCP project maintenance while walking/kayaking. The COSM will add a static CC presence at Clear Springs to enforce the Texas wild-rice exclusion zones and minimize the impacts occurring to San Marcos salamanders in the eastern spillway.	**Appendix M2**
Management of Aquatic Vegetation and Litter Below Sewell Park (EAHCP § 5.3.3)	Dislodge and remove floating vegetation mats and remove inorganic litter regularly.	Removed 249 ft^3 pounds of litter and 15,927 ft^3 of floating vegetation mats.	Continue to implement current removal efforts.	**Appendix M1**

Table 6.3-1. City of San Marcos 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (EAHCP § 5.3.4)	Designate routes for the transportation of HAZMAT that will minimize the potential for impacts to the San Marcos River and its tributaries.	COSM revised the HAZMAT route based on Texas Department of Transportation (TxDOT) review that indicated that the route on the east side of the San Marcos River should only follow state roads. The west side route, using Wonder World Drive, did meet requirements and will be pursued.	The Wonder World Drive route will be submitted for approval to TxDOT as a HAZMAT route.	N/A
Reduction of Non-Native Species Introduction (EAHCP § 5.3.5)	Establish an education campaign targeted at reducing the introduction of non-native species and provide people with disposal sites for unwanted aquatic animals and plants to deter aquarium dumps into waterbodies.	Education and outreach efforts included: placing flyers in dorms; signage and making presentations describing harm caused by releasing non-native fish; advertising at city and university sponsored events; conducting a polespear tournament; using social media; using websites. Also, the donation drop-off at the Discovery Center received 43 unwanted fish with 70 percent being adopted.	Continue to implement current efforts.	N/A
Sediment Removal Below Sewell Park (EAHCP § 5.3.6)	Remove sediment from the San Marcos River between City Park and IH-35; efforts specifically targeted for Texas wild-rice habitat.	No sediment was removed in 2019.	No sediment removal activities will occur in 2020.	N/A
Designation of Permanent Access Points and Bank Stabilization (EAHCP § 5.3.7)	Stabilize banks and maintain a healthy riparian buffer in City Park, at the Hopkins Street underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and at the Cheatham Street underpass using stone terraces and native vegetation along the riparian zone to include permanent access points to the river where possible.	Eight access points were monitored. Four points exhibited undermining with only Dog Beach access point exhibiting significant undermining. In October, the front row of boulders in the center section separated from the structure and will require repairs.	Access points will be monitored semiannually through measurements of undermining and gaps between rocks.	**Appendix M3**
Control of Non-Native Plant Species (EAHCP § 5.3.8)	Develop and implement a non-native plant removal program from Spring Lake downstream to the city boundary to remove and replace aquatic, littoral, and riparian non-native plant species with native species covering a minimum of 15 meters (m) of the riparian zone, where possible.	From Sink Creek at Bert Brown crossing to Capes' Dam, over 100 yards (yds) of initial treatment of littoral invasive non-native plants was accomplished. For non-native SAV removal, see **Table 6.3-4** and **Table 6.3-6**	Continue to remove non-native vegetation and plant native aquatic and littoral vegetation. Aquatic plant restoration efforts will seek to achieve the long-term goals of native aquatic plant species as defined by Table 34 of the SAV Report.	**Section 6.3.2**, **Appendix M1**, **Appendix M4**, and **Appendix M5**

Table 6.3-1. City of San Marcos 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Control of Harmful Non-Native and Predator Species (EAHCP § 5.3.9)	Implement a non-native species control program that targets the suckermouth armored catfish (Loricariidae), tilapia (*Oreochromis species* (spp.)), red-rimmed melania (*Melanoides tuberculata*), and the giant ramshorn snail *(Marisa cornuarietis)* and conduct annual monitoring and maintenance to ensure continued control of invasive species.	Performed routine removal sessions throughout the year to remove non-native fish and animal species (**Table 6.3-7**).	Regular removal of the tilapia, suckermouth catfish, and snails will continue with monthly monitoring and bi-annual tournaments.	**Section 6.3.3**, **Table 6.3-7,** and **Table 6.3-8**
Native Riparian Habitat Restoration (EAHCP § 5.7.1)	Restore riparian habitats with native species on COSM and Texas State property from Clear Springs to Stokes Island, and establish a program for private landowners to implement riparian restoration with the opportunity for reimbursement.	Removed and treated invasive re-growth from Sewell Park to Capes Dam and portions of San Marcos River tributaries.	Maintenance of riparian areas from Clear Springs to Stokes Park will continue. The COSM will continue to focus on restoration of public areas with volunteer groups.	**Section 6.3.4** and **Appendix M6**
Septic System Registration and Permitting Program (EAHCP § 5.7.3)	Establish a registration, evaluation, and permitting program for aerobic and anaerobic septic systems.	As of December 31, 2019, 619 septic systems were registered within the COSM's jurisdiction according to the San Marcos Environmental Health Department; eight new regulated septic systems were added in 2019.	Continue to implement septic system registration and permitting program (COSM Ordinance, Section 86.152).	N/A
Minimizing Impacts of Contaminated Runoff (EAHCP § 5.7.4)	Excavate and stabilize two areas for the construction of two water quality best management practices (BMPs) in the vicinity of the San Marcos River and regularly monitor these BMPs.	Two water quality BMPs (City Park Pond and Downtown Pond) were completed, or nearly completed, in two of the riverside parks.	All activities and funds associated with this Conservation Measure have been completed.	N/A
Management of HHW (EAHCP § 5.7.5)	Continue to expand the existing HHW program and offer collection locations available to the public.	Drop-off center hosted 175 participants per month. The reuse center hosted 62 customers per month and disposed of 160,000 lbs. of HHW.	Increase participation rates and continue to enhance awareness of the impact of HHW on the environment, particularly Covered Species habitat.	**Appendix M7**
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6)	Establish a program to protect water quality and reduce the impact of impervious cover based on recommendations from the San Marcos Water Quality Protection Plan.	City Park biofiltration pond construction completed and Downtown Pond construction and Sessom Creek Restoration channel design nearly completed.	Complete construction of the Downtown Pond and manage the system post-construction to ensure vegetative establishment and long-term success. Implement the next phase of the Sessom Creek project by finalizing designs and contract documents.	**Section 6.3.5** and **Appendix M8**

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

Texas wild-rice was increased through maintenance of existing stands and planting efforts with a focus on reaches that have not already exceeded the 2027 goal from Table 34 of the SAV Report. **Table 6.3-2** details the Texas wild-rice planting data tracked throughout the year.

Texas wild-rice was not planted in Spring Lake due to construction work on Spring Lake Dam, which required relocating a portion of the Texas wild-rice that was already present near the western spillway. As *Hygrophila polysperma* (Hygrophila) removal efforts progress within Spring Lake, more suitable habitat for Texas wild-rice should become available in the future. **Table 6.3-2** shows the number of Texas wild-rice individuals planted in the City Park and Upper IH-35 LTBG reaches during 2019.

Table 6.3-2. Number of Texas wild-rice Individuals Planted, and Estimated Area of Texas wild-rice Planted in the San Marcos River by Reach in 2019

LTBG Reach	Individuals Planted	Estimated Area Planted (m^2)
City Park	600	25.1
Upper IH-35	660	44.4
TOTAL RIVER	**1,260**	**69.5**

Significant progress has been made towards restoration and enhancement of Texas wild-rice in the San Marcos River. **Figure 6.3-1** illustrates the coverage of Texas wild-rice observed in the fall through the EAA's annual survey of Texas wild-rice in August 2019. The estimated total coverage of Texas wild-rice was 10,488 m^2, which is a total increase of 5,837 m^2, or 125 percent from 2013 coverage of 5,095 m^2. **Table 6.3-3** quantifies the expansion of Texas wild-rice by river segment and reach type, from 2013 to 2019, and the remaining amount needed to attain the goals for the Texas wild-rice throughout the San Marcos River. Additional information, including figures and tables, can be found in the COSM and Texas State 2019 Submerged Aquatic Plant Management Report (**Appendix M1)**.

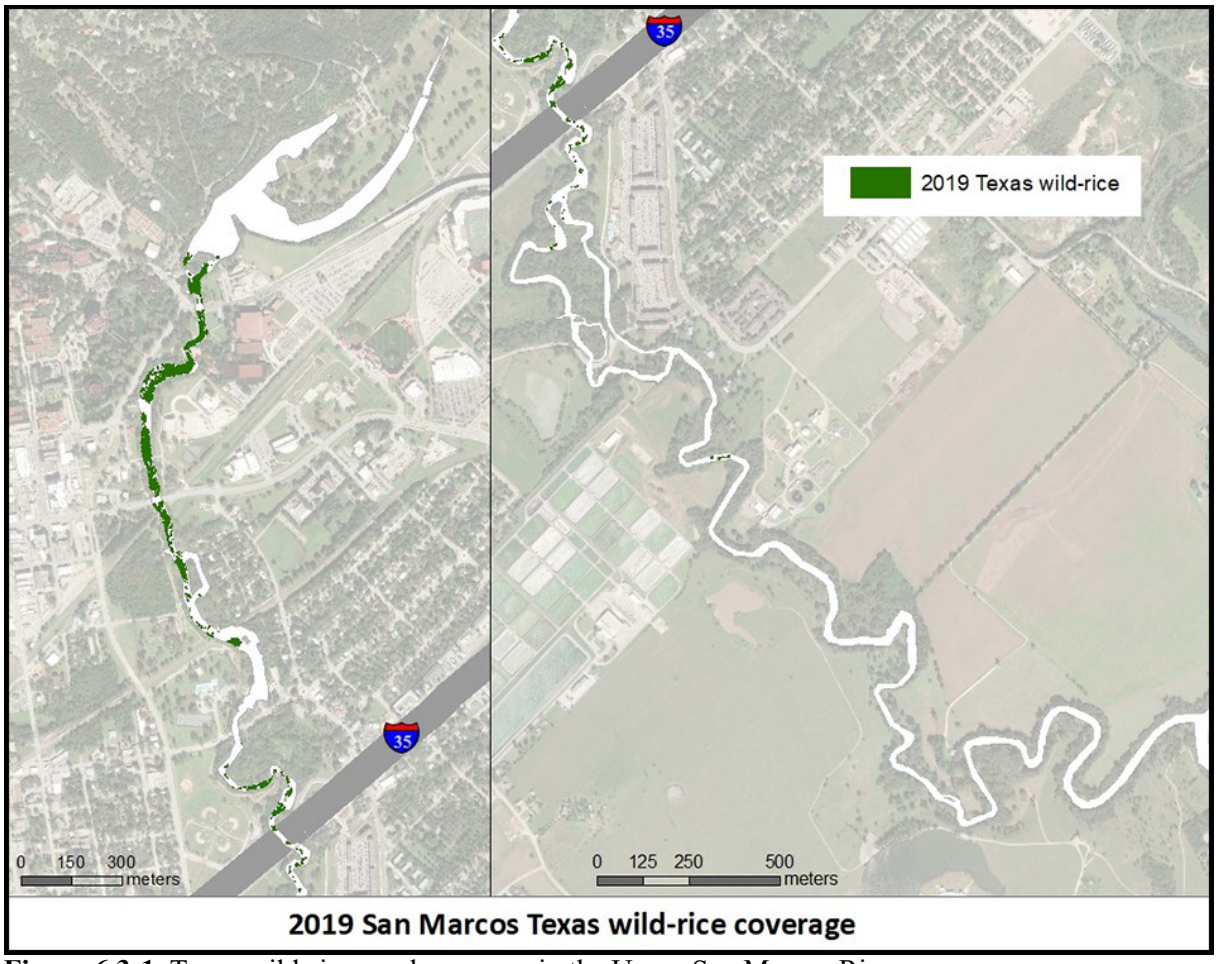

Figure 6.3-1. Texas wild-rice areal coverage in the Upper San Marcos River.

Table 6.3-3. Areal Coverages of Texas wild-rice by Reach in San Marcos River for 2013 and 2019, Changes Detected Since 2013, and EAHCP Long-Term Program Goal

Reach	Reach Type	Area coverage (m^2)			
		2013	2019	Changes from 2013 – 2019	EAHCP Long-Term Program Goal
Spring Lake	RR	42	192	150	1,000
Spring Lake Dam	LTBG	376	1,376	1,000	700
Sewell Park	RR	945	1,140	195	1,100
Below Sewell – City Park	RR	1,733	3,105	1,372	2,300
City Park	LTBG	351	1,653	1,302	1,750
Hopkins St – Snake Island	RR	718	1,552	834	950
Cypress Island – Rio Vista Dam	RR	0	398	398	350
IH-35 (Upper and Lower)	LTBG	361	893	532	1,050
Below IH-35	RR	125	179	54	280
TOTAL RIVER		**4,651**	**10,488**	**5,837**	**9,480**

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

6.3.2.1 Non-Native Aquatic Plant Removal

Aquatic vegetation restoration activities in 2019 included 1) removal of non-native, invasive aquatic vegetation, 2) planting of native aquatic plants, and 3) monitoring, mapping, and maintenance of restored areas. **Figure 6.3-2** illustrates the location and boundaries of LTBG Reaches and Restoration Reaches (RR) in the San Marcos River that have restoration goals. Additional information, including figures and tables of non-native removal and native plantings, can be found in the COSM and Texas State University 2019 Submerged Aquatic Plant Management Report, **Appendix M1 and M4**.

Non-native aquatic plant removal in 2019 shifted to a top-down approach that included non-designated reaches that have not been worked in the past. **Table 6.3-4** quantifies the approximate amount and location of non-native plant removal. The primary focus is manual removal of *Hydrilla verticillata* (Hydrilla) with all visible sources being removed from the designated work zones for 2019. **Figure 6.3-3** illustrates the extensive removal of non-native aquatic plants such as hydrilla, and the planting of native aquatic vegetation in the Below Sewell Park to City Park Restoration Reach. Upstream areas of the work zone and the current work zone are maintained with hydrilla sweeps until no regrowth is evident. Any patches of *Zizaniopsis miliacea* (cutgrass) present in a work area were removed. This top-down approach reduces the spread and establishment of non-natives from upstream to downstream, thus enhancing the viability and long-term success of restoration efforts. **Table 6.3-5** displays the amount and reach of native aquatic vegetation plantings during 2019.

Compliance for this measure is based on total coverage of fountain darter habitat in m^2 specified in Table 34 of the SAV Report. The overall status of aquatic vegetation coverage and 2019 restoration efforts are summarized in **Table 6.3-6**.

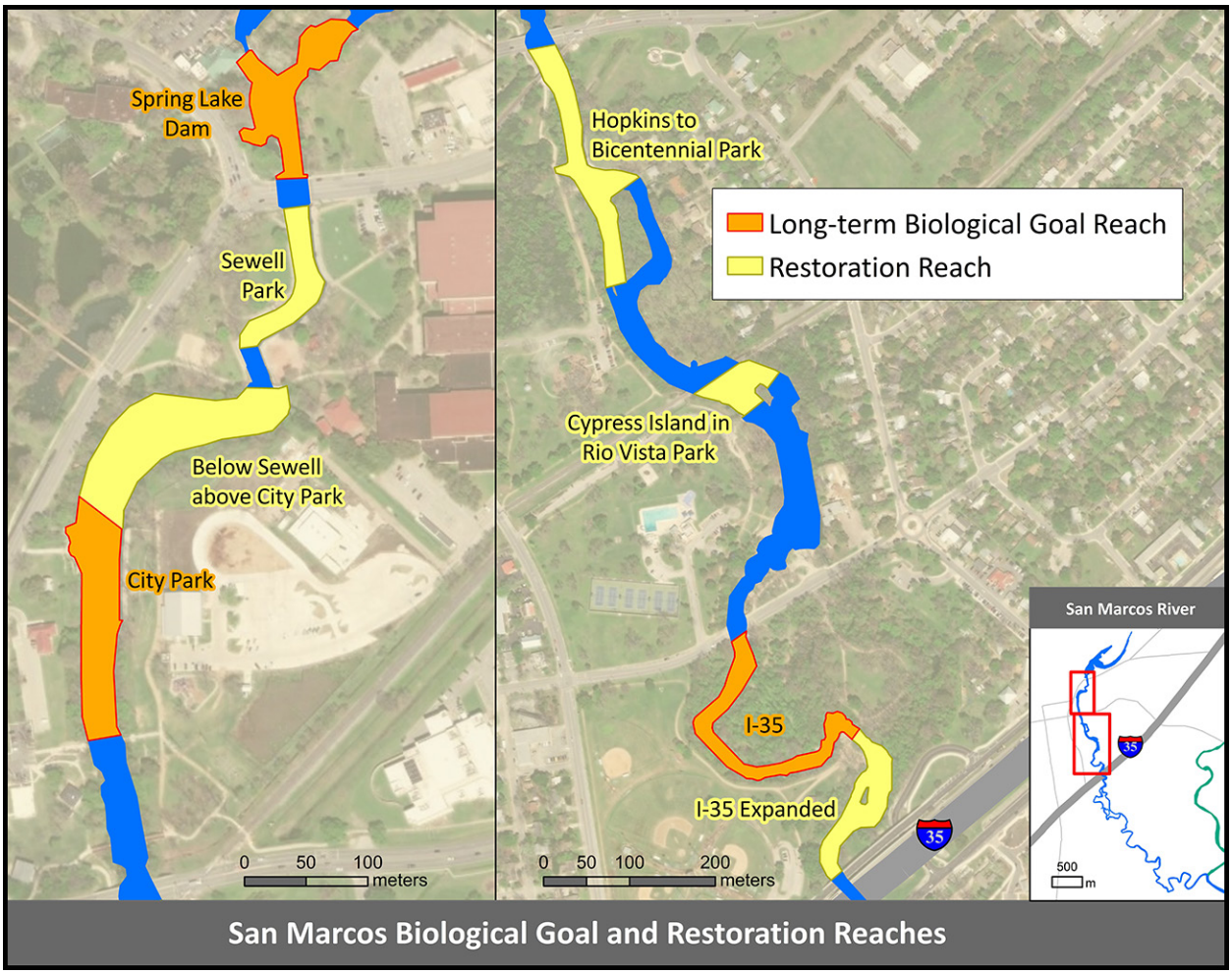

Figure 6.3-2. LTBG and Restoration reaches in the San Marcos River system.

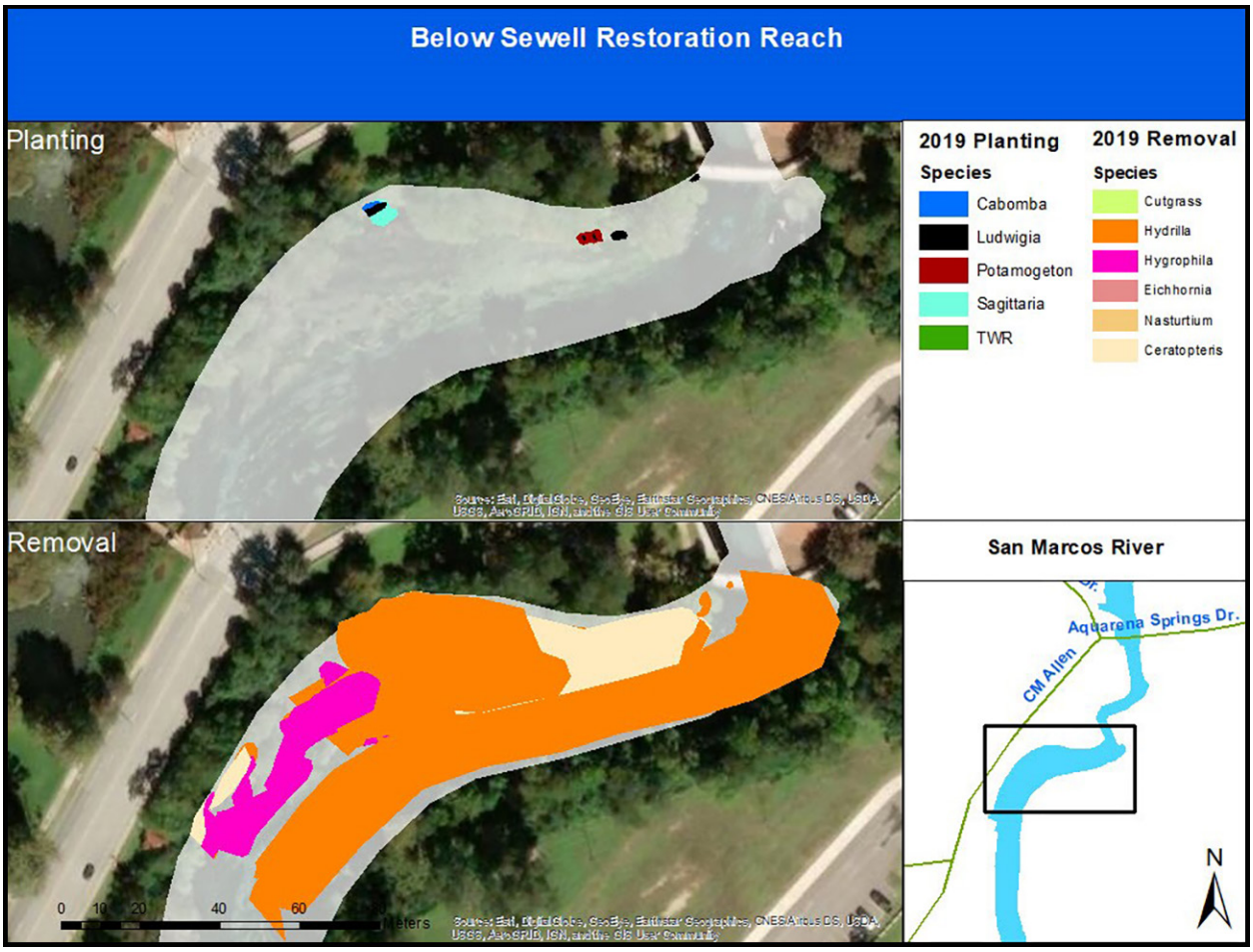

Figure 6.3-3. Aquatic non-native vegetation removal and planting of native aquatic vegetation in Below Sewell Park to City Park Restoration Reach in 2019.

Table 6.3-4. Estimated Area (m^2) of Non-native Vegetation and Floating Non-native Vegetation Removed in 2019

River Segment	Species	Area Removed (m^2)
Spring Lake	*Hygrophila*	1,745.5
Spring Lake Dam LTBG	*Hydrilla*	10.9
	Hygrophila	20.4
	Maintenance Sweep	1.3
	Nasturtium	17.2
	Ceratopteris	21.5
Sewell Park	*Hydrilla*	10.3
	Hygrophila	27.5
	Maintenance Sweep	1.8
	Nasturtium	2.1
	Ceratopteris	5.2

Table 6.3-4. Estimated Area (m^2) of Non-native Vegetation and Floating Non-native Vegetation Removed in 2019

River Segment	Species	Area Removed (m^2)
Below Sewell*	*Hydrilla*	844.6
	Hygrophila	1,001.9
	Maintenance Sweep	44.7
	Nasturtium	121.7
	Ceratopteris	709.0
	Eichhornia	1.4
	Zizaniopsis	2.8
City Park LTBG*	*Hydrilla*	1,063.7
	Hygrophila	106.4
	Maintenance Sweep	51.9
	Nasturtium	2.8
	Ceratopteris	7.4
Below City to Hopkins*	*Hydrilla*	1,987.2
	Hygrophila	174.1
	Maintenance Sweep	40.4
	Zizaniopsis	41.3
Hopkins	*Hydrilla*	404.0
	Hygrophila	5.0
Bicentennial	*No Removal*	0
Cypress Island	*No Removal*	0
Rio Vista	*No Removal*	0
IH-35 LTBG	*Hydrilla*	43.5
	Hygrophila	3.1
IH-35 Lower	*Hydrilla*	18.2
	Hygrophila	48.9
TOTAL RIVER	*Hydrilla*	4,382.3
	Hygrophila	3,132.8
	Maintenance Sweep	140.0
	Nasturtium	143.8
	Ceratopteris	743.1
	Eichhornia	1.4
	Zizaniopsis	44.1

* Denotes river segments that were designated as work zones in 2019.

Table 6.3-5. Native Species Planted in San Marcos River in 2019

River Segment	EAHCP Reach Designation	Species	No. of Individuals Planted	Area Planted (m^2)
Spring Lake	RR	*No Planting*	0	0
Spring Lake Dam	LTBG	*No Planting*	0	0
Sewell Park	RR	*Potamogeton*	800	21.1
		Sagittaria	52	4.4

Table 6.3-5. Native Species Planted in San Marcos River in 2019

River Segment	EAHCP Reach Designation	Species	No. of Individuals Planted	Area Planted (m^2)
Below Sewell*	RR	*Cabomba*	528	4.2
		Ludwigia	608	20.2
		Potamogeton	750	15.1
		Sagittaria	519	35.4
City Park*	LTBG	*Potamogeton*	2,610	28.9
Below City to Hopkins*	None	*No Planting*	0	0
Hopkins/Snake Island	RR	*No Planting*	0	0
Bicentennial	None	*No Planting*	0	0
Cypress Island	RR	*No Planting*	0	0
Rio Vista	None	*No Planting*	0	0
IH-35 Upper	LTBG	*No Planting*	0	0
IH-35 Lower	RR	*No Planting*	0	0
TOTAL RIVER		*Cabomba*	528	4.2
		Hydrocotyle	0	0
		Ludwigia	608	20.2
		Potamogeton	4,160	65.1
		Sagittaria	571	39.8

* Denotes river segments that were designated as work zones in 2019.

Table 6.3-6. San Marcos Long-Term Biological Goal and Restoration Reach Fountain Darter Habitat (Aquatic Vegetation) Status in m^2

Reach	Aquatic Vegetation Species	Native Aquatic Vegetation Coverage (m^2)		
		2018	Fall 2019	EAHCP Long-Term Program Goal
LTBG Reaches				
Spring Lake Dam	*Ludwigia*	22.4	12.6	100
	Cabomba	1.52	4.4	50
	Potamogeton	147.99	117	200
	Sagittaria	22.29	52.3	200
	Hydrocotyle	0	45	50
City Park	*Ludwigia*	65.28	41.75	150
	Cabomba	50.1	54.78	90
	Potamogeton	203.34	391.3	1,450
	Sagittaria	106.84	50.6	300
	Hydrocotyle	0	0	10
IH-35 (Upper)	*Ludwigia*	10.12	5.5	50
	Cabomba	31.98	37	50
	Potamogeton	0	3	250
	Sagittaria	17.11	31.8	150
	Hydrocotyle	3.81	1.55	50

Table 6.3-6. San Marcos Long-Term Biological Goal and Restoration Reach Fountain Darter Habitat (Aquatic Vegetation) Status in m^2

Reach	Aquatic Vegetation Species	Native Aquatic Vegetation Coverage (m^2)		
		2018	Fall 2019	EAHCP Long-Term Program Goal
Restoration Reaches				
Sewell Park	*Ludwigia*	3.8	*	25
	Cabomba	3.4	*	25
	Potamogeton	113.8	*	150
	Sagittaria	0	*	25
	Hydrocotyle	0	*	10
Below Sewell to City Park	*Ludwigia*	5.4	34	50
	Cabomba	2.2	12	50
	Potamogeton	113.8	578.8	500
	Sagittaria	392.4	478	700
	Hydrocotyle	38	43.5	20
Hopkins to Snake Island	*Ludwigia*	2.4	*	50
	Cabomba	108.3	*	50
	Potamogeton	63.5	*	475
	Sagittaria	1,258.6	*	750
	Hydrocotyle	0	*	10
Cypress Island	*Ludwigia*	18.24	*	50
	Cabomba	200.52	*	50
	Potamogeton	6.1	*	150
	Sagittaria	14	*	50
	Hydrocotyle	0	*	0
IH-35 (Lower)	*Ludwigia*	136.1	64.5	50
	Cabomba	40	63.4	100
	Potamogeton	0	0	250
	Sagittaria	274.6	384.5	450
	Hydrocotyle	5.5	27.1	50

* These sections were not mapped in 2019.

6.3.2.2 Non-Native Littoral Plant Removal

From Sink Creek at Bert Brown Crossing to Cape's Dam, over 100 yards of initial treatment of littoral invasive non-native plants was accomplished in 2019 (**Figure 6.3-4**). All the littoral invasive non-native plants from Sink Creek to Capes Dam are now under control. Maintenance activities are requiring less time but will be necessary for the long-term. Additional figures and pictures can be found in **Appendix M5**.

Figure 6.3-4. Map of littoral sites remaining after receiving treatment in 2019.

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

During the spawning season (March to May) tilapia were eliminated via bowfishing and spearfishing with a speargun in the slough arm of Spring Lake. After the spawning season and throughout summer (June to September), the tilapia were targeted via spearfishing in the river below Spring Lake. Bi-annual polespear tournaments occurred in spring and fall. These tournaments provide another successful way to remove tilapia and suckermouth catfish in the river. Removal amounts are shown in **Table 6.3-7** and **Table 6.3-8**.

In 2019, zero suckermouth catfish were observed in Spring Lake and three sailfin catfish were removed with pole spears during a night dive. Removal amounts of suckermouth and sailfin catfish are shown in **Table 6.3-7** and **Table 6.3-8** that occurred downstream of Spring Lake dam.

Red-rimmed and giant ramshorn snails were hand-collected in areas of large concentrations primarily below Spring Lake dam (**Table 6.3-7** and **Table 6.3-8**). Snails were also included in the biannual spearfishing tournament, with an award given for most weight in snails removed.

Table 6.3-7. 2019 Non-Native Species Removal Totals

Species	Total Biomass (lbs.)	Total Number	Average Biomass/Individual (lbs.)
Tilapia	4,468	1,293	3.5
Catfish (Suckermouth & Sailfin)	4,610	8,105	0.57
Nutria	440	39	11.3
Red-rimmed snail	24.2	-	-
Giant ramshorn snail	15.4	-	-

Table 6.3-8. Total Number of Species and Biomass Removed Through All Spearfishing Tournaments to Date (2015 – 2019)

Species	Total Number	Total Biomass (lbs.)
Plecostomus	3,170	1,663
Tilapia	106	197
TOTALS	**3,276**	**1,860**

6.3.4 Native Riparian Habitat Restoration (EAHCP § 5.7.1)

The COSM's contractor, staff and volunteers performed riparian area non-native invasive plant removal (**Figure 6.3-5**) over the spring and fall of 2019. Invasive regrowth was located and removed in the EAHCP riparian areas along the San Marcos River and along a portion of Willow Creek as outlined in the COSM 2019 Work Plan (**Appendix J3**). Starting at the banks just below the last foot bridge in Sewell Park and finishing just below Capes Dam, the COSM mechanically or chemically treated Chinese tallow, chinaberry, ligustrum, Chinese privet, paper mulberry, tree of heaven, giant reed, Japanese honeysuckle, catclaw vine, heavenly bamboo, red-tipped photinia, golden bamboo, Chinese pistache, johnsongrass, bastard cabbage, and lilac chaste tree. Trunks are placed onsite along contours to slow down storm water and enhance infiltration. Additional information about 2019 activities can be found in **Appendix M6**.

Figure 6.3-5. Map of riparian restoration work done along right bank below IH-35.

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

The COSM completed the City Park biofiltration pond in 2019 and the Downtown Pond retrofit will be completed in early 2020. Design plans for Sessom Creek stabilization for Phases 1 (**Figure 6.3-6**) and 2 will be at 99 percent and 90 percent, respectively, by December 31, 2019. Additional information about 2019 activities can be found in **Appendix M8**.

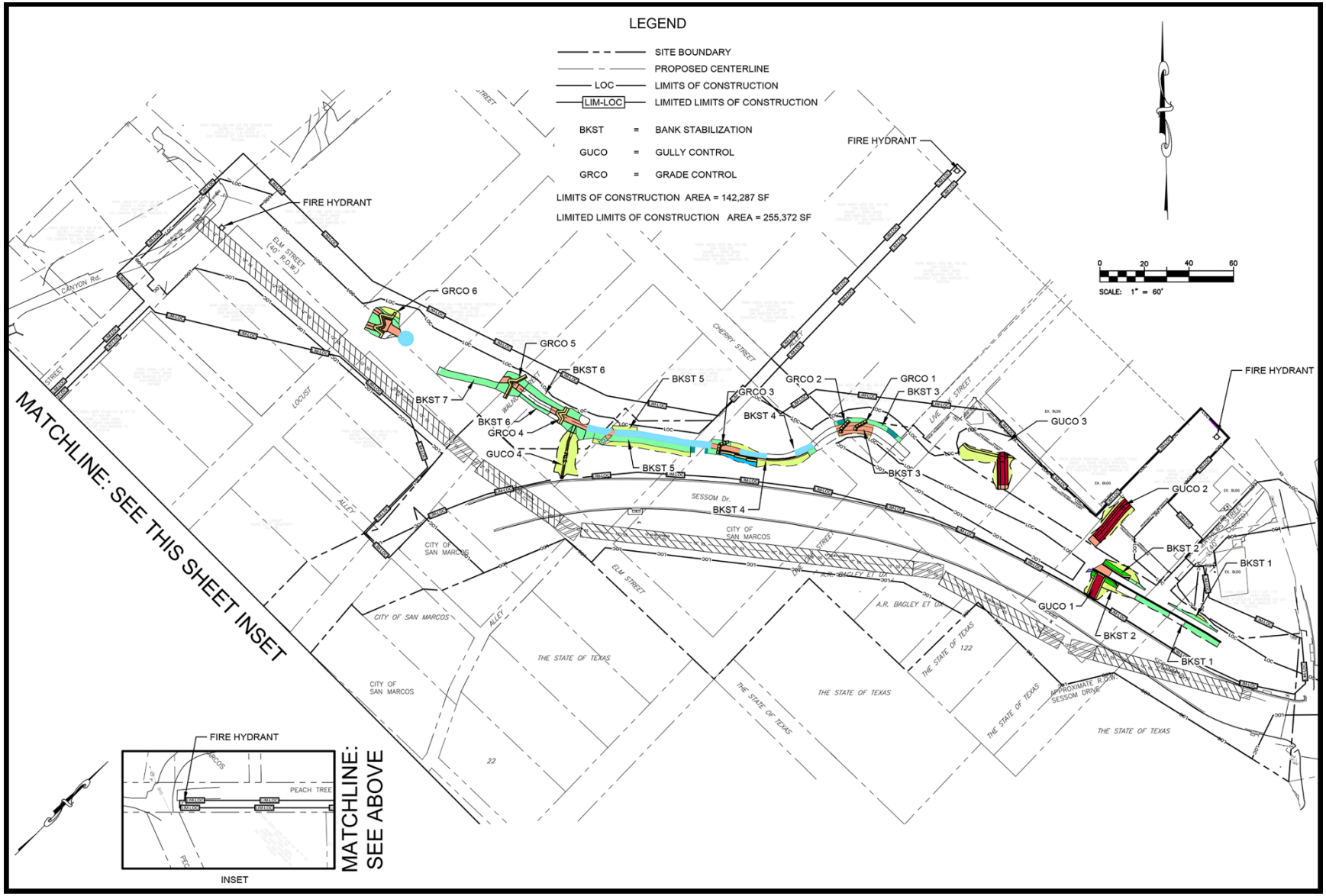

Figure 6.3-6. Map of Sessom Creek Phase 1 Best Management Practices.

6.4 Texas State University

Texas State is responsible for the following measures listed in **Table 6.4-1**. Implementation of these Conservation Measures has been accomplished in partnership with the COSM, as specified in the EAHCP to maintain consistency in EAHCP measures that jointly affect the Covered Species and their habitats in the San Marcos River. Work Plans and Funding Applications for 2019 program activities and 2020 proposed program activities are included as **Appendix J3** and **Appendix J6,** respectively.

Table 6.4-1. Texas State University 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Texas wild-rice Enhancement and Restoration (EAHCP §§ 5.4.1 and 6.3.5)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1**, **Section 6.3.1** and **Appendix M1** of this Annual Report.	See related discussion in **Table 6.3-1**, **Section 6.3.1** and **Appendix M1** of this Annual Report.	N/A
Management of Recreation in Key Areas (EAHCP § 5.4.2)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1**, **Section 6.3.2** and **Appendix M2** of this Annual Report.	See related discussion in **Table 6.3-1**, **Section 6.3.2** and **Appendix M2** of this Annual Report.	N/A
Management of Vegetation (EAHCP § 5.4.3)	Hand-cutting and a harvester boat will be used to manage aquatic vegetation in Spring Lake.	• Aquatic vegetation maintenance activities by volunteers accounted for 2,016 dive hours in Spring Lake. • 1,112 yd^3 of aquatic vegetation was harvested by boat in Spring Lake.	Texas State will continue programs outlined in the EAHCP and in the 2020 Texas State Work Plan.	**Section 6.4.1**
Sediment Removal in Spring Lake and Sewell Park (EAHCP § 5.4.4)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM. Remove sediment from the San Marcos River between Spring Lake and Sewell Park. Funding for this Conservation Measure has been transferred to the Impervious Cover/Water Quality protection conservation measure (EAHCP §5.7.6) per the Non-routine AMP Proposal approved in fall 2017.	See related discussion in **Table 6.3-1** of this Annual Report. No sediment removal occurred in 2019.	No activities are proposed.	N/A
Diversion of Surface Water (EAHCP § 5.4.5)	Surface water diversions will be reduced when flow is less than 80 cfs.	• Permitted pumping was not reduced since total San Marcos River flows were greater than 80 cfs • 15 ac-ft/year was diverted (Certificate 18-3865)	Continued to reduce or cease the diversion of surface water as required by flow conditions.	N/A

Table 6.4-1. Texas State University 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Restoration of Native Riparian Vegetation (EAHCP § 5.71)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1**, **Section 6.3.4** and **Appendix M6** of this Annual Report. No restoration work was needed in upper Sewell Park in 2019.	See related discussion in **Table 6.3-1**, **Section 6.3.4** and **Appendix M6,** of this Annual Report. Volunteers will be used if additional planting is needed in 2020.	N/A
Sessom Creek Sand Bar Removal (EAHCP § 5.4.6)	Texas State and the COSM will conduct a study of sediment removal options to determine the best procedure to remove this sand and gravel bar that minimizes impacts to Covered Species. Texas State will submit the study for review though the AMP and implement the actions coming out of that process.	Activities were completed in 2016; this Conservation Measure is complete.	No activities are proposed.	N/A
Diving Classes in Spring Lake (EAHCP § 5.4.7)	-Divers show an understanding of the Covered Species and critical habitats in Spring Lake and the laws and regulations relevant to them. Divers must exhibit good buoyancy control, can avoid contact with Covered Species and critical habitat, and maintain distance from the lake bottom. -No more than 16 trained divers may be present in Spring Lake at any time. -Training will be conducted for check-out dives and Self-Contained Underwater Breathing Apparatus (SCUBA) classes no more than three times per day with a maximum of sixteen students per class.	A total of 5,011 dives occurred in Spring Lake.	Diving class program will continue consistent with the protocols identified in the EAHCP.	**Section 6.4.2** and **Table 6.4-3**
Research Programs in Spring Lake (EAHCP § 5.4.8)	Research in Spring Lake needs prior review and approval by the Meadows Center for Water and the Environment (MCWE) to assess impacts to Covered Species and researchers will be educated to limit take, where take cannot be avoided. Individual permits from the USFWS will be obtained, if necessary.	27 research projects occurred in Spring Lake covering topics that included a diversity of biota studies, EAHCP, and volunteer activities.	Research programs will be consistent with the protocols identified in the EAHCP.	**Section 6.4.3** and **Table 6.4-4**
Management of Golf Course and Grounds (EAHCP § 5.4.9)	Develop and implement a Grounds Management Plan, including an IPMP, that considers the appropriate application of environmentally-sensitive chemicals to reduce negative impacts to neighboring ecosystems.	Began construction of recreation fields; construction is not yet complete.	Finalize Grounds Management Plan and IPMP for recreation fields.	N/A
Boating in Spring Lake and Sewell Park (EAHCP § 5.4.10)	Restrict boating at Spring Lake 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.	Spring Lake Programs: + 6,889 glass-bottom boat tours + 887 canoe/kayak tours	Continue implementing existing programs.	N/A
Reduction of Non-Native Species Introduction (EAHCP § 5.4.11)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1** and **Section 6.3.5** of this Annual Report.	See related discussion in **Table 6.3-1** and **Section 6.3.5** of this Annual Report.	N/A

Table 6.4-1. Texas State University 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
Control of Non-Native Plant Species (EAHCP §5 .4.12)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1** and **Section 6.3.4** of this Annual Report.	See related discussion in **Table 6.3-1** and **Section 6.3.4** of this Annual Report.	N/A
Control of Harmful Non-Native and Predator Species (EAHCP § 5.4.13)	Texas State extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.	See related discussion in **Table 6.3-1** and **Section 6.3.3** of this Annual Report.	See related discussion in **Table 6.3-1** and **Section 6.3.8** of this Annual Report.	N/A

6.4.1 Management of Vegetation (EAHCP § 5.4.3)

6.4.1.1 Management of Submerged and Floating Aquatic Vegetation in Spring Lake

Spring Orifice Maintenance

Texas State personnel at the MCWE in conjunction with qualified Dive Authorization Course (DAC) 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-m radius of each target spring with a machete. The aquatic vegetation within the next 1.5-m radius area around each target spring was cut to a height of 30 centimeters (cm) and the cut material allowed to flow downstream with the current. Aquatic vegetation within the next 3-m radius of target springs was sheared to height of 1 m and cut vegetation allowed to drift downstream. **Table 6.4-2** provides a summary of work conducted for this EAHCP Conservation Measure.

Table 6.4-2. Aquatic Vegetation Maintenance Activities Within Spring Lake in 2019

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
Aquatic Maintenance Dives	0.00	10.00	6.00	12.00	15.00	12.00	15.00	10.00	10.00	8.00	6.00	4.00	**108.00**
Aquatic Maintenance Dive Hours (average 1.25 hrs/dive)	0.00	12.50	7.50	15.00	18.75	15.00	18.75	12.50	12.50	10.00	7.50	5.00	**135.00**
AquaCorps (Vols)	128.00	144.00	122.00	129.00	121.00	138.00	158.00	215.00	150.00	128.00	120.00	60.00	**1,613.00**
AquaCorps Dive Hours (average 1.25 hrs/dive)	160.00	180.00	152.50	161.25	151.25	172.50	197.50	268.75	187.50	160.00	150.00	75.00	**2,016.25**

Harvester Boat

Maintenance of submerged and floating aquatic vegetation followed the protocols outlined in the EAHCP (EAHCP § 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 two or three times a month. The estimated aquatic vegetation harvest is approximately 10 to 12 cubic yards (yd^3)/per cutting. The total estimated harvest is approximately 1,112 yd^3 for the year.

6.4.1.2 Management of Aquatic Vegetation below Spring Lake Dam to City Park

Texas State collaborated with the COSM to control aquatic vegetation mats entrained on Texas wild-rice stands below Spring Lake Dam to the end of Sewell Park. Aquatic vegetation was removed by pushing and removing floating mats, as specified in the EAHCP.

6.4.2 Diving Classes in Spring Lake (EAHCP § 5.4.7)

The MCWE updated the Spring Lake Management Plan to reflect all the requirements under the ITP and EAHCP. This includes the following EAHCP Conservation Measures:

1) Spring Lake Dive Authorization Program (EAHCP § 5.4.7.1) – No more than 16 volunteer divers/day and ≤ 8 at one time.

2) Texas State Continuing Education (EAHCP § 5.4.2) – 16 divers/class; ≤ 3 classes/day; restricted to the Dive Training Area.

3) Texas State SCUBA Classes (EAHCP § 5.4.7.3) – 16 students/class; ≤ 3 classes/day; restricted to the Dive Training Area.

4) Texas State Snorkeling Program (EAHCP §§ 5.3.2 and 5.4.7) – 462 snorkel tour participants.

Diving activities in Spring Lake in 2019 are summarized in **Table 6.4-3**.

Table 6.4-3. Diving Activities in Spring Lake in 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Reporting Period Totals
Aquatic Maintenance	0	10	6	12	15	12	15	10	10	8	6	0	104
Texas State Student Dives	0	12	0	49	4	1	16	2	0	22	36	0	142
Public Open Water (OW) Divers	265	376	435	430	188	230	242	140	152	103	239	0	2,800
Volunteer Divers	128	144	122	129	121	138	158	215	150	128	120	60	1,613
Research Dives	4	0	2	6	1	4	7	6	14	20	0	0	64
External Dives (EAA, USFWS, etc.)	4	1	0	17	8	0	0	0	0	6	0	0	36
New volunteers	18	19	12	22	23	23	26	10	15	16	39	0	223
Wounded Warriors (groups not individual #'s)	1	1	6	6	1	3	0	0	2	0	9	0	29
TOTALS	**420**	**563**	**583**	**671**	**361**	**411**	**464**	**383**	**343**	**303**	**449**	**60**	**5,011**

6.4.3 Research Programs in Spring Lake (EAHCP § 5.4.8)

The Chief Science Officer at the MCWE chairs the Spring Lake Environmental Committee, which oversees all access to Spring Lake. To this end, MCWE developed an online access request form and these forms are available on the MCWE website. 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 involves 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 6.4-4** summarizes the research/access activities in Spring Lake.

Table 6.4-4. Research and/or Access Activities on Spring Lake in 2019

Researcher	Department /Agency	Description
Benson, Daniel	Office Facilities Planning/Design	Overlook Structural Load test project
Blasingame, Dale C.	School of Journalism/Mass Comm	MC1100M Student project; Unmanned Aerial Vehicle (drone) (UAV) test flights and observations
Bristow, McKenna Gabor, Catlin	Texas State Biology	Characteristics of sex pheromone in sailfin mollies
Childers, Bart	Scally Wompus	Event – Triathlon
Cochran, Jerry	Texas Water Safari	Texas Water Safari Canoe Race
Coleman, William	Texas State Biology	Cotton Cloth lures Comal Riffle Beetle traps
Daniel, Kristy	Texas State Biology	Science, Technology, Engineering, and Math (STEM) Undergraduate Research Experience; interviews, observations, data collections
Davis, Allison	UT Depart. of Integrative Biology	Sailfin mollie collections seine, dip net, minnow traps
Dussler, Rob	Meadows Center	Request to address failing/unserviceable railing at headwaters
Dussler, Rob; Deringer, Anthony	Meadows Center; Camous Rec	Grounded Theory, Experimental Education, Mindfulness techniques; Snorkel experience
Green, Michael	Texas State Biology	Green heron research; live capture, study of movement, and site fidelity
Hathcock, Chris	USFWS	Texas wild-rice surveys
Huffman, David; Allison, S.; Leach, J.	Texas State Biology	Fish collections: centrarchids (sunfish, bass); data collections, examinations, for Huffman et al. research
Kollaus, Kristy; Furl, Chad	EAA/Texas State Biology	Collecting Bass for tissue sampling for EAHCP
Kollaus, Kristy; Furl, Chad	EAA/Texas State Biology	Collecting gambusia for tissue sampling for EAHCP
Lemke, David	Texas State Biology	BIO 4410/5410 Field Biology of Plants; classroom instruction; plant collections
Menchaca, Nick	Atlas Environmental	Invasive animal removal
Miner, Krystie; Gabor, Catlin	Texas State Biology	Sunfish collections for research; line and pole/seining
Moreno, July	Mermaid Society of Texas	Mermaid Ball 2019
Oborny, Edmund	Bio-West	Edwards Aquifer Research and Data Center salamander; fountain darter survey
Rocha, Maria	Indigenous Cultures Institute	Annual Powwow
Rose, Francis	Texas State Biology	Trapping/monitoring turtle community
Ruckstuhl, Eric	EBR Enterprises	Invasive vegetation removal
Rylander, Rebekah	Texas State Biology	Nest Box research/study
Schwinning, Susan	Texas State Biology	Student project; plant specimen collections (juniper, pine, cypress)
Seidel, Nick	Campus Recreation	Texas State Triathlon Event
Wallendorf, Aaron	Meadows Center	Re-install Texas Water Safari Race start marker/plaque

6.5 San Antonio Water System

SAWS, in coordination with the EAA through an Interlocal Contract (ILC), is responsible for implementation of the measures under the EAHCP listed in **Table 6.5-1**.

Table 6.5-1. San Antonio Water System 2019 EAHCP Implementation and Proposed 2020 Activities

Conservation Measure	EAHCP Obligation	2019 Compliance Action	Proposed 2020 Compliance Action	Annual Report Reference
SAWS ASR Springflow Protection (EAHCP § 5.5.1)	This key springflow protection measure, in addition to RWCP, VISPO, and Stage V, requires SAWS to inject and store EAHCP Groundwater in its ASR and to forbear making withdrawals from the Edwards Aquifer under its EAA-issued Edwards permits under certain drought conditions and allows the use of SAWS ASR EAHCP stored water by no more than 126,000 ac-ft or 46,000 ac-ft annually during a repeat of the DOR as defined in the EAHCP and the ILC between EAA and SAWS.	Drought conditions that require SAWS forbearance were not triggered in 2019. The EAA contributed 16,667 ac-ft as defined by the ILC.SAWS recharged through injection and stored 13,597 ac-ft of EAHCP Groundwater into the SAWS ASR Project; the difference between what EAA contributed and what was stored was credited to EAHCP Groundwater from SAWS consistent with the ILC.	Enforced if triggered, withdrawals under SAWS Edwards permits will remain unpumped when the J-17 Index Well is less than 630 ft msl and the ten-year rolling recharge average of the Edwards Aquifer is at or below 500,000 ac-ft and EAA water rights enrolled as leases and forebearance agreements will remain unpumped when the ten-year rolling recharge average is at or below 500,000 ac-ft. The balance remaining for injection and storage to meet the storage goal of 126,000 ac-ft of EAHCP Groundwater is 15,552 ac-ft. Completion of storage for the remaining amount is anticipated in 2020.	**Table 6.1-1** and **Section 6.5**
Phase II Expanded Use of the SAWS ASR and Water Resources Integration Program (WRIP) Pipeline (EAHCP § 5.5.2)	The presumptive action for Phase II of the HCP involves the use of SAWS ASR with a planned construction of the WRIP Pipeline.	The IC voted to approve the EAHCP Comprehensive Phase II Work Plan and a Nonroutine AMP Proposal in May 2019 that did not include the use of SAWS WRIP as the presumptive Phase II Conservation Measure because it was not needed.	N/A	N/A

In 2013, the ILC was developed between the EAA and SAWS over a seven-month period. The ILC translates the conceptual elements of SAWS ASR commitment in Section 5.5.1 of the EAHCP into measurable activities related to both parties' responsibilities. Summaries of SAWS and EAA actions related to fulfilling these responsibilities in 2019 are provided below. San Antonio Water System Aquifer Storage and Recovery Regional Advisory Group and Staff Work Group

The EAHCP and the ILC provide for continued dialog and interaction. Under the ILC, SAWS has the responsibility to facilitate two groups. In 2019, both groups met in compliance with the EAHCP and the ILC.

The first group is the SAWS ASR Regional Advisory Group as described in the EAHCP. Per the requirements of the EAHCP, a twelve-person Regional Advisory Group consisting of four representatives of SAWS, the EAHCP Program Manager, and one representative each from the EAA, an EAA permit holder for irrigation purposes, a representative of small municipal aquifer users, a representative of the COSM and CONB, an environmental representative (including TPWD), a representative of industrial aquifer users, and downstream interests provides advice to SAWS regarding the implementation of the program. **Table 6.5-2** lists the members of the SAWS ASR Regional Advisory Group who met on September 9, 2019.

Table 6.5-2. Members of the SAWS Aquifer Storage and Recovery Regional Advisory Group in 2019

Entity	Appointee	Alternate
SAWS	Darren Thompson	Patrick Shriver/Roger Placencia
SAWS	Shawn Dorn	Patrick Shriver/Roger Placencia
SAWS	Karen Guz	Patrick Shriver/Roger Placencia
SAWS	Roger Placencia	Patrick Shriver
EAA	Roland Ruiz	Marc Friberg
Irrigator	Rader Gilliland	Adam Yablonski
Small Municipal	Bruce Alexander	No alternate named
Springs Communities	Ryan Kelso	Mike Short
Environmental Interest	Cindy Loeffler	Chad Norris
Industry	Buck Benson	Louisa Eclarinal
Downstream Interest	Nathan Pence	Charlie Hickman
EAHCP Program Manager	Scott Storment	Jamie Childers

The second group is a Staff Work Group. SAWS is responsible for organizing and facilitating the Staff Work Group between staffs of SAWS and the EAA. Per the requirement of the ILC, an eight-person Staff Work Group consisting of four members of SAWS' staff and four members of the EAA's staff. The members are to have experience in evaluating drought conditions, factors affecting aquifer levels and springflows at Comal Springs, meteorology, aquifer and springflow modeling, or related expertise, and provides advice to each agency regarding their respective duties and obligations under the ILC for the implementation of the program.

Injection and Storage of EAHCP Groundwater by SAWS in 2019

In 2019, SAWS recharged through injection and stored 13,597 ac-ft of EAHCP Groundwater into the SAWS ASR Project. Through 2019, SAWS has recharged through injection and has in storage a total of 110,448 ac-ft of EAHCP Groundwater as shown in **Figure 6.5-1**. Beneficial rainfall in 2019 enabled

injection and storage of EAHCP Groundwater throughout the year. The balance remaining for injection and storage to meet the storage goal of 126,000 ac-ft of EAHCP Groundwater is 13,027 ac-ft. Completion of storage of this remaining amount will be in 2020.

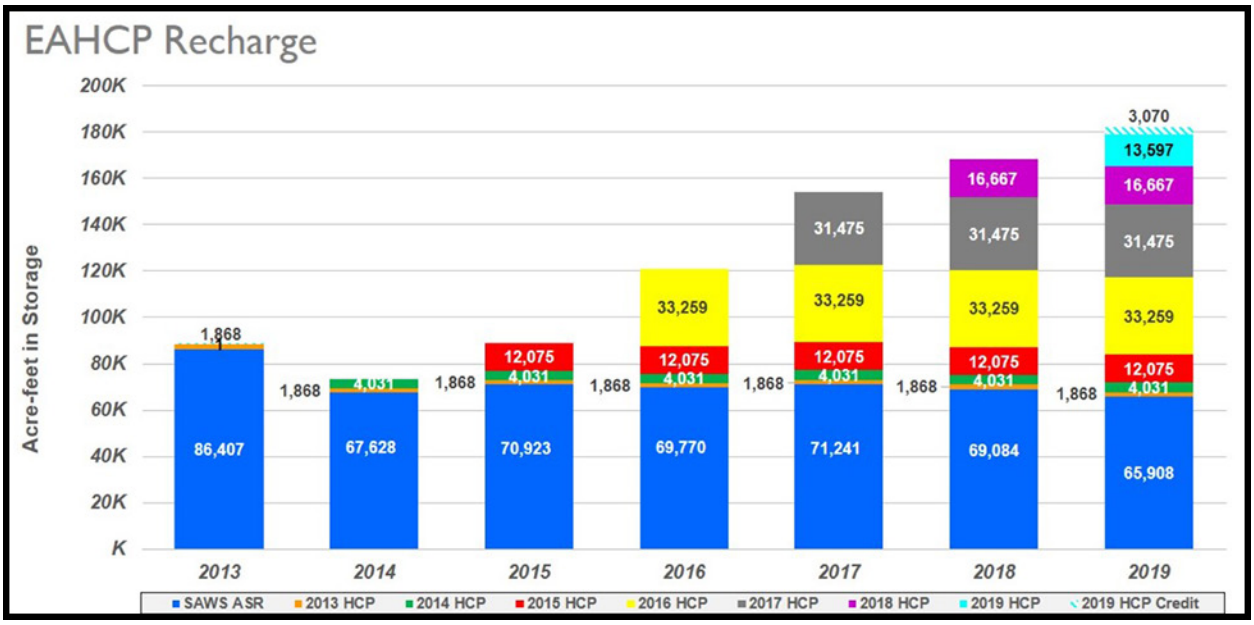

Figure 6.5-1. Total EAHCP water stored at the SAWS ASR (2013 – 2019).

Groundwater Rights Pooling Program for Aquifer Storage and Recovery

By a "master agreement," the EAA has created a program whereby EAA permit holders may contribute any "unpumped amount" under their permits into a "pool" administered by the EAA for the purpose of transfer to SAWS so that SAWS may recharge through injection such water into the SAWS ASR for the purpose of springflow protection under Section 5.5.1 of the EAHCP. This "pooling" program is complementary to the formal EAA ASR leasing/forbearance agreement program. No groundwater withdrawal rights were made available to SAWS under this program in 2019.

6.6 Texas Parks & 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 a state "scientific area" (SSA) for "the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value" (Texas Parks & Wildlife Code § 81.501).

6.6.1 San Marcos State Scientific Areas (EAHCP § 5.6.1)

To minimize the impacts of recreation, TPWD has designated a 2-mile segment of the public waters of the San Marcos River as an SSA in the San Marcos Springs ecosystem (31 TAC § 57.910) to provide expanded protections to Texas wild-rice.

6.6.2 Comal State Scientific Areas (EAHCP § 5.6.1)

To protect existing and restored fountain darter habitat, EAHCP obligations under sections 2.1, 2.7, 5.2.2.2, and 5.6.1 indicate that TPWD will also pursue an SSA within the Comal River system. No new activities were performed in 2019 in this regard.

7.0 RECOMMENDATIONS FOR MOVING FORWARD

The Permittees are now in their seventh year of implementing the EAHCP. With the benefit of experience—including during wide-ranging weather conditions—and time, the Permittees continue to gain perspective and practical insights into implementation of the EAHCP. The Permittees recommend the following as priorities based upon this knowledge and experience.

7.1 Committee and Work Group Activities

EAHCP staff will conduct committee meetings in 2020 consistent with the FMA along with hosting special workshops and establishing a new work group. Staff will also close out program activities to transition from Phase I to Phase II of the ITP in 2020. A report of SAMP activities will be delivered and finalized in 2020. A summary of the report and activities performed during the transition will be presented to the IC.

A contractor will also be in place in 2020 to provide potential options to pursue at the culmination of the current ITP in 2028. The contractor will serve in an advisory role to offer guidance and expertise as it relates to ITP rollovers and the potential options available to the EAHCP. Staff will use the options identified to help frame the discussions and direction of the EAA and the EAHCP IC as the parties evaluate how best to move forward in seeking a new ITP.

Finally, a Work Group charge will be proposed to the IC in 2020 to follow through on addressing springflow related issues raised in the discussion document circulated to SH members on May 22, 2019. The SH recommended a technical evaluation be completed to understand the potential impacts of predicted extended low-flow periods in both spring systems on the Comal Springs riffle beetle, San Marcos salamander, Texas wild-rice, and fountain darters.

7.2 Edwards Aquifer Authority

New contracts will be awarded in 2020 to ensure program activities are compliant with state and federal permits, perform water quality monitoring, prepare annual reports, print newsletters and support outreach efforts, and map Spring Lake SAV. Interlocal Agreements between the EAA, COSM, and CONB will also be renewed in 2020.

The EAHCP Chief Science Officer will revisit water quality monitoring activities to develop a new water quality monitoring contract and ensure commitments of the EAHCP are achieved. Current EAHCP water quality monitoring activities are more than $100,000 over EAHCP Table 7.1 allocated amounts each year. This review will look for changes to monitoring activities that maintain the intent of the EACHP while reducing the overall cost to be more in line with allocated EAHCP Table 7.1 dollars.

Finally, EAHCP staff will participate at the National HCP Coalition Annual Meeting in Texas, in 2020.

7.3 City of New Braunfels

The CONB, in coordination with the EAHCP, will continue to develop suggestions and strategies for future Impervious Cover and Water Quality Protection Projects (EAHCP § 5.7.6) around the Comal system.

In addition to monitoring the threat of the gill parasite *Centrocestus formosanus*, observations for the parasite *Haplorchis pumilio* will occur around Pecan Island in Landa Lake.

As a result of the CSRB Work Group, management and mitigation practices for the CSRB may be subject to change, however, overall riparian and aquatic habitat restoration activities will continue throughout 2020.

Finally, the CONB's commitment to issue Certificates of Inclusion (COIs), as outlined in EAHCP § 5.2.3, was reaffirmed in the Comprehensive Phase II Work Plan.

7.4 City of San Marcos

The COSM and Texas State will continue to coordinate efforts to achieve progress towards fulfillment of their Conservation Measures; particularly in the areas of recareation COIs, submerged aquatic vegetation management, and HHW management.

The Comprehensive Phase II Work Plan reaffirmed the COSM's commitment to issue COIs, as outlined in EAHCP § 5.3.2.1.

Submerged aquatic restoration and removal of invasive aquatic plants in San Marcos has been very effective in 2019 due to implementation of a new top-down approach. While the aquatic vegetation restoration team will continue planting native plants to achieve the long-term goals of Table 34 of the SAV Report, the schedule and work sites have been modified to allow for extensive removal of the invasive, hydrilla. *Hygrophila* removal efforts have not been as effective due to *hygrophila* spreading from upstream sources, such as Spring Lake. Therefore, the EAA will contract a survey team in early 2020 to assess and document the location and amount of *hygrophila* and other non-natives in Spring Lake. The removal team, along with volunteers, will target these stands for removal in 2020. This approach seeks to reduce the spread of non-natives downstream, below Spring Lake, and protect the established, native vegetation.

7.5 Texas State University

Texas State is expected to work closely with the COSM in 2020 to address non-native SAV in Spring Lake for the benefit of downstream habitat. No other changes to Conservation Measures are recommended for 2020.

7.6 San Antonio Water System

No changes to Conservation Measures are recommended moving forward.

7.7 Texas Parks & Wildlife Department

The Comprehensive Phase II Work Plan reaffirm's TPWDs commitment to establish a State Scientific Area (SSA) in the Comal River following completion of habitat restoration protective of the fountain darter as described in EAHCP §§ 5.2.2.2 and 5.6.1. Therefore, efforts to establish an SSA in the Comal River are expected after 2023 when the inital aquatic vegetation restoration planting and removal is expected to be complete and maintanence is expected to begin.

8.0 LITERATURE REVIEW

Appendix N lists articles and reports related to the Covered Species, habitat, and other items associated with the EAHCP developed since the last annual report. This review includes journal articles, study reports, and theses and dissertations published or approved from December 1, 2018 to November 30, 2019 and any additional literature from 2018 found to have been undocumented in the 2019 annual report. The literature search was accomplished by conducting online searches of academic databases (such as EBSCO and JSTOR), Google Scholar, Texas State Dissertations and Theses, and the EAA document library.

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LIST OF ALL SPECIES OF MANAGEMENT INTEREST REFERENCED[6]

Common Name	Scientific Name
Covered Species Under Incidental Take Permit No. TE-63663A-1 and the Edwards Aquifer Habitat Conservation Plan	
Comal Springs dryopid beetle	*Stygoparnus comalensis*
Comal Springs riffle beetle	*Heterelmis comalensis*
Comal Springs salamander	*Eurycea* sp.
Fountain darter	*Etheostoma fonticola*
Peck's cave amphipod	*Stygobromus pecki*
San Marcos gambusia	*Gambusia georgei*
San Marcos salamander	*Eurycea nana*
Texas blind salamander	*Eurycea (=Typhlomolge) rathbuni*
Texas cave diving beetle (or Edwards Aquifer diving beetle)	*Haideoporus texanus*
Texas troglobitic water slater	*Lirceolus smithii*
Texas wild-rice	*Zizania texana*
Species included in the Submerged Aquatic Vegetation Objectives	
Delta arrowhead	*Sagittaria platyphylla*
Creeping primrose-willow	*Ludwigia repens*
Carolina fanwort (or Cabomba)	*Cabomba caroliniana*
Illinois pondweed	*Potamogeton illinoensis*
Mosses, liverworts, and allies	Bryophytes
Umbrella pennyroyal (or manyflower marshpennywort)	*Hydrocotyle umbellata*
Texas wild-rice	*Zizania texana*
Native Aquatic Plant Species Used in Restoration	
Grassleaf mudplantain	*Heteranthera dubia*
Native Species	
Big claw river shrimp	
Non-native Animal and Plant Species Removed or Monitored	
Armored catfishes (or suckermouth catfishes)	Loricariidae
Chinaberry	*Melia azedarach*
Chinese privet	*Ligustrum sinense*
Chinese tallow	*Triadica sebifera*
Elephant ear (or coco yam, or taro)	*Colocasia esculenta*
Giant ramshorn	*Marisa cornuarietis*
Giant reed	*Arundo donax*
Gill parasite (no common name)	*Centrocestus formosanus*
Hydrilla (or water thyme)	*Hydrilla verticillata*
Indian swampweed	*Hygrophila polysperma*
Japanese honeysuckle	*Lonicera japonica*
Japanese privet (or Japanese ligustrum)	*Ligustrum japonicum*
Nutria	*Myocastor coypus*
Red-rim melania	*Melanoides tuberculatus*

[6] Sources for common and scientific names are Integrated Taxonomic Information System (ITIS-North America 2020); and PLANTS National Database (U.S. Department of Agriculture Natural Resources Conservation Service 2020).

LIST OF ALL SPECIES OF MANAGEMENT INTEREST REFERENCED[6]

Common Name	Scientific Name
Tapegrass (or eelgrass)	*Vallisneria spiralis*
Tilapia (or blue tilapia)	*Oreochromis* spp.
Watercress	*Nasturtium officinale*
Water hyacinth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*
Water sprite	*Ceratopteris thalictroides*
White mulberry	*Morus alba*
Zebra mussel	*Dreissena polymorpha*

GLOSSARY OF TERMS INCLUDED IN THE 2019 EAHCP ANNUAL REPORT

Term or Phrase	Term or Phrase Definition
Conservation Measure	Specified projects to be implemented by the Permittees in order to minimize and mitigate to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of the Covered Species due to the performance of the Covered Activities by the Permittees during the term of the ITP.
Covered Activity	Those activities identified in the ITP and the EAHCP and performed by the Permittees within the boundaries of the EAA, including recreation and pumping from the Edwards Aquifer within the EAA's boundaries, for which incidental take coverage has been provided during the term of the ITP.
Critical period	A period characterized by certain defined lower aquifer levels, which are primarily managed by the triggering of increasing withdrawal restrictions from the Aquifer.
Critical period sampling	High flow and low flow specific sampling to evaluate disturbance and recovery, as well as declining or improving conditions linked to flow. High flow (after a flood event) sampling must be approved by EAA staff working with the contractor. Low flow sampling is linked to a series of flow triggers.
Curtail or Curtailment	The act of reducing or restricting something. In the case of a Forbearance Agreement, the right to withdrawal under an EAA Groundwater Withdrawal Permit would be reduced or restricted.
Defined period of extreme drought Drought/drought conditions Extreme drought conditions	In the EAHCP, the "springflow protection" Conservation Measures are based off of the specific drought triggers that are tailored for each measure, except for the RWCP, which has no drought triggers. These measures are designed to prevent springflows at Comal Springs and San Marcos Springs from being reduced below certain levels stated in the EAHCP during a repeat of the "Drought of Record," which refers to the six-year drought that occurred from 1951 through 1956, and specifically to a drought characterized by an average recharge for any seven-year period of less than 168,700 ac-ft as derived from the period 1950 through 1956. Reference to drought or extreme drought is in perspective of similar experiences.
Destructive scour Scour	The removal of sediment such as sand or rocks, and vegetation due to swiftly moving water from flood or severe storm event.
EAA Act	The Act of May 30, 1993, 73rd Leg., R.S., ch. 626, 1993 Tex. Gen. Laws 2350, as amended.

GLOSSARY OF TERMS INCLUDED IN THE 2019 EAHCP ANNUAL REPORT

Term or Phrase	Term or Phrase Definition
EAA Groundwater Withdrawal Permit	An Initial Regular Permit or Regular Permit issued by the EAA.
Forbearance	The complete curtailment of all or part of a right to make withdrawals under a specific EAA Groundwater Withdrawal Permit.
Forbearance Agreement	A contractual agreement whereby a permit holder agrees to the complete curtailment of all or part of the permittee's or permit holder's right to make withdrawals in the future under a specific EAA Groundwater Withdrawal Permit when certain conditions, commonly referred to as "triggers" are met in exchange for compensation.
High flow	Referencing a flood event or severe storm event that could have negatively impacted the Covered Species and their habitat. System monitoring association with high flow must be approved by EAA staff and is not quantitatively defined in the EAHCP.
Initial Regular Permit	An EAA Groundwater Withdrawal Permit originally issued by the EAA under Subsection 1.16(d) of the EAA Act.
Instars	An insect developmental stage between larvae to adult. Each instar is a separate molt.
Lease	As used in the SAWS ASR Program, a Lease is a contractual arrangement to presently grant the exclusive possession of the right to make withdrawals from the Edwards Aquifer under an EAA Groundwater Withdrawal Permit.
Long-Term Biological Goal Reach	River segments in both the Comal and San Marcos rivers that are specifically specified in the EAHCP and hold quantitative goals associated with specific plants regarded as fountain darter habitat.
Low flow(s) Low flow conditions Extreme low flow	A period of springflow that decreases below the long-term average and the minimum averages identified in Tables 4-2 and 4-13 of the EAHCP significantly. Low-flow may also be specified in the Comal system as 130 cfs or lower, and in the San Marcos system as 120 cfs or lower based on Condition M in the ITP.
Negative impacts	Generic term associated with impacts to the Covered Species and their habitat through reduced springflow, flood, contaminated runoff, excess recreation in protected areas, and other potentially threatening activities to the Comal and San Marcos Springs ecosystems.
Phase I – EAHCP Implementation	Phase I of the EAHCP is the time period between the years 2013 – 2020 of the ITP, during which the

GLOSSARY OF TERMS INCLUDED IN THE 2019 EAHCP ANNUAL REPORT

Term or Phrase	Term or Phrase Definition
	Permittees implemented the Habitat Restoration, Springflow Protection, Research, Modeling, and Monitoring, and Refugia Conservation Measures required by the EAHCP and the ITP to determine their effectiveness in achieving the EAHCP Biological Goals and Objectives.
Phase II – EAHCP Implementation	Phase II of the EAHCP is the period of the ITP during the years 2020 – 2028 when continued implementation of existing, or modifications to existing, Conservation Measures, or implementation of new Conservation Measures may be necessary to achieve the Biological Goals and Objectives in the EAHCP as a result of the Strategic Adaptive Management Process.
Regular Permit	An EAA Groundwater Withdrawal Permit issued by the EAA after August 12, 2008, resulting from the sale or amendment of an Initial Regular Permit or the consolidation of two or more such permits.
Riparian	Land adjacent to a river or stream.
Restoration Reach	River segments in both the Comal and San Marcos rivers created out of the 2016 AMP to satisfy the EAHCP Key Management Objective of proportionally expanding SAV restoration beyond the LTBG reaches.
Strategic Adaptive Management Process	The SAMP is employed during the transition from Phase I (2013-2020) to Phase II (2020-2028) of the EAHCP and the ITP. Specifically, the decisions made through SAMP pertain to the selection of Conservation Measures for Phase II of EAHCP implementation. SAMP is essentially the formal use of the Adaptive Management Process identified in Sections 7.13 and potentially 7.14 of the FMA, as the EAHCP transitions from Phase I to Phase II, to answer the following questions (FMA §7.13.7): • Are any of the current Biological Objectives not necessary to meet the Biological Goals? • Are any of the current the Biological Objectives not adequate to meet the Biological Goals? • Are any of the current Phase I Conservation Measures not necessary to meeting the Biological Objectives? • Are the Phase I Conservation Measures meeting the Biological Objectives? • Are any of the current Phase I Conservation Measures not achieving the Biological Objectives? • Has the Science Review Panel failed to make a determination, or is inconclusive about, whether the current Phase I Conservation Measures are achieving the Biological Objectives?

GLOSSARY OF TERMS INCLUDED IN THE 2019 EAHCP ANNUAL REPORT

Term or Phrase	Term or Phrase Definition
Texas wild-rice Reach	River segments in the San Marcos River specified in the EAHCP that provide quantitative goals associated with Texas wild-rice restoration.
Tiller	A stem produced by grass plants and refers to all shoots that grow after the initial parent shoot grows from a seed.
Trigger	To cause an event or situation to happen or exist. In the case of the VISPO, CPMP, and SAWS ASR springflow protection programs, including the Forbearance Agreements associated therewith, a trigger would be a condition that causes or requires the curtailment of all or part of the right to make withdrawals under a specific EAA Groundwater Withdrawal Permit.
Withdrawal	An act that results in taking groundwater from the Edwards Aquifer by or through manmade facilities, including pumping.