Edwards Aquifer Authority
2020 Work Plan

2020 Edwards Aquifer Authority Work Plan Budget

EAHCP Section	Conservation Measure	Table 7.1	Available Budget for 2020	Estimated 2020 Budget	Delta between Available and Estimated
5.5.1	ASR Leasing & Forbearance [a]	$4,759,000	$4,759,000	$5,891,594	($1,132,594)
	ASR O&M	$2,194,000	$2,194,000	$408,255	$1,785,745
5.1.3	RWCP	$1,973,000	$600,400	$600,400	$0
5.1.2	VISPO [a]	$4,172,000	$4,172,000	$2,508,070	$1,663,930
5.1.4	Stage V	NA	NA	NA	NA
6.3.1	Biological Monitoring	$400,000	$400,000	$755,774[b]	($355,774)
5.7.2	Water Quality Monitoring	$200,000	$200,000	$330,410	($130,410)
6.3.3	Ecological Model	$25,000	$0	$0	$0
6.3.4	Applied Research	$0	$250,000	$250,000	$0
5.1.1	Refugia	$1,678,597	$1,151,682	$1,151,682	$0
FMA §2.2	Program Management	$750,000	$750,000	$1,033,435	($283,435)
	Science Review Panel	$0	$0	$0	$0
Total		**$16,151,597**	**$14,477,082**	**$12,929,620**	**$1,547,462**

a. Expected to change as leases are renewed through 2019 and 2020. Estimate presented based on best available data to date

b. Includes Critical Period Monitoring if required

5.5.1 Edwards Aquifer Authority and San Antonio Water System Aquifer Storage and Recovery Work Plan

Section 5.5.1 of the Edwards Aquifer Habitat Conservation Plan (EAHCP) assigns acquiring leases and options of water permits for use in the San Antonio Water System (SAWS) Aquifer Storage and Recovery (ASR) to the Edwards Aquifer Authority (EAA). SAWS will operate the ASR infrastructure and retain control of day-to-day operations of the ASR facility related to EAHCP water injection and recovery. The EAA will ensure compliance with EAHCP requirements through management of the Interlocal Contract between the EAA and SAWS for the Use of the Twin Oaks Aquifer Storage and Recovery Project for Contribution to Springflow Protection, which became effective August 14, 2013. The contract outlines the responsibilities of both parties, including administration and implementation.

Long-term Objective:
The objective of SAWS Twin Oaks ASR (ASR now run out of H_2O Oaks facility) system is to deliver 126,000 acre-feet of Edwards Aquifer groundwater. This water is best managed to offset pumping from Edwards Aquifer wells during a repeat of a drought similar to the drought of record and acquire an additional 50,000 acre-feet of agricultural, municipal, industrial groundwater withdrawal rights to either be made available for physical storing in / crediting to the Regional ASR balance or may be forborne.

Target for 2020:
The ASR contract between EAA and SAWS will continue to be implemented. EAA is the leasing agent for ASR leases and will continue providing SAWS with notices of availability of EAHCP groundwater. As filling nears 126,000 acre-feet, future water acquired by the EAA through contractual agreements with permit holders will be utilized for forbearance purposes during a repeat of a drought of record. During a drought of record, the ASR may be used by SAWS to offset forbearance and an additional 50,000 acre-feet of groundwater will go unpumped by permit holders in the region. In year 2020 the total amount of water available from multi-year leases is 15,924 acre-feet and it is expected that 126,000 acre-feet of EAHCP groundwater will be in storage by the end of the year. Any additional groundwater secured by EAA above this amount will be used to meet forbearance obligations as outlined in the EAHCP.

ASR Program:
Description of the SAWS ASR: The SAWS H2 Oaks ASR is an underground storage reserve in the Carrizo Aquifer in southern Bexar County. As a SAWS water management project, it is designed to store Edwards water when demand is less than available supply. The stored water is returned to San Antonio for use when demand is high and Edwards supply is restricted by Critical Period Management and other drought-related limitations.

The capacity and capabilities of the SAWS ASR are such that it can be used to meet SAWS ratepayer expectations and, if operated as described in the EAHCP, will play a significant role as a Phase I activity to protecting the Covered Species at Comal and San Marcos Springs.

Operations: The Edwards Aquifer Habitat Conservation Plan Program Interlocal Contract between the Edwards Aquifer Authority and The San Antonio Water System for the Use of the Twin Oaks Aquifer Storage and Recovery Project for contribution to Springflow Protection, effective August 14, 2013, takes elements of the EAHCP's ASR flow protection strategy and places them into an operations contract.

Injection: Storage of EAHCP groundwater shall be at the discretion of SAWS and will be dependent on operating conditions. All EAHCP groundwater made available to SAWS before June 30th, 2020, will be physically stored or credited as if stored, and will be used to meet any forbearance from the Aquifer should triggers defined in the Interlocal Contract occur in 2020.

Forbearance and Recovery: Forbearance of Edwards Aquifer pumping from certain wells will occur when the ten-year rolling recharge average is less than 500,000 acre-feet and the ten-day average of aquifer levels measured at the J-17 index well drop below 630 feet mean sea level (MSL). The annual amount of water to be recovered from the ASR during a repeat of the drought of record is outlined in Exhibits E & F of the Interlocal Contract. Changes to the Presumptive Forbearance Schedule outlined in Exhibit E may be approved as outlined in Section 5.3 of the Interlocal Contract.

Leasing: In 2020 the total amount of water available under long-term leases is 15,924 acre-feet. The amount of groundwater withdrawal rights secured by the EAA is enough water to meet the filling goal of 126,000 acre-feet. In 2018, EAA staff began marketing long-term (ten-year) forbearance agreements with regional permit holders effective in 2019. A total of 14,609 acre-feet in forbearance agreements are still needed in order to have 50,000 acre-feet of groundwater withdrawal rights under EAA control that will remain unused during drought of record conditions.

Monitoring:
The EAA will actively manage the Interlocal Contract with SAWS. Status reports and updates will be provided regularly to the Implementing Committee.

ASR Regional Advisory Group: Per Section 5.5.1 of the EAHCP, a 12-person SAWS ASR Regional Advisory Group will meet to advise SAWS as SAWS makes the decisions relating to the operation of the ASR facility relevant to the EAHCP. Membership on the Regional Advisory Group will include: four representatives from the San Antonio Water System, the EAHCP Program Manager; one representative each from the EAA, EAA permit holder for irrigation purposes, small municipal pumpers, the spring cities, environmental interests, industrial pumpers, and downstream interests.

Budget:

Table 7.1:

$4,759,000 – Lease Options
$2,194,000 – O&M
$6,953,000 – Total

2020 available budget:

$4,759,000 – Lease Options
$2,194,000 – O&M
$6,953,000 – Total

Estimated 2020 budget:*

$5,891,594 – Lease & Forbearance Options
$408,255 – O&M
$6,299,849 – Total

*Actual expenditures for 2020 will be determined by the terms of the Interlocal Contract depending on the quantity of EAHCP groundwater physically stored, the amount of active water leases, and the cost of eligible operation and maintenance activities. Budgeted money that is not spent will be placed in the reserve fund.

5.1.3 Regional Water Conservation Program

Long-term Objective:
To reduce withdrawals from the Edwards Aquifer by 10,000 acre-feet, realized through implementation of conservation measures that will conserve 20,000 acre-feet of water.

Background: Conservation is one of four springflow protection measures of the Edwards Aquifer Habitat Conservation Plan (EAHCP) intended to reduce aquifer withdrawals, and subsequently increase aquifer level and springflow. The concept is to reduce aquifer withdrawals by 10,000 acre-feet and the EAHCP contemplates using a Regional Water Conservation Program (RWCP) to achieve this goal.

In order to provide an immediate benefit to the aquifer and springflow, several entities within the EAA jurisdictional area have agreed to make Initial Commitments to the EAA Groundwater Trust. The initial contribution of 10,000 acre-feet solicited from EAA permit holders was placed in the Groundwater Trust for a period of ten years (Table 1).

The Initial Commitment is returned to the permit holders through the implementation of conservation initiatives and technical assistance provided by the EAHCP. As conservation savings accrue, one-half of the savings are realized by the party participating in the RWCP and the other half is placed in the Groundwater Trust for the remaining term of the EAHCP ITP; allowing the original donors to have their donated water returned on a pro-rata basis. Consequently, 20,000 acre-feet of conservation savings are necessary for full return of the Initial Commitments.

Table 1: Initial Commitment Contracts

Entity	**Acre-Feet of Water Donated**
San Antonio Water Supply	8,000
City of San Marcos	300
Texas State University	100
TOTAL	**8,400**

These Initial Commitments are to be returned to the permit holder at the end of 10 years or when an equal amount is identified as conserved and in reserve by the RWCP. Initial Commitments will be returned to the permit holder in a proportion equal to their contribution.

In late 2015, a specific leak repair program contract 15-780-HCP with SAWS was negotiated and executed, that will fulfill the goal of the 10,000 acre-feet in the EAA Groundwater Trust by 2020 (Table 2). The contract covers the remainder of the ITP and is estimated to conserve almost 20,000 acre-feet accrued over the first five years. The 15-780-HCP contract is an extension of leak repair capabilities. SAWS hires contractors to expand the number of leak repairs that qualify under the agreement, many attributed to SAWS increased vigilant leak detection program funded entirely by SAWS. Regular progress reports from SAWS to EAHCP staff provide number of leaks repaired and an estimate of the overall savings within the time-period of reporting. An annual report is provided to communicate the overall savings realized throughout the year.

Table 2: SAWS – EAA 5-year water savings commitment and fiscal obligation

Water	2016	2017	2018	2019	2020	Total
Estimated Savings (AF)	4,745	4,745	4,745	4,745	632	19,612
Commitment to the Groundwater Trust (AF)	2,372.5	2,375.5	2,372.5	2,372.5	316	9,806
Payment	$4,507,750	$4,507,750	$4,507,750	$4,507,750	$600,400	$18,631,400

With the payment of $950 per acre-foot of water conserved that has been used as a standard for other RWCP participants, the contract will cost $18,631,400. The remaining 9,800 acre-feet will be kept in the Groundwater Trust necessary to complete the 10,000 acre-foot goal.

Target for 2020:
With the execution and implementation of the contract with SAWS in 2016, the RWCP will have effectively met its conservation goal in 2020. The Regional Water Monitoring Committee submitted a letter communicating to the Implementing Committee in fall of 2017 the finalization of the RWCP. Effort in 2020 will be to monitor, and report upon, the work SAWS continues to implement in association with their contract with EAA for leak repair.

Monitoring:
As part of this contact, SAWS is obligated to transfer to the EAA Groundwater Trust half of the water saved under this program. SAWS will provide a total of three summary reports capturing and quantifying yearly milestones.

Budget:
Table 7.1:
$1,973,000

2020 available budget:
$600,400

Estimated 2020 budget:
$600,400

5.1.2 Voluntary Irrigation Suspension Program Option

Long-term Objective:

The goal of VISPO is to enroll 41,795 acre-feet (AF) of permitted irrigation rights (base and/or unrestricted) that will remain unused in years of severe drought based on the approved 2019 minor amendment. Permit holders are enrolled in five-year and ten-year VISPO agreements and will be compensated based on the amount of water enrolled and the program selected. Table 1 below shows the initial payment scale for the five and ten-year VISPO programs. If the water level at the J-17 index well in San Antonio is at or below 635 feet on October 1 of any year, program participants are contractually obligated to suspend the use of their enrolled water for the following year - beginning on January 1.

Table 1: VISPO Enrollment Options

Years	Fee	1	2	3	4	5
5*	Stand-by	50.00	50.75	51.51	52.28	53.06
	Suspension**	150.00	152.25	154.53	156.84	159.18
5***	Stand-by	$54	$54	$54	$54	$54
	Suspension**	$160	$160	$160	$160	$160
10	Stand-by	57.50	57.50	57.50	57.50	57.50
	Suspension**	172.50	172.50	172.50	172.50	172.50

Years	Fee	6	7	8	9	10
10	Stand-by	70.20	70.20	70.20	70.20	70.20
	Suspension**	210.60	210.60	210.60	210.60	210.60

***The amount of each payment escalates at 1.5% annually over the five years of the program.

**Suspension payment is made in addition to stand-by payment.

***5-year program rate beginning 2019.

In year 2018 the total enrollment of 40,921 acre-ft. was sustained. Beginning January 1, 2019, over 9,489 acre-ft. of the 5-year agreements expired including an additional 15,812 acre-feet beginning in year 2020. Beginning May 2018, EAA staff began marketing 5-year VISPO forbearance agreements in an attempt to re-enroll permit holders with expiring VISPO agreements. Table 2 reflects the current distribution of enrolled water and is reflective of new enrollments and any amendments made to VISPO agreements.

Table 2: VISPO Enrolled Water by County

Program	Atascosa (AF)	Bexar (AF)	Comal (AF)	Hays (AF)	Medina (AF)	Uvalde (AF)	Total (AF)
5-year	516	665	0	0	2,952	9,671	13,804
10-year	0	1,573	0	0	7,953	6,094	15,620
Total	516	2,238	0	0	10,905	15,765	29,424

VISPO did not trigger on October 1, 2018; therefore, all enrolled water can be used by the permit holders in 2019. Table 3 reflects total payout by year for enrolled water.

Table 3: VISPO Total Payout by Year

Year	Payment Type	Total Enrolled (AF)	Total
2014	Stand-by	22,388	$1,201,938
2015	Suspension	40,921	$8,677,262
2016	Stand-by	40,921	$2,188,500
2017	Stand-by	40,921	$2,209,000
2018	Stand-by	40,921	$2,228,300
2019	Stand-by	39,646	$2,320,309
		Grand Total	$18,825,309

Target for 2020:
The effort to re-enroll participants back into the VISPO forbearance program began in year 2018 and will continue throughout 2019. It is expected that EAA staff will re-enroll lost water from expiring agreements and secure up to 40,921 acre-feet by year 2020. Staff will observe the J-17 index well on October 1, 2019 and respond by making payments in a timely fashion and monitor pumping to confirm compliance.

Budget:
Table 7.1:
$4,172,000

2020 available budget:
$4,172,000

Estimated 2020 budget:
$2,508,070

5.1.4 Edwards Aquifer Authority Stage V Critical Period Management

Stage V Critical Period Management was developed and included in the Edwards Aquifer Habitat Conservation Plan to help decrease withdrawals and maintain adequate spring flows at both Comal and San Marcos Springs during times of drought. On February 14, 2012, the Edwards Aquifer Authority (EAA) Board of Directors voted to amend its Critical Period Management (CPM) Program to include the new emergency Stage V. Implementation of Stage V results in a reduction of 44% to municipal, industrial and irrigation permit holders in both pools of the Edwards Aquifer who are authorized to withdraw more than 3 acre-feet per year. Stage V became effective as a rule on March 18, 2013 when the Incidental Take Permit was issued by the U.S. Fish and Wildlife Service.

2020 Implementation:
EAA staff monitors daily aquifer levels in both the San Antonio and Uvalde Pools of the Edwards Aquifer Region, if at any time, the 10-day average for aquifer or springflow levels in either pool reaches the designated trigger for Stage V, the EAA General Manager will issue a Notice of Commencement for implementation in five newspapers within the EAA jurisdiction. Notice will also be posted at the EAA's office and on the EAA website. All affected permit holders will also be provided written notice of implementation of Stage V and the requirement to reduce pumping by 44%.

Permit Holder Assistance:
The EAA provides an online Critical Period Calculator to assist permit holders in calculating CPM reductions as they apply to each individual permit holder's total authorized withdrawal amount throughout the year. EAA staff also assists permit holders through "one-on-one" customer service offerings as may be necessary.

Triggers:
The triggers for Stage V in the San Antonio Pool are as follows: the 10-day average at the J-17 index well in San Antonio falls below 625 mean sea level (msl); or the 10-day average at Comal Springs falls below 45 cubic feet per second (cfs); or the 3-day average at Comal Springs falls below 40 cfs. In the Uvalde Pool, Stage V is triggered when the 10-day average at the J-27 index well falls below 840 msl.

Reporting:
By rule, permit holders are required to report their annual groundwater use to the EAA by January 31 for all groundwater used the preceding year. Permit holders who use more Edwards groundwater than authorized annually are subject to enforcement action.

6.3.1 Biological Monitoring Program for the Comal and San Marcos Aquatic Ecosystem

Long-term Objective:
Since 2000, the Edwards Aquifer Authority (EAA) has undertaken biological monitoring of the Comal and San Marcos spring systems. In 2013, the elements of the program were incorporated into the Biological Monitoring Program (BioMP) for the Edwards Aquifer Habitat Conservation Plan (EAHCP).

The purpose of the BioMP is "to monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities" (EAHCP § 6.3.1). The BioMP includes: (1) Comprehensive Sampling, (2) any triggered Critical Period Monitoring, (3) any high flow triggered monitoring (4) and any EAHCP-specific sampling required by Section 6.4.

Target for 2020:
The 2020 BioMP for the Comal and San Marcos aquatic ecosystems will continue to include Baseline and Critical Period Monitoring along with Disturbance impact assessment and overall Take Determinations. The 2020 BioMP will continue to use the standard operating procedures adopted in 2016 as a result of the Biological Monitoring Work Group (EAHCP 2016) in addition to what is noted in this document. These standard operating procedures were instituted for the BioMP beginning in 2017.

Monitoring:
Aquatic Vegetation Mapping: The contractor will conduct aquatic vegetation mapping in the four long-term monitoring reaches in the Comal Springs system and in the three long-term monitoring reaches in the San Marcos Springs system. The comprehensive mapping is conducted using a GPS unit with real-time differential correction with sub-meter accuracy.

Zebra Mussel Monitoring: The contractor will conduct zebra mussel monitoring using passive techniques in both the Comal and San Marcos rivers.

Texas wild-rice Mapping: The contractor will map all Texas wild-rice from Spring Lake downstream to the confluence of the Blanco River on an annual basis. The annual mapping will occur during the summer (July-August). The location of every stand of wild-rice will be recorded using a GPS unit with real-time differential correction with sub-meter accuracy.

Fountain Darter Sampling: The contractor will conduct drop and dip netting and visual aquatic surveys with SCUBA during the Spring and Fall sampling events. Additional dip net sampling will be conducted during the Summer sampling event. Aquatic vegetation will be mapped in the reaches prior to drop and dip net activities.

Drop Net Sampling: Drop netting will be used to sample fountain darters in identified reaches of the rivers in specific aquatic vegetation types that have been selected through stratified random sampling. Fountain darters will be identified, counted, measured, examined for condition and returned to the river at the point of collection. Other fish will be identified and released, or preserved, and identified in a laboratory. Live rams-horn snails will be counted, measured, and destroyed. Exotic Asian snails and Asian clam will be identified, general abundance recorded,

then destroyed. The number of crayfish per drop net will be noted. Furthermore, the vegetation type, height, areal coverage, substrate type, mean column velocity, velocity at 15 centimeters (cm) above the bottom, water temperature, conductivity, and dissolved oxygen levels will be recorded at each location.

Dip Net Sampling: The contractor will conduct dip net timed surveys, as well as presence/absence surveys in specified sections throughout the spatial extent of both systems. Fountain darters collected by dip net monitoring will be examined for gill condition. Timed surveys will be conducted in all habitat types within each section, moving upstream during the sampling process, up to a depth of 1.4 m, with prime darter habitat receiving the most effort.

Presence/absence surveys will be conducted by taking 4 dip net sweeps at 50 permanent sample site locations within the 4 representative reaches at Comal Springs (Upper Spring reach [5 locations], Landa Lake reach [20 locations], Old Channel reach [20 locations], and New Channel reach [5 locations]), and the 50 permanent sample site locations within the three representative reaches in San Marcos Springs (Spring Lake Dam reach [15 locations], City Park reach [20 locations], and I-35 reach [15 locations]).

Visual Fountain Darter Survey: Visual aquatic surveys will be conducted using SCUBA in a fixed location in Landa Lake to identify fountain darters at depths deeper than conventional sampling methods allow.

Comal Springs Invertebrate Sampling: The contractor will conduct sampling for Comal Springs invertebrates during the Spring and Fall sampling events.

One drift net each will be placed over the main spring orifice of Spring Run 1, Spring Run 3, and Spring Run 7 at Comal Springs. All endangered invertebrates will be identified and counted in the field and returned to the orifice they were collected upon completion of the 24-hour sample period. All other invertebrates will be preserved and transported to an off-site laboratory for taxonomic classification. Coordination with the USFWS San Marcos Aquatic Resources Center (SMARC) will take place each time to assist with refugia collections when needed.

The Comal Springs riffle beetle cotton lure standard operating procedure, or a suggested (and EAHCP staff approved) alternate method, and quantitative survey methods will be utilized to conduct Comal Springs riffle beetle sampling in three locations (Spring Run 3, western shoreline of Landa Lake, and Spring Island area). Ten springs within each of the three locations will be identified for sampling by the contractor.

The Comal Springs riffle beetle cotton lure standard operating procedure and cotton lure quantitative survey method allow Comal Springs riffle beetles to be identified, counted, and returned to their spring of origin. Other spring invertebrates collected on the lures will also be noted. These include two other riffle beetles (*Microcylloepus* sp. And *Stenelmis* sp.), Comal Springs dryopid beetles (Stygoparnus comalensis), and Peck's cave amphipod (*Stygobromus pecki*).

In 2018, a Comal Springs riffle beetle Work Group was convened to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. This Work Group may produce recommendations which will modify the current BioMP. A work plan amendment may follow in the latter part of 2019 for inclusion into the 2020 Work Plan.

Salamander Visual Observations: The contractor will conduct salamander sampling during each Spring and Fall sampling event. Comal Salamander surveys will be timed and conducted by observation from the surface or dive mask and snorkel at Spring Run l, Spring Run 3, Spring Island spring runs, and at the eastern outfall at Spring Island.

San Marcos salamander surveys follow the quantitative sampling method described in Nelson, J. (M.S. Thesis, Texas State University, 1993). Observations for the San Marcos salamander will be done by dive mask and snorkel or SCUBA for three, 5-minute timed surveys per area. San Marcos salamanders will be counted, measured and the overall substrate where they were found documented.

In both systems, sampling will require turning over rocks in the sample site for set periods of time in order to expose the salamanders and obtain a visual count. Whenever possible, all rocks will be returned to their original location. For this monitoring, salamanders will only be observed, and no collections will occur.

Comal Springs Discharge Measurements: The contractor will conduct discharge measurements on Comal Springs during the Spring and Fall sampling events. Discharge measurements will be conducted at Spring Runs 1, 2, and 3, Upper Spring Run Reach, and the Old Channel below Elizabeth Street and will be used to establish the contributions of each major spring run to total discharge in the river and to establish the relative proportion of water flowing in the Old and New Channels.

Water Quality Sampling: The contractor will maintain and download existing thermistors located throughout each system. Standard water quality parameters (water temperature, conductivity compensated to 25°C, pH, dissolved oxygen [mg/l], water depth at sampling point, and observations of local conditions) will be sampled during drop net sampling and fish community sampling activities.

Fixed Station Photography: The contractor will photo document each established, fixed station photograph site. Photographs involve an upstream, across, and downstream picture of the reach and capture key changes in the habitat in the reach.

Macroinvertebrate Community Assessment: The macroinvertebrate community assessment will be conducted using rapid bioassessment (RBA) protocol as described in "Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data." TCEQ RG-416. 2014. The RBAs will be conducted in 5 reaches in the Comal and 4 reaches in the San Marcos at the drop-net fountain darter sites. One composite sample will be collected from each reach (i.e. 9 samples total across both systems). Macroinvertebrate community assessments will be conducted during Comprehensive Sampling and Critical Period Monitoring events.

Fish Community Sampling:
SAN MARCOS SYSTEM—Fish will be sampled at two locations within Spring Lake associated with San Marcos salamander surveys (Big Riverbed and Hotel Area) and one location just upstream of the eastern spillway. Two different SCUBA techniques will be used to document the fish within the three locations, mesohabitat and microhabitat surveys. Three additional SCUBA survey locations will occur in the San Marcos River (Upper, Mid, and Lower), located in representative deep areas where seining has proven to be inefficient. The exact location of the SCUBA sampling within each section may change slightly based on conditions at the time of the sampling event.

In addition to SCUBA, fish in the San Marcos River will be sampled among five sites within three reaches (Upper: Sewell, Veteran's Park, Middle: Crook's Park, and Lower: San Marcos Wastewater Treatment plant and Smith property) via seines within wadeable habitats. Multiple seine hauls will occur along a river transect perpendicular to the flow. Within each seine haul, fish will be identified, measured, examined for disease, and native fish returned to the river. Exotics will be removed from the system as per scientific permit. In addition to fish data, habitat data will be collected for each seine haul including current velocity, water depth, substrate composition, in-stream coverage, climatic conditions, and mesohabitat type.

COMAL SYSTEM—Fish will be sampled at three locations within Landa Lake via SCUBA surveys. In particular, one of the SCUBA survey locations in Landa Lake will be in the same as the ongoing fountain darter belt transect survey. In addition, SCUBA surveys will be conducted within the Upper Spring Run, Old Channel, and New Channel sections of the Comal River. Two different SCUBA techniques will be used to document the fish within the three locations, mesohabitat and microhabitat surveys.

In addition to SCUBA surveys, three locations (Upper Spring Run, New Channel, and Old Channel) will be sampled via seines among wadeable habitats to evaluate and track fish populations in the Comal River. Multiple seine hauls will occur along a river transect perpendicular to the flow. Within each seine haul, fish will be identified, measured, examined for disease, and native fish returned to the river. Exotics will be removed from the system as per scientific permit. In addition to fish data, each seine haul will include habitat measurements (i.e. current velocity, water depth, substrate composition, in-stream coverage, climatic conditions, and mesohabitat type).

EAHCP Habitat Baseline and Disturbance Determination: This determination is intended to fulfill Section M 1a and 2a of the Incidental Take Permit (ITP).
DOCUMENT BASELINE HABITAT CONDITIONS—The contractor will use January 1 of the contract year GIS mapping, biomonitoring data and other existing sources to establish occupied habitat for the EAHCP Covered Species. Specific to Item M (la and 2a) of the ITP, only occupied habitat within the Comal and San Marcos springs/river ecosystems will be included.

DOCUMENT EAHCP MITIGATION AREAL EXTENT PER PROJECT—The contractor will work with staff and contractors from the City of New Braunfels, City of San Marcos and Texas State University, coordinating through EAA staff, to describe in GIS map form, representing a snapshot

in time on December 31 of the contract year, the areal extent of all direct EAHCP mitigation and restoration activities in the Comal and San Marcos springs systems.

If GIS files of the project/affected areas are unavailable, the contractor will either: l) map those areas directly with high grade GPS in real-time, or 2) use existing areal imagery to pinpoint and outline locations with subsequent, supplemental GPS ground truth mapping. The contractor will ensure that areas represented on all maps are representative of actual mitigation, not concept areas.

Assessment of Net Disturbance: The contractor will evaluate the baseline maps versus the EAHCP project maps and quantify the area of direct disturbance that may have potential effects from mitigation and restoration activities as described in Item M (la and 2a) of the ITP. The focus will be on quantifying the direct impacts (removal of non-native vegetation, etc.) via areal coverage of habitat, but will also describe potential indirect impacts (turbidity, etc.) qualitatively. This analysis will not extend beyond comparisons of areal coverage of occupied habitat.

Annual "Take" Estimate: The contractor shall estimate Take for each of the Covered Species utilizing the information generated by the BioMP, the information and guidance in Chapters 4 and 6 of the EAHCP, the Biological and Conference Opinion issued by USFWS, and any other relevant information. The purpose of this Take estimation is to ensure compliance with Section H of the ITP.

Critical Period Monitoring: The Critical Period Monitoring component will be performed on both systems and be based upon established flow trigger levels for each system. The type and extent of sampling conducted is dependent on the respective trigger level and is designed to be duplicative of full biomonitoring sampling and will include species-specific sampling based on the flow triggers.

HIGH/LOW FLOW MONITORING—The contractor will conduct high flow Critical Period Monitoring only after the following triggering criteria are met:

a) The daily average flow exceeds 385 cubic feet per second (cfs) in the San Marcos aquatic ecosystem or 500 cfs in the Comal aquatic ecosystem (total flow through the ecosystem as measured at the USGS gauging station located immediately downstream of the ecosystem); and

b) After conducting a joint visual inspection of the aquatic ecosystem with the contractor, EAA staff determines that high flow Critical Period Monitoring is warranted and approved.

Before high flow Critical Period Monitoring is conducted, the sampling parameters must be recommended by the contractor and pre-approved by EAA staff, based on professional judgment, and may include any parameter from the full biomonitoring sampling, with the exception of gill net sampling.

The Comal and San Marcos springs systems flow-based triggers are associated with specific sampling parameters.

SAN MARCOS SYSTEM SAMPLING—Low flow Critical Period Monitoring for the San Marcos River triggers at 120 cfs, with Texas wild-rice vulnerable stand monitoring as described in Task 3 of the Comprehensive Sampling Program. Monitoring will occur at 5 cfs declines or a maximum of once per week. The first Full Sampling Event is triggered at 100 cfs, with subsequent declining Full Sampling Events triggering at 85, 60, 25, and 10-0 cfs for a total of five declining Full Sampling Events. In addition, two recovery Full Sampling Events would be conducted as the system rebounds from the low flow period. Between Full Sampling Events, habitat evaluations, per every 5 cfs decline, would be conducted again not to exceed weekly monitoring.

COMAL SYSTEM SAMPLING— Low flow Critical Period Monitoring for the Comal River triggers at 200 cfs. This triggers the first Full Sampling Event with 4 subsequent Full Sampling Events being triggered at 150, 100, 50, and 10-0 cfs, respectively. Two recovery Full Sampling Events are scheduled as the flows rebound and stabilize from drought conditions. The Comal system also has habitat evaluations scheduled between Full Sampling Events; however, at 10 cfs increments again not to exceed weekly observation. An additional component for the Comal system is the detailed riffle beetle habitat evaluation and spring orifice condition documentation that is triggered at 120 cfs and continued at 10 cfs increments during decline.

A review of historic flow records indicates that the lower the flow, the lower the chance an even lower flow event will occur, thus reducing the chances of a complete decline and recovery as outlined above. Typically, both systems rebound from drought conditions due to a tropical depression rainfall event or some other weather pattern that produces a large amount of rainfall over the watershed. Flows typically come up rapidly and require a period of stabilization before the collection of biological data is meaningful.

Gill Net Evaluation: In addition to the full sampling activities, the contractor will conduct gill net evaluations in the immediate vicinity of the fountain darter SCUBA surveys in Spring Lake and Landa Lake. The Spring Lake evaluation will be triggered at 85 cfs and lower triggers. The Landa Lake assessment will be triggered at 100 cfs and lower triggers. The survey is designed to examine exotic fish concentrations and stomach content analyses with respect to predation of listed species. The number of each species (native and non-native) collected in the gill net and the data will be recorded and converted to catch per unit effort.

Water Quality Grab Sampling: The contractor will collect water quality grab samples at the established triggers at 18 stations longitudinally distributed in the San Marcos system and 12 stations longitudinally distributed in the Comal system. The samples will be from the surface, mid-depth and near bottom.

EAHCP Low Flow Sampling: To protect the Covered Species, Chapter 6 of the EAHCP contains specific flow requirements for both systems that trigger sampling events. This sampling is in addition to the Comprehensive Sampling and Critical Period Monitoring components and consists of an increased frequency of sampling for aquatic vegetation, Texas wild-rice mapping, as well as additional sampling of fountain darters, Comal Springs riffle beetles, and salamanders.

Budget:
Table 7.1:
$400,000

2020 available budget:
$400,000

Estimated 2020 budget:
$755,774*

*Includes Critical Period Monitoring if required

5.7.2 Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs

Long-term Objective:

This work plan details the sampling strategy and protocols for surface water quality monitoring in 2020 for the Edwards Aquifer Habitat Conservation Plan (EAHCP) (Section 5.7.2) implemented by the Edwards Aquifer Authority (EAA), utilizing a third-party contractor. The goal of the water quality monitoring program, first implemented in 2013, is to detect water quality impairments that may negatively impact the listed species. If certain constituents of concern are detected at levels indicating the potential for adverse effects, the Implementing Committee members with jurisdictional authority will be consulted to identify sources and consider best management practices (BMPs) to reduce and/or eliminate the constituents of concern. If necessary, additional testing could be included in the current or following year to assist in determining the source of contamination and the Science Committee could be consulted to assist with BMP identification and source determination.

Target for 2020:

In 2015, the EAHCP received the *National Academy of Sciences (NAS) Report 1* (2015) containing recommendations for EAHCP's Monitoring, Modeling and Applied Research programs, including the Expanded Water Quality Monitoring Program. From *Report 1,* a list of water quality monitoring recommendations was presented to the NAS Recommendation Review Work Group (NAS Work Group). Based on the NAS Work Group assessment, at its February 18, 2016, meeting, the Implementing Committee convened the 2016 EAHCP Expanded Water Quality Monitoring Program Work Group (WQWG) to carry out a holistic review of the Expanded Water Quality Monitoring Program, considering the recommendations of NAS, the NAS Work Group, the input of the Science Committee, the Permittees, and subject matter experts. The purpose of the WQWG was to produce a final report for review by the Implementing Committee, developed through a consensus-based decision-making process. The WQWG held meetings from March to May 2016. This work plan reflects inclusion of the changes recommended by the WQWG.

For 2020, the contractors will use the same sampling locations used in 2017 as shown in the attached Figures 1 through 4. However, changes in springflow, surface water runoff, land use, site security and access may dictate minor modification to sample collection locations and schedules as sampling efforts progress. Any minor changes resulting from these factors that are necessary because of safety or equipment concerns will be noted in the field sample sheets and dedicated field books. Should logistics or safety issues require any significant changes to this work plan, the sampling contractors shall report those issues to the EAA. Subsequently, the EAA will present those changes to the Science and Implementing committees for review and approval as needed prior to their implementation.

Monitoring:

Comal Springs: Comal Springs discharges an average of about 290 cubic feet second (cfs) into Landa Lake, located within the city of New Braunfels, Texas. Comal Springs is considered a spring complex with multiple discharge points along the 4,500-foot reach of Landa Lake. The springs issue from the Edwards Group limestone along the 4,500-foot section of the northeast-southwest trending escarpment formed by the Comal Springs Fault. Landa Lake forms the headwaters of the Comal River which flows approximately two miles before entering the Guadalupe River.

Discharge measurements have been collected from Comal Springs since 1933, and the EAA has been collecting water quality samples for more than ten years. EAA collects samples from Spring 1, Spring 3, and Spring 7 on a biannual basis during normal flow conditions and more frequently when dictated by research interests. Spring 1, Spring 3, and Spring 7 discharge into Landa Lake and make up part of the Comal Springs complex. Figure 1 indicates these historical groundwater sampling locations. Water quality samples are collected and analyzed for field parameters including dissolved oxygen (DO), pH, conductivity, temperature and alkalinity[1]. Samples are also submitted to an EAA contracted laboratory for analysis of cations, anions, nutrients, metals, VOCs, SVOCs, herbicides and pesticides, bacteria, TOC, PCBs, and phosphorous.

SAMPLING METHODS—All samples will be collected following the EAA's *Field Sampling Plan* or contractor's established methodology upon approval by the EAA. Samples shall be analyzed by a laboratory accredited by the National Environmental Laboratory Accreditation Program (NELAP). No requests to deviate from the EAA's *Field Sampling Plan* have been received or approved to date.

SURFACE WATER PASSIVE SAMPLING—Passive samples are to be collected during the 2020 sampling effort using a passive diffusion sampling device. Devices will be obtained from Amplified Geochemical Imaging LLC (AGI) or be equivalent to AGI devices in functionality and parameters available for analysis. Sample locations for passive diffusion samples (PDS) in Figure 1 are Upper Springs (near Bleiders Creek), Upper Landa Lake (near Spring Island), Lower Landa Lake (above outfalls), Upper Old Channel (Elizabeth Street), and USGS Gauge (above San Antonio Street Bridge).

The passive sampling effort shall be performed in February, April, June, August, October, and December. The devices shall be installed for a two-week interval at the same locations as the sediment samples. When conducting passive sampling events, the contractor will also sample for pharmaceutical and personal care products using a Poly Organic Chemical Integrative System (POCIS) at the most downstream sample site (U.S. Geological Survey [USGS] gauge above San

[1] Field alkalinity analysis will be conducted within seven days of sample collection.

Antonio Street Bridge). The parameter set for PDS is listed in Table 1 and the parameter set for POCIS is listed in Table 2.

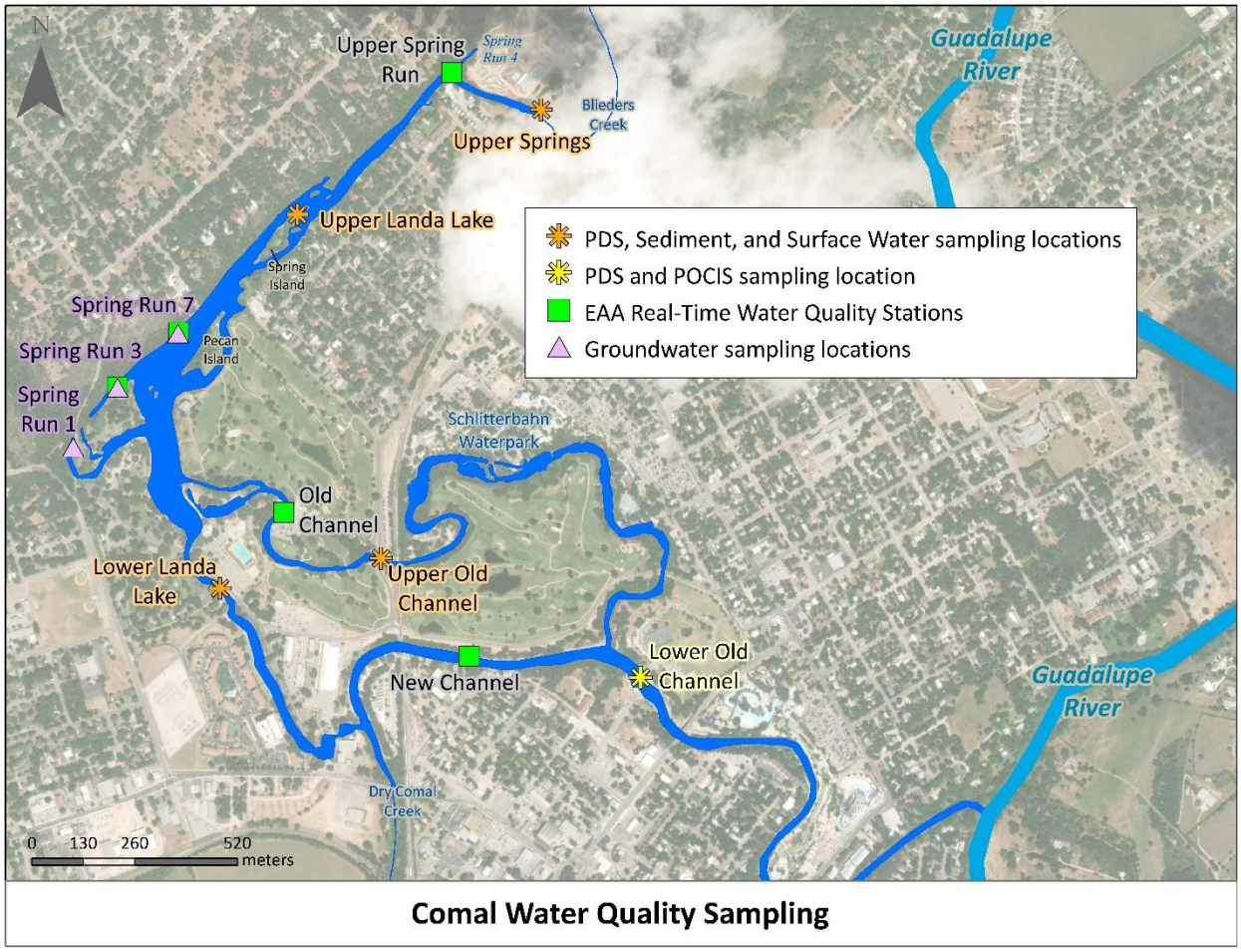


Figure 1. Comal System Groundwater Sampling Locations, Passive Diffusion Sampler (PDS) and POCIS Sampling Locations, and EAA Real-Time Water Quality Station Locations

Table 1. Analytical Parameters for Passive Diffusion Samplers (PDS)

PDS devices are to be placed at the locations listed Figures 2 and 6, for a two-week time period in the months of February, April, June, August, October, and December.
PDS devices will be from Amplifed Geochemical Imaging, LLC, or equivalent and shall provide analyses for the following: TPH, BTEX, 1,3,5 and 1,2,4-trimethylbenzene, MTBE, phenanthrene, naphthalene1-methyl naphthalene, octane, cis and trans-1,2,-dichloroethene, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, 1,2-dichloroethane, carbon tetrachloride, trichloroethene, tetrachloroethene, chlorobenzene, 1,4-dichlorobenzene, 1,1,2-trichloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,3-dichlorobenzene, and 1,2-dichlorobenzene.

Table 2. Analytical Parameters for Poly Organic Chemical Integrative Samplers (POCIS)

POCIS diffusion samplers are to be placed at the locations listed Figures 1 and 3, for a four-week time period in the months of February, April, June, August, October, and December.
17-a-Estradiol, 17-a-Ethynylestradiol, 17-b-Estradiol, Diethylstilbestrol, Epitestosterone, Estriol, Estrone, Progesterone, Testosterone, Bisphenol A, Diclofenac, Gemfibrozil, Ibuprofen, Iopromide, Naproxen, Salicylic Acid, Triclosan, Acetaminophen, Amoxicillin, Atenolol, Atorvastatin, Azithromycin, Caffeine, Carbamazepine, Ciprofloxacin, Cotinine, DEET, Diazepam, Fluoxetine, Galaxolide (HHCB), Meprobamate, Methadone, Oxybenzone, Phenytoin (Dilantin), Praziquantel, Primidone, Quinoline, Sucralose, Sulfamethoxazole, TCEP, TCPP, TDCPP, and Trimethoprim

STORMWATER SAMPLING PROGRAM—One stormwater sampling event will be performed in 2020 to evaluate stormwater and runoff quality from the urban landscape. A stormwater sampling event will be triggered when the flow rate at the USGS Comal Springs gauging station (#08169000) above San Antonio Street Bridge increases by 5% or if there is a 20% change in three of the five water quality parameters measured in the downstream real-time water quality monitoring probe. Five samples will be collected at Upper Springs (near Blieders Creek) and New Channel (below confluence with Dry Comal Creek) with the remaining sites sampled only three times (Figure 2). Sampling times will be spaced to reflect changes in the stream hydrograph (one to three during initial rise or first flush, one at peak flow and one during the recession limb).

Stormwater samples will be analyzed using the methods found in Table 3 with duplicate samples as describe in Table 4.

SEDIMENT SAMPLING—The contractor will conduct one sediment sampling event at each of the PDS sampling locations (Figure 1). Three samples will be collected at each sample site and composited into one sample for analysis. Sediment samples will be analyzed for the parameters shown in Table 5.

FISH COMMUNITY SAMPLNG—Fish collections from the Comal River system will be conducted during odd numbered years in conjunction with routine Biological Monitoring sampling so no collections will occur this year.

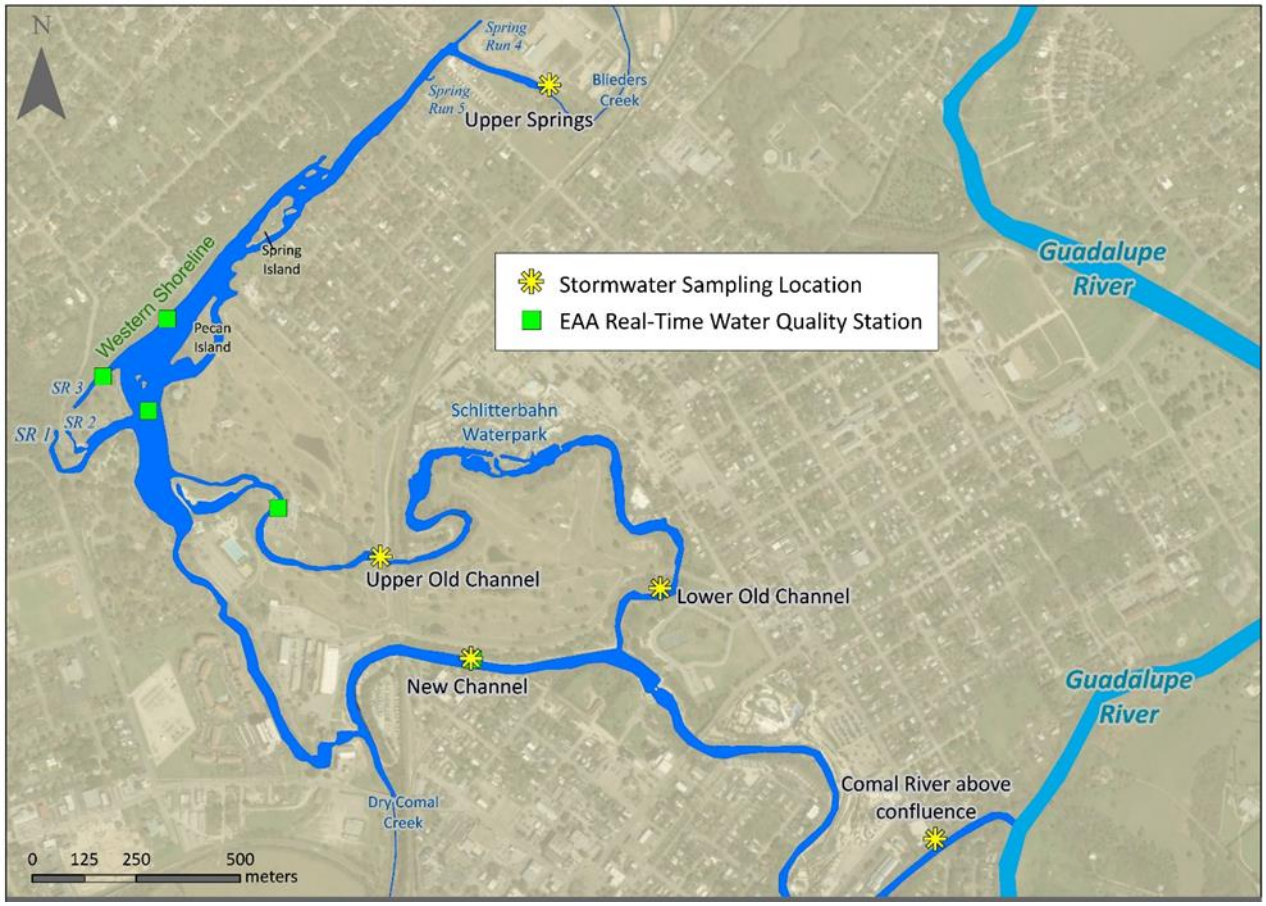


Figure 2. Comal System Stormwater Sampling Locations

Table 3. Analytical Parameters for Assessing Water Quality—Even Years

Analyses
Volatile Organic Compounds (VOCs)
Semi-volatile Organic Compounds (SVOCs)
Organochlorine Pesticides
Polychlorinated Biphenyls (PCBs)
Organophosphorous Pesticides
Herbicides
Metals (Al, Sb, As, Ba, Be, B, Cd, Cr [total], Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn)
General Chemistry (GWQP) Total Alkalinity (as CaCO3), Bicarbonate Alkalinity (as CaCO3), Carbonate Alkalinity (as CaCO3), Cl, Br, NO_3, SO_4, Fl, pH, TDS, TSS, Ca, Mg, Na, K, Si, Sr, CO_3, and Total Suspended Solids (TSS).
Phosphorus (total)
Total Organic Carbon (TOC),
Dissolved Organic Carbon (DOC)
Kjeldahl Nitrogen
Bacteria Testing (*E coli*)
Caffeine

Method	**Method Description**	**Protocol**
8260B	Volatile Organic Compounds	(GC/MS) SW846
8270C	Semivolatile Organic Compounds	(GC/MS) SW846
8081B	Organochlorine Pesticides	(GC) SW846
8082A	Polychlorinated Biphenyls (PCBs)	by Gas Chromatography SW846
8141A	Organophosphorous Pesticides	(GC) SW846
8151A	Herbicides	(GC) SW846
6010B	Metals	(ICP) SW846
6020	Metals	(ICP/MS) SW846
7470A	Mercury	(CVAA) SW846
300.0	Anions,	Ion Chromatography
340.2	Fluoride	MCAWW
365.4	Phosphorus,	Total EPA
9040C	pH	SW846
9060	Organic Carbon,	Total (TOC) SW846
SM 2320B	Alkalinity	SM
SM 2540C	Solids,	Total Dissolved (TDS) SM
SM 2540D	Solids, Total Suspended (TSS)	SM
351.2	Nitrogen, Total Kjeldahl	MCAWW
1694	Caffeine	

Protocol References:
EPA = US Environmental Protection Agency
MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
SM = "Standard Methods For The Examination Of Water And Wastewater",
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Table 4. Number of required QA/QC Samples for Stormwater and Sediment Sampling

QA/QC Samples (Duplicates/EQ Blanks)	**Equip. Blanks**	**Duplicates**	**Total**
Comal Surface Water=	2	2	4
San Marcos Surface Water=	2	2	4
Comal Stormwater=	2	4	6
San Marcos Stormwater=	2	6	8
Comal Sediments=	1	1	2
San Marcos Sediments=	1	1	2
Total Costs QA/QC Samples	**10**	**16**	**26**

Table 5. Analytical Parameters for Assessing Water Quality from Sediment Sample Locations

Analyses
Volatile Organic Compounds (VOCs)
Semi-volatile Organic Compounds (SVOCs)
Organochlorine Pesticides
Polychlorinated Biphenyls (PCBs)
Organophosphorous Pesticides
Herbicides
Metals (Al, Sb, As, Ba, Be, B, Cd, Cr [total], Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn)
General Chemistry Total Alkalinity (as CaCO3), Bicarbonate Alkalinity (as CaCO3), Carbonate Alkalinity (as CaCO3), Ca, Mg, Na, K, Chloride, Sulfate, Fluoride, Si, Sr, Nitrate as N, pH, Total Dissolved Solids (TDS), and Total Suspended Solids (TSS).
Phosphorus (total)
Total Organic Carbon (TOC),
Dissolved Organic Carbon (DOC)
Bacteria Testing (*E coli*)

Method	**Method Description**	**Protocol**
8260B	Volatile Organic Compounds	(GC/MS) SW846
8270C	Semivolatile Organic Compounds	(GC/MS) SW846
8081B	Organochlorine Pesticides	(GC) SW846
8082A	Polychlorinated Biphenyls (PCBs)	by Gas Chromatography SW846
8141A	Organophosphorous Pesticides	(GC) SW846
8151A	Herbicides	(GC) SW846
6010B	Metals	(ICP) SW846
6020	Metals	(ICP/MS) SW846
7470A	Mercury	(CVAA) SW846
300.0	Anions,	Ion Chromatography
340.2	Fluoride	MCAWW
365.4	Phosphorus,	Total EPA
9040C	pH	SW846
9060	Organic Carbon,	Total (TOC) SW846
SM 2320B	Alkalinity	SM
SM 2540C	Solids,	Total Dissolved (TDS) SM
SM 2540D	Solids, Total Suspended (TSS)	SM

Protocol References:
EPA = US Environmental Protection Agency
MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
SM = "Standard Methods For The Examination Of Water And Wastewater",
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

REAL-TIME INSTRUMENT WATER QUALITY DATA LOGGING PROGRAM—Continuous water quality monitoring stations will continue in 2020 at Upper Spring Run, Spring Run 3, Spring 7, Old Channel, and New Channel (below confluence with Dry Comal Creek) (Figure 1).

Monitoring will be performed using a data logging sonde capable of collecting data on 15-minute intervals. The parameters measured will include temperature, dissolved oxygen, pH, and specific conductivity. These data will be evaluated to identify short-term and long-term water quality variations of the spring system as well as changes in water quality related to stormwater runoff. This monitoring effort will continue to be performed by EAA staff in 2020.

San Marcos Springs: Located in San Marcos, Texas, on the campus of Texas State University, San Marcos Springs discharges an average of about 175 cfs into Spring Lake. The springs issue from the Edwards Group limestone along the northeast-southwest trending escarpment formed by the San Marcos Springs Fault. Spring Lake forms the headwaters of the San Marcos River. Discharge measurements have been collected from San Marcos Springs since 1957, and the EAA has been collecting water quality samples for more than ten years.

EAA collects water quality samples from Deep Spring and Hotel Spring at least biannually, with more frequent sampling based on specific research interests. Both Deep and Hotel springs are in the bed of Spring Lake and make up part of the San Marcos Springs complex. Figure 3 indicates the locations of spring sampling at San Marcos Springs. Water quality samples are collected and analyzed for field parameters including dissolved oxygen (DO), pH, conductivity, temperature and alkalinity[2]. Samples are also submitted to the EAA contract laboratory for analysis of cations, anions, nutrients, metals, VOCs, SVOCs, herbicides and pesticides, bacteria, TOC, PCBs, and phosphorous.

SAMPLING METHODS—All samples will be collected following the EAA's *Field Sampling Plan* or contractor's established methodology upon approval by the EAA. Samples shall be analyzed by a NELAP accredited contract laboratory. To date, no requests to deviate from the EAA's *Field Sampling Plan* have been received or approved.

SURFACE WATER PASSIVE SAMPLING—Passive samples are to be collected during the 2020 sampling effort using a passive diffusion type sampling device. Devices will be obtained from AGI or be equivalent to AGI devices in functionality and parameters available for analysis. Sample locations for PDS samples are Sink Creek, Spring Lake, Sessoms Creek, City Park, Rio Vista Dam, IH-35 reach, and Capes Dam/Willow Creek (Figure 3).

The passive sampling effort shall be performed in February, April, June, August, October, and December. The devices shall be installed for a two-week interval at the same locations as the sediment samples. Each passive sampling effort will also include a POCIS placed only at the most downstream sample site (Capes Dam/Willow Creek). The parameter set for PDS samples is listed in Table 1 and the parameter set for POCIS is listed in Table 2.

[2] Field alkalinity analysis will be conducted within seven days of sample collection.

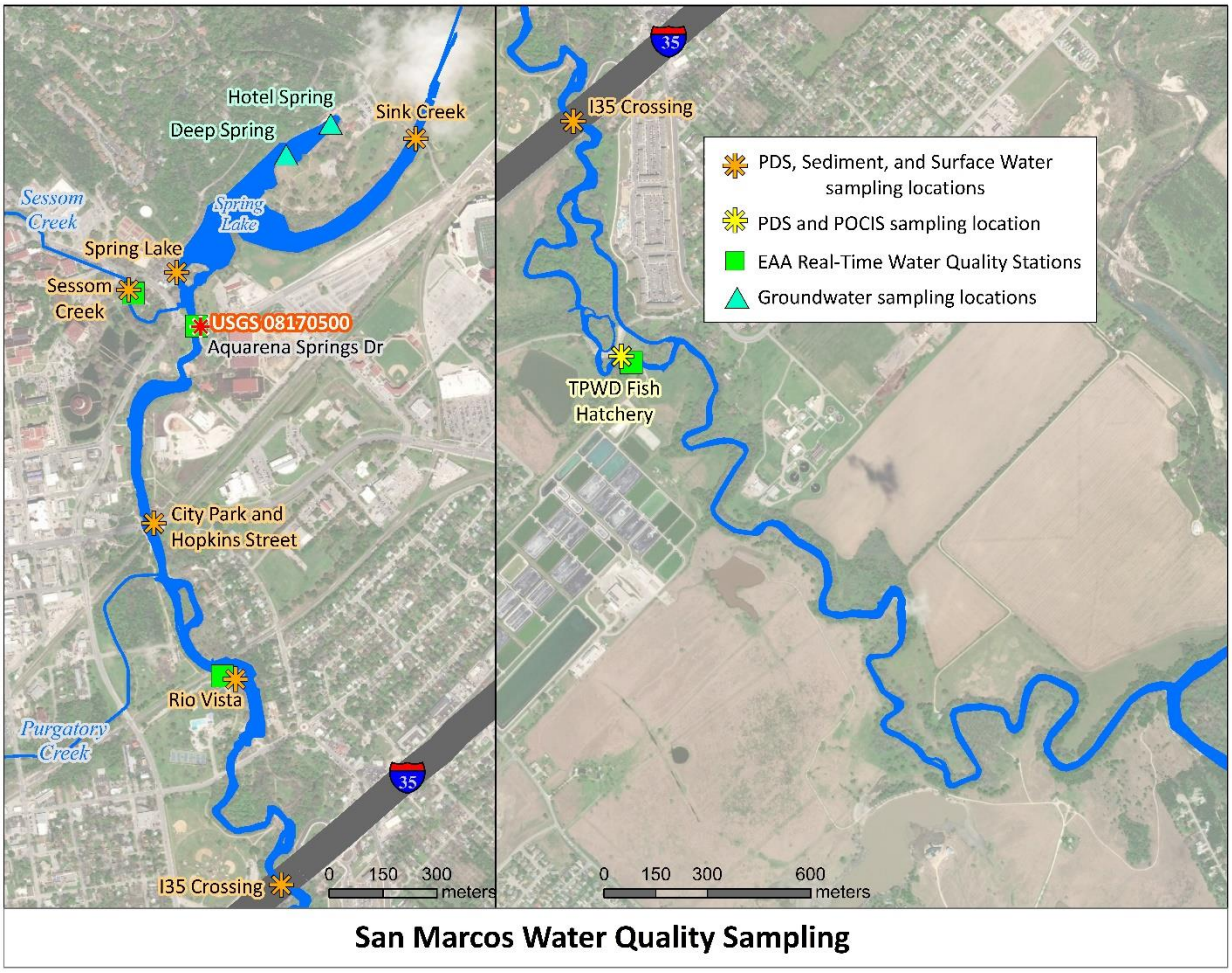


Figure 3. San Marcos System Groundwater, Passive Diffusion Sampler (PDS), POCIS, and EAA Real-Time Water Quality Station Locations

STORMWATER SAMPLING PROGRAM—The contractor will perform one stormwater sampling event each year. A stormwater sampling event will be triggered when the flow rate at the USGS San Marcos Springs gauging station (#08170500) increases by 5% or there is a 20% change in three of the five water quality parameters measured in the downstream telemetered real-time water quality monitoring probe. Three stormwater samples will be collected from each stormwater sampling location during a stormwater sampling event with the exception of Sessom and Sink creeks where five samples will be collected (Figure 4). Sampling times will be spaced to reflect changes in the stream hydrograph (one to three during initial rise or first flush, one at peak flow and one during the recession limb). Stormwater samples will be analyzed for the parameters listed in Table 3 with duplicate samples as describe in Table 4.

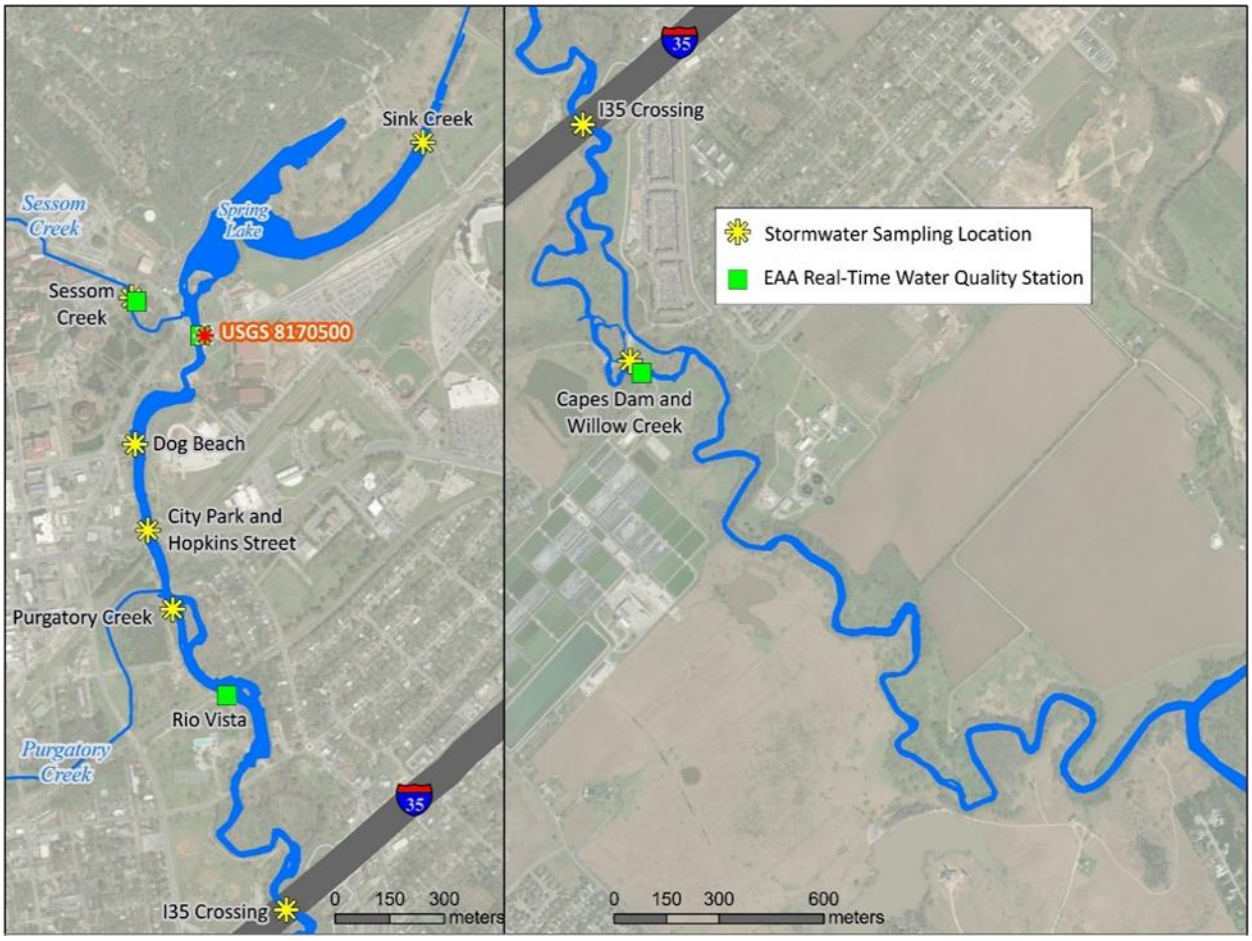


Figure 4. San Marcos System Stormwater Sampling Locations

SEDIMENT SAMPLING—The contractor will conduct one sediment sampling event at each of the PDS sampling locations (Figure 3). Three samples will be collected at each sample site and composited into one sample for analysis. Sediment samples will be analyzed for the parameters shown in Table 5.

FISH COMMUNITY SAMPLNG—Fish from the San Marcos River system will be collected during odd numbered years in conjunction with routine Biological Monitoring sampling, so tissue sampling will not occur in 2020.

REAL-TIME INSTRUMENT WATER QUALITY DATA LOGGING PROGRAM—Continuous water quality monitoring stations will operate in 2020 at the USGS gauging station (Aquarena Springs Drive), Rio Vista Dam, and Texas Park and Wildlife Department Fish Hatchery (Figure 3).

Monitoring will be performed using a data logging sonde capable of collecting data at 15-minute intervals. The parameters measured will include temperature, dissolved oxygen, pH, and specific

conductance. These data will be evaluated to identify short-term and long-term water quality variations of the spring system as well as changes in water quality related to stormwater runoff. Continuous water quality monitoring stations will be operated and maintained by EAA in 2020.

Water Quality Monitoring Reporting: The contractors will compile and present sampling results in an annual report to the EAA. The report will include an evaluation of analytical data, discussions of results that exceed comparative or regulatory standards, a discussion of water and sediment quality, laboratory reports and field data sheets, photographs, sampling locations and rationale, description of sampling methods, and a description and rationale for any deviations from the Water Quality Sampling Plan due to logistics or safety issues. The report is to be submitted electronically and will be reviewed internally by EAA.

Data Compilation, Analyses and Reporting: Data collected as a result of the 2020 EAHCP Water Quality Monitoring Plan will be compiled and analyzed, and the results will be presented to the Implementing Committee by February 15, 2021; prior to inclusion in the annual EAHCP Annual Report, which is required by Sections 6.2.4 and 9.3 of the EAHCP and Section 11.1c of the Implementing Agreement. The report will include an evaluation of all analytical data, including graphs, key photographs and general summary of results.

Funding is requested for maintenance and replacement needs for existing real-time instruments, as well as data transmission and web hosting fees. A detailed budget for the real-time instruments is listed in Table 6. Table 7 presents estimated costs for other water quality monitoring.

This 2020 Water Quality Work Plan will be reviewed by the Science Committee prior to implementation. The Science Committee will be asked to confirm the need for additions or changes to this Water Quality Work Plan.

Table 6. Estimated Costs Real-Time Water Quality Monitoring at Comal and San Marcos Springs for Operation and Maintenance

Comal Springs (Five Stations)	
One new Eureka Manta+ Probe (equipped to monitor Dissolved Oxygen, Temperature, pH, and Specific Conductance)	$7,000
Maintenance Costs for repairs and supplies (calibration standards, batteries, etc.)	$9,500
Emergency funds	$2,500
Comal Springs Total =	**$19,000**
San Marcos Springs (Four Stations)	
One new Eureka Manta+ Probe (equipped to monitor Dissolved Oxygen, Temperature, pH, and Specific Conductance)	$7,000
Maintenance Costs for repairs and supplies (calibration standards, batteries, etc.)	$9,500
Emergency funds	$2,500
San Marcos Springs Total =	**$19,000**
Grand Total =	**$38,000**

Table 7. Estimated Costs for Water Quality Monitoring at Comal and San Marcos Springs

Task	Comal Springs	San Marcos Springs
Stormwater Runoff Sampling	$ 69,332.00	$ 83,704.00
Surface Water Passive Diffusive Sampling	$ 29,911.50	$ 37,759.50
Sediment Sampling	$ 16,105.00	$ 22,548.00
Fish Tissue Sampling	$ 0.00	$ 0.00
Meetings, Presentations, and Reporting	$ 16,525.00	$ 16,525.00
2020 Total =	$131,873.50	$160,536.50
Grand Total =		**$292,410.00**

Budget:

Table 7.1:

San Marcos Springs water quality monitoring and protection (EAHCP § 5.7.2 and 5.7.6): $100,000

Comal Springs water quality monitoring (EAHCP § 5.7.4): $100,000

2020 available budget:

$200,000

Estimated 2020 budget:

Real-time Instruments (RTI): $38,000 (Table 6)

Other Water Quality Monitoring: $292,410 (Table 7)

Justification for Budget Adjustment: The real-time water quality data logging instrumentation is in need of funding for maintenance, in addition spare instrumentation is needed to prevent

extended down time in the event of catastrophic failure. The instruments also require funding for calibration fluids, batteries, and other incidental costs. Cost details are provided in Table 6. Other water quality monitoring costs are consistent with previous years based on the parameters developed through past work groups and committees.

6.3.3 Ecological Modeling

Long-term Objective:
The development of a mechanistic ecological model (Ecomodel) is assigned to the Edwards Aquifer Authority (EAA) per section 6.3.3 of the Edwards Aquifer Habitat Conservation Plan (EAHCP). The purpose of the Ecomodel is to evaluate potential adverse effects to Covered Species and their critical habitat, and to the extent such effects are determined to occur, quantify their magnitude and develop alternate strategies.

Target for 2020:
No Ecological Modeling work is anticipated in 2020.

Budget:
Table 7.1
$25,000

2020 available budget:
$0

Estimated 2020 budget*
$0

*There is no proposed budget for 2020.

6.3.4 Applied Research

Long-term Objective:
Applied research added a valuable component to Phase I of the EAHCP to better understand the ecological dynamics for all Covered Species.

Target for 2020:
Savings from Phase I will be applied to perform research to support a better understanding of existing Conservation Measures and collect data to support efforts to define biological goals for the next Incidental Take Permit expected in 2028.

Budget:
Table 7.1:
$0

2020 available budget:
$250,000

Estimated 2020 budget:
$250,000*

* $1,995,506 remains from the Table 7.1 Phase I budget. $1,995,506 divided over 8 years, the time remaining in the current Incidental Take Permit is roughly $250,000.

5.1.1 Refugia

The U.S. Fish and Wildlife Service's (USFWS) San Marcos Aquatic Resources Center (SMARC) and Uvalde National Fish Hatchery (UNFH) will provide refugia, salvage, reintroduction, and monitoring services in fulfillment of the Refugia Contract (Contract # 16-822-HCP) between the Edwards Aquifer Authority (EAA) and the USFWS.

This annual work plan and associated cost estimate have been developed per the requirements of contract number 16-822-HCP for the Implementation of the Refugia Program under the EAHCP. The tasks and subtasks that follow provide the details for the services to be performed in 2020, which provide for the maintenance of a refugia population of the Covered Species (Table 1) including the salvage, propagation, and restocking of the species, if species-specific habitat triggers occur and species are extirpated, plus research conducted on the Covered Species.

Table 1: Eleven species identified in the EAHCP and listed for coverage under the ITP

Common Name	Scientific Name	ESA Status
Fountain darter	*Etheostoma fonticola*	Endangered
Comal Springs riffle beetle	*Heterelmis comalensis*	Endangered
San Marcos gambusia	*Gambusia georgei*	Endangered*
Comal Springs dryopid beetle	*Stygoparnus comalensis*	Endangered
Peck's Cave amphipod	*Stygobromus pecki*	Endangered
Texas wild-rice	*Zizania texana*	Endangered
Texas blind salamander	*Eurycea rathbuni*	Endangered
San Marcos salamander	*Eurycea nana*	Threatened
Edwards Aquifer diving beetle	*Haideoporus texanus*	Petitioned
Comal Springs salamander	*Eurycea* sp.	Petitioned
Texas troglobitic water slater	*Lirceolus smithii*	Petitioned

*The San Marcos gambusia was last collected in the wild in 1983 and may already be extinct.

Long-term Objective:

Background: Section 5.1.1 of the EAHCP requires the EAA to provide a series of refugia, with back-up populations, to preserve the capacity for these species to be re-established in the event of the loss of population due to a catastrophic event.

The concept of refugia is to house and protect adequate populations of the Covered Species and to conduct research activities to expand knowledge of their habitat requirements, biology, life histories, and effective reintroduction techniques. Actions and funding contained within this work plan will be limited to the Covered Species listed in the EAHCP and those associated species that have significant impact on the Covered Species such as predators, competitors, pathogens, parasites, food, cover, and shelter.

2020 Assumptions:

As work plans are developed almost a year prior to implementation, it is possible that methods described herein may be contingent on the status of the current year's activities or authorization from the EAHCP process. If conditions change, this work plan may need to be amended to

accommodate realized outcomes.

- Target numbers for the standing and refugia stocks to be housed at both the UNFH and SMARC are established by the USFWS-EAA Refugia Contract (Contract # 16-822-HCP).
- Species capture rates are expected to be similar to historic values.
- Mortality rates of specimens held in captivity are expected to be similar to historic values.
- Target species collection numbers from the 2019 Work Plan are expected to be reached.
- Staff members remain employed at the two Service facilities throughout the performance period.

Target for 2020 Task 1. Refugia Operations:

Standing Stocks: The existing stocks at the SMARC and UNFH will be considered standing stocks under the executed contract (Contract # 16-822-HCP) and will be held in Service facilities until EAA specific Refugia and Quarantine facilities are complete and functional. USFWS staff will take all appropriate steps to collect and maintain standing/refugia stocks at their respective target captive population size in order to provide refugia for all the Covered Species. Table 2 displays the target species numbers.

Table 2: Species target refugia numbers and census

Species	Standing Stock	Refugia Stock	Salvage Stock	Anticipated SMARC census (Jan 2020)	Anticipated SMARC census (Dec 2020)	Anticipated UNFH census (Jan 2020)	Anticipated UNFH census (Dec 2020)
Fountain Darter (Comal)	1000	1000 including specimens within the standing stock	2000	300	400	200	300
Fountain Darter (San Marcos)	1000	1000 including specimens within the standing stock	2500	500	500	500	500
Texas Wild-Rice	430	430 including specimens within the standing stock	1500	215	215	150	215
Texas Blind Salamander	500	500 including specimens within the standing stock	500	110	125	15	30
San Marcos Salamander	500	500 including specimens within the standing stock	500	250	250	250	250
Comal Springs Salamander	500	500 including specimens within the standing stock	500	80	100	50	75
Peck's Cave Amphipod	500	500 including specimens within the standing stock	500	250	250	160	250
Comal Springs Riffle Beetle	500	500 including specimens within the standing stock	500	#	#	#	#
Comal Springs Dryopid Beetle	500	500 including specimens within the standing stock	500	*	*	*	*
Edwards Aquifer Diving Beetle	500	500 including specimens within the standing stock	500	*	*	*	*
Texas Troglobitic Water Slater	500	500 including specimens within the standing stock	500	*	*	*	*

for 2020 we plan on collecting Comal Springs riffle beetles mainly to support research purposes rather than standing stock, until we can increase survivability in captivity
*catch rates and hatchery survival are uncertain given the rarity of the species

Collection: In 2020, we will collect Covered Species as required to reach and maintain target standing and refugia stock numbers as shown in Table 2. Species collections will be coordinated with other ongoing EAHCP activities (e.g. Biological Monitoring Program) so that collections for refugia do not adversely impact other efforts. Species specific collections will be carried out through a variety of passive and active collection methods. Prior to collections, Hazard Analysis Critical Control Point (see Appendix A of the 2017 EAA Work Plan) will be conducted to minimize aquatic invasive species transfer. Collection efforts will be documented and reported to EAA. Captured specimens will be divided between the SMARC and UNFH facilities in order to ensure redundancy and to expedite the obligation to establish and maintain two refugia populations at separate locations. All species will be held in respective quarantine areas until their health has been assessed. Once it is determined that specimens are free from pathogens, parasites, and invasive species they will be incorporated into the general refugia population. USFWS will share reports, including test results, produced as part of the quarantine process. Species-specific collection plans generally follow those detailed within the 2019 Work Plan; however, collection efforts vary based upon collection and knowledge gained during the previous year's collection efforts. The following sections briefly describe planned 2020 collection, maintenance, and propagation efforts for each species.

Fountain Darters:

COLLECTION—Fountain darters in 2020 will be collected primarily in coordination with the Spring and Fall Biomonitoring events to create efficiencies and reduce habitat disturbance. After fountain darters are collected via drop nets for biomonitoring, USFWS staff will retain them for refugia purposes. Specimens will be collected along a longitudinal gradient. Approximately equal proportions of fish from upper and lower reaches in the Comal (upper = above Landa Lake dam; lower = below Landa Lake dam) and San Marcos (upper = Spring Lake, Middle = Spring Lake dam to Rio Vista dam, lower = below Rio Vista dam to Capes dam) rivers will be collected. Historically, approximately 20% of the fountain darters collected annually succumb to natural mortality. If unusual mortality events occur, they will be thoroughly investigated, and summary reports will be conveyed to the EAA as part of the monthly reports. As a result, fish collections will target additional fish so that as individuals perish the remainder within the captive population should not decrease below the target number between collection events. Higher mortality rates of incoming Comal fountain darters have been seen in the past collections. We are currently working with the Fish Health Unit to determine the cause(s). Due to this we will target fewer Comal fountain darters to collect and have in Standing Stock until survivability is improved. Due to the detection of largemouth bass virus in Comal fountain darters throughout the Comal River habitat, all Comal fountain darters will be maintained in quarantine facilities in consideration of other species located on the two stations.

As part of quarantine procedures, a subset of fish (N = 60 per river) will be sent to the southwest regional Fish Health Unit or equivalent facility for pathogen (bacteria, virus, and parasite) testing prior to specimen incorporation into the general refugia population following standardized methods outlined within USFWS and AFS-FHS (2016) and AFS-FHS (2005); reports will be provided to EAA.

MAINTENANCE—Water quality (i.e., temperature, pH, dissolved oxygen, total dissolved gasses) will be monitored and recorded weekly. Fountain darters will be fed live foods reared or

purchased. Ponds will be utilized to produce zooplankton and amphipods. Amphipods will be collected from other managed ponds and raceways. Black worms will be purchased when necessary along with other food resources (i.e. blood worms, brine shrimp, etc.) if the need arises. Food items are not routinely examined for pathogens. However, if they are suspect and tested for pathogens all diagnostic results will be conveyed to the EAA within monthly reports.

PROPAGATION—Standing and refugia stocks for each river will be maintained to discourage reproduction unless EAHCP triggers occur. Fish will be maintained by their geographical locations. If reintroduction is warranted, subsets from each geographical location will be communally spawned. Subset groups will be culled to an equal number of progeny prior to release.

Texas wild-rice:

COLLECTION—Texas wild-rice tillers will be collected from San Marcos River reaches (Fig. 1), with a break during summer months when wild-rice does not fare well due to heat stress. In 2020 collections for SMARC will target stands that are not already part of the refugia population or require supplementation. Collections for UNFH will continue to build their refugia numbers and representative locations. The refugia populations will reflect the wild populations in both their respective proportion and genetic diversity that was historically documented within San Marcos River (Wilson et al. 2016). During tiller collection, the GPS coordinates, area coverage, and depth of the stand or individual plant will be recorded so the exact location of the clone is known. For larger stands, tillers will be collected at the beginning, middle and end of the stand, or every 20% of the stand's total length for the largest stands. Tiller collection will be done by wading and SCUBA diving. Please note that during the 2018 Texas wild-rice survey no plants were found in Section I. Sections J and K were not surveyed. Plants were found in sections E, G, and H. All sections will be re-evaluated during the 2019 Texas wild-rice survey.

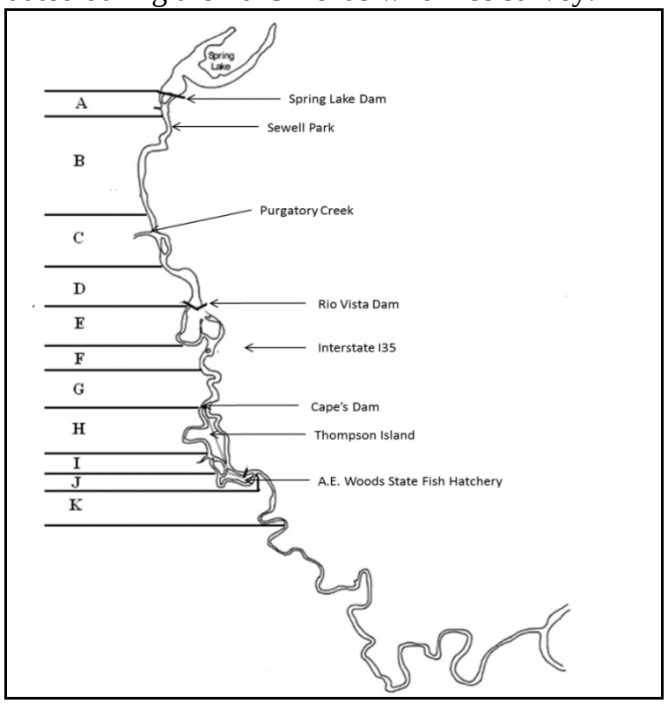


Figure 1 Letters define designated San Marcos River reaches where Texas wild-rice is collected for refugia populations.

MAINTENANCE—Once tillers have been successfully rooted they will be tagged and maintained so that their collection location is known.

PROPAGATION—Plants will be maintained so sexual reproduction does not occur within the refugia population, unless EAHCP triggers occur. If reintroduction is warranted, seeds and tillers from each geographical location will be produced. Plants produced from seeds and tillers would be transplanted back within their original geographic location.

Texas blind salamanders:

COLLECTION—Texas blind salamanders will be collected through the use of nets and traps. Traps will be deployed quarterly for approximately 12 consecutive days with traps checked every 2-4 days to collect Texas blind salamander individuals from Primers Fissure, Johnson's well, Rattlesnake cave, and Rattlesnake well (Table 3). To avoid oversampling these habitats, only 1/3 of salamanders observed from each of these locations will be collected during quarterly sampling events. Salamanders will also be collected from a driftnet on Diversion Springs in Spring Lake fished throughout the year during times when we are not actively trapping in caves and wells. Specimens from this site will all be kept, given the assumption that any Texas blind salamander leaving a spring orifice that enters a stream or lake environment will ultimately succumb to predation. These sites will be checked for specimens up to three times per week when applicable. All specimens will be transported live and maintained in the SMARC or UNFH refugia. Drift nets on Sessom Creek and Texas State University Artesian Well are generally checked by Texas State University staff, live Texas blind salamanders are transferred to SMARC according to their permits. USFWS staff may periodically check nets on these sites when they are not being checked by Texas State University staff.

MAINTENANCE—Specimens will be marked by collection location. As part of quarantine procedures, all salamanders of each species will be non-lethally cotton swabbed. These samples will be sent to the southwest regional Fish Health Unit to screen for *Batrachochytrium dendrobatidis* (Bd, commonly referred to as chytrid fungus) and *Batrachochytrium salamandrivorans* (Bsal) prior to specimen incorporation into the general refugia population. Chytrid testing will occur in batches where groups of five swabs will be pooled for analysis. Duplicate individual swabs will be retained in case further testing is warranted. All salamanders will be held in quarantine for at least 30 days and until test results have returned. Chytrid (Bd) fungus has caused mortalities in amphibian species; however, some species appear to have innate immunity. Previous tests of wild caught salamanders at SMARC (both Texas Blind and San Marcos) have almost always tested positive for Bd. Clinically, the salamanders appear normal and do not have any lesions or signs of disease. Positive testing for Bsal will be treated more cautiously as it has not yet been documented in this area (or anywhere in North America); these salamanders would remain in quarantine until further study and recommendations from FWS Fish Health. Salamander tank and system maintenance such as acid washing and system sterilization will occur annually or as needed to ensure proper system function. Water quality will be monitored and recorded weekly. Salamanders will be fed live foods reared or purchased. Ponds will be utilized to produce amphipods. Amphipods will be collected from other managed ponds and raceways. Black worms will be purchased when necessary along with other food resources (i.e. blood worms, brine shrimp, etc.) if the need arises.

PROPAGATION—Standing and refugia stocks will be maintained to encourage reproduction. Salamanders will be marked with visible elastomers, coded by their geographical locations. All progeny will be maintained separately by generations. If reintroduction is warranted, an attempt will be made to produce offspring from each geographical location.

San Marcos salamanders:

COLLECTION—San Marcos salamanders will be collected up to quarterly from below Spring Lake dam and with SCUBA teams in Spring Lake (Table 3). The drift net on Diversion Springs will be checked routinely and specimens will be kept from this location. Collection efforts will be coordinated with the EAHCP Biological Monitoring Program. All specimens will be transported live and maintained in the SMARC and UNFH refugia. Historically, approximately 30% of the San Marcos salamanders collected annually succumb to natural mortality. As a result, salamander collections will target additional specimens so that as individuals perish the remainder within the captive population should not decrease below the target number between collection events.

MAINTENANCE—As part of quarantine procedures, all salamanders of each species will be non-lethally cotton swabbed. These samples will be sent to the southwest regional Fish Health Unit to screen for *Batrachochytrium dendrobatidis* (Bd, commonly referred to as chytrid fungus) and *Batrachochytrium salamandrivorans* (Bsal) prior to specimen incorporation into the general refugia population. Chytrid testing will occur in batches where groups of five swabs will be pooled for analysis. Duplicate individual swabs will be retained in case further testing is warranted. All salamanders will be held in quarantine for at least 30 days and until test results have returned. Chytrid (Bd) fungus has caused mortalities in amphibian species; however, some species appear to have innate immunity. Previous tests of wild caught salamanders at SMARC (both Texas Blind and San Marcos) have almost always tested positive for Bd. Clinically, the salamanders appear normal and do not have any lesions or signs of disease. Positive testing for Bsal will be treated more cautiously as it has not yet been documented in this area (or anywhere in North America); these salamanders would remain in quarantine until further study and recommendations from FWS Fish Health. Salamander tank and system maintenance such as acid washing and system sterilization will occur annually or as needed to ensure proper system function. Water quality will be monitored and recorded weekly. Salamanders will be fed live foods reared or purchased. Ponds will be utilized to produce amphipods. Amphipods will be collected from other managed ponds and raceways. Black worms will be purchased when necessary along with other food resources (i.e. blood worms, brine shrimp, etc.) if the need arises.

PROPAGATION—Standing and refugia stocks will be maintained to encourage reproduction. All progeny will be maintained separately by generation. If reintroduction is warranted, pair-wise and group mating will be employed to produce offspring. Stocking will occur once juveniles have reached 30 mm total length.

Comal Springs salamanders:

COLLECTION—Comal Springs salamanders will be collected up to quarterly from Comal Spring Runs 1-3 and Spring Island and surrounding areas (Table 3) by hand with dipnets using snorkelers. Close coordination with the EAHCP biological monitoring program will take place to ensure that to the degree practicable, refugia collections do not overlap with specific EAHCP long-term

monitoring locales. In the event overlap of sampling areas is unavoidable, Comal salamanders for refugia will be collected at a rate of no more than 10% of salamanders observed in those specific locales per daily sampling trip. A SCUBA team will be used for a portion of these collection efforts if necessary. Annual natural mortality will be recorded.

MAINTENANCE—As part of quarantine procedures, all salamanders of each species will be non-lethally cotton swabbed. These samples will be sent to the southwest regional Fish Health Unit to screen for *Batrachochytrium dendrobatidis* (Bd, commonly referred to as chytrid fungus) and *Batrachochytrium salamandrivorans* (Bsal) prior to specimen incorporation into the general refugia population. Chytrid testing will occur in batches where groups of five swabs will be pooled for analysis. Duplicate individual swabs will be retained in case further testing is warranted. All salamanders will be held in quarantine for at least 30 days and until test results have returned. Chytrid (Bd) fungus has caused mortalities in amphibian species; however, some species appear to have innate immunity. Previous tests of wild caught salamanders at SMARC (both Texas Blind and San Marcos) have almost always tested positive for Bd. Clinically, the salamanders appear normal and do not have any lesions or signs of disease. Positive testing for Bsal will be treated more cautiously as it has not yet been documented in this area (or anywhere in North America); these salamanders would remain in quarantine until further study and recommendations from FWS Fish Health. Salamander tank and system maintenance such as acid washing and system sterilization will occur annually or as needed to ensure proper system function. Water quality will be monitored and recorded weekly. Salamanders will be fed live foods reared or purchased. Ponds will be utilized to produce amphipods. Amphipods will be collected from other managed ponds and raceways. Black worms will be purchased when necessary along with other food resources (i.e. blood worms, brine shrimp, etc.) if the need arises.

PROPAGATION—Standing and refugia stocks will be maintained in gender-mixed groups to allow for reproduction. All progeny will be maintained separately by generation. If reintroduction is warranted, pair-wise and group mating will be employed to produce offspring. Stocking will occur once juveniles have reached 30 mm total length.

Comal Springs riffle beetle:

COLLECTION—Comal Spring riffle beetle collection in Spring Runs 1-3 and around Spring Island will be up primarily for research purposes with fewer numbers being held just for Standing Stock purposes as research into increasing survival rates is conducted (Table 3). Collections from the Spring and Fall Biomonitoring will be transferred to USFWS for refugia purposes. Riffle beetles will be collected with cotton lures. Cotton lures will be deployed in a variety of locations (Spring Runs 1, 2, 3, N = 5-15 lures per spring run; western shore of Landa Lake, N = 5 lures; Spring Island and associated Spring Lake habitats N = 15-20 lures) following EAHCP standard operating procedures (Hall 2016).

MAINTENANCE—Specimens will not be maintained by collection location. Comal Springs riffle beetles will be maintained within custom built aquatic holding units and fed detrital matter and matured biofilms colonized on cotton lures.

PROPAGATION—Propagation methods for this species are being developed.

Peck's Cave amphipod:

COLLECTION—Peck's Cave amphipod collection will occur up to four times annually (Table 3). Adult Peck's cave amphipods will be collected with drift nets and by hand collection at variety of locations (drift nets: Spring Run 3, N = 2; Spring Island and associated Spring Lake habitats: hand collection). Collections will continue build up to target Standing Stock numbers.

MAINTENANCE—Specimens will not be maintained by collection location. Peck's Cave amphipods will be maintained within custom built aquatic holding units and fed commercial flake fish feeds.

PROPAGATION—Propagation methods for this species are being developed as part of standard refugia operations.

Comal Springs dryopid beetle:

COLLECTION—Comal Springs dryopid beetles will be collected primarily through the use of wooden lures and hand picking from submerged wood found in the Comal Spring system. If dryopid beetles are found on cotton lures used for Comal Spring riffle beetles they will also be retained (Table 3). We will potentially conduct two events of trapping in Panther Canyon Well during the year as access to the well and staff time allows. These will be bottle traps checked weekly for a month.

MAINTENANCE—Specimens will not be maintained by collection location. Comal Spring dryopid beetle will be maintained within custom built aquatic holding units and fed detrital matter and matured biofilms colonized on cotton lures.

PROPAGATION—Propagation methods for this species are being developed as part of normal refugia operations and research projects.

Edwards Aquifer diving beetle:

COLLECTION—Drift nets will be used to collect Edwards Aquifer diving beetle (Table 3). Drift nets will be set at a variety of locations where the species has been collected in the past (Texas State University Artesian Well N = 1; and Diversion Springs N = 1). Drift nets will be deployed and checked by USFWS staff when we are able to sample Texas State University Artesian Well (when not being used by Texas State staff).

MAINTENANCE—Specimens will not be maintained by collection location. Captured specimens will be transferred to the SMARC and housed in custom made aquatic holding systems. Edwards Aquifer diving beetles are predators; they will be fed small invertebrates (e.g., ostracods).

PROPAGATION—Propagation methods for this species are to be determined and will be conducted as part of normal refugia operations.

Texas troglobitic water slater:

COLLECTION—Texas troglobitic water slater will primarily be collected using a drift net on Diversion Springs, but organisms found on lures in the Comal Springs system will also be retained (Table 3).

MAINTENANCE—Captured specimens will be transferred to the SMARC and housed in custom made aquatic holding systems. Initially the species will be fed detrital matter and matured biofilms colonized on cotton lures. The species is also fed fish flake food to supplement their diet.

PROPAGATION—Propagation methods for this species are to be determined and will be conducted as part of normal refugia operations.

Table 3. A tentative schedule for all species sampling during 2020. Collections listed here are subject to change with extenuating circumstances such as weather and coordination with external partners. EEA and partners will be notified of sampling dates as they become known or changed.

Edward's Aquifer Species Collection Plan 2020			
Date (month)	**Interval**	**Location**	**Target Species**
Continuous	Check nets T and F every week; drift net collections suspended during Texas blind salamander trapping weeks	Diversion Springs	Texas Blind salamander, San Marcos salamander, Edward's Aquifer diving beetle, and troglobitic water slater
January	Check every T & F for 2 consecutive weeks	Rattlesnake Cave & Rattlesnake Well	Texas blind salamander
January	Set lures	Spring Runs, Landa Lake	CSRB, CSDB, PCA, TTWS
February	Check every T & F for 2 consecutive weeks	Primer's Fissure & Johnson's Well	Texas blind salamander
February	Collect lures	Spring Runs, Landa Lake	CSRB, CSDB, PCA, TTWS
February	1-day sampling event	San Marcos River	Texas wild-rice
March	1-2 day sampling event	Spring Lake and below dam	San Marcos salamander
March	1-day sampling event, hand pick	Landa Lake	Peck's Cave amphipod
April	Check every T & F for 2 consecutive weeks	Rattlesnake Cave & Rattlesnake Well	Texas blind salamander
April	1-day sampling event	San Marcos River	Texas wild-rice
April	Throughout, coincide with bio-monitoring	San Marcos River, Comal River	Fountain darters, CSRB, CSDB

Edward's Aquifer Species Collection Plan 2020			
Date (month)	**Interval**	**Location**	**Target Species**
May	Check every T & F for 2 consecutive weeks	Primer's Fissure & Johnson's Well	Texas blind salamander
May	1-2 day sampling event	Comal Springs	Comal Springs salamander
May	1-day sampling event	San Marcos River	Texas wild-rice
June	1-day sampling event, hand pick	Landa Lake	Peck’s Cave amphipod
July	Check every T & F for 2 consecutive weeks	Rattlesnake Cave & Rattlesnake Well	Texas blind salamander
August	Check every T & F for 2 consecutive weeks	Primer's Fissure & Johnson's Well	Texas blind salamander
August	1-day sampling event, hand pick	Landa Lake	Peck’s Cave amphipod
September	1-2 day sampling event	Spring Lake and below dam	San Marcos salamander
October	Check every T & F for 2 consecutive weeks	Rattlesnake Cave & Rattlesnake Well	Texas blind salamander
October	Throughout, coincide with bio-monitoring	San Marcos River, Comal River	Fountain darters, CSRB, CSDB
October	1-day sampling event	San Marcos River	Texas wild-rice
November	Check every T & F for 2 consecutive weeks	Primer's Fissure & Johnson's Well	Texas blind salamander

Edward's Aquifer Species Collection Plan 2020			
Date (month)	**Interval**	**Location**	**Target Species**
November	Beginning of month set lures	Spring Runs, Landa Lake	Comal Springs riffle beetle, Comal Springs dryopid beetle
November	1-day sampling event, hand pick	Landa Lake	Peck's Cave amphipod
November	1-2 day sampling event	Comal Springs	Comal Springs salamander
December	Check and reset lures	Spring Runs, Landa Lake	Comal Springs riffle beetle, Comal Springs dryopid beetle
December	1-day sampling event	San Marcos River	Texas wild-rice

Refugium Stocks:

COLLECTION—Standing Stock numbers contribute to Refugium Stock numbers and collections will continue until Standing stock numbers are attained. In the event that Refugium Stock triggers, outlined in the contract, are reached and Standing Stock are not at full capacity, special targeted collections will be conducted to build up numbers.

MAINTENANCE—Maintenance will be conducted in a similar manner described for standing stocks.

PROPAGATION—Propagation for stocking is not anticipated during 2020.

Salvage Stocks:

COLLECTION—If species-specific salvage triggers defined in the EAHCP are reached, the SMARC, in consultation with the EAA, will accommodate salvaged organisms no more than two times during the 12-year period. If triggers for multiple species are simultaneously reached, species collections during salvage operations will be prioritized based upon the perceived species-specific effect of reduced river and spring flow and habitat degradation (i.e. EAHCP triggers). Those species that are river obligate species (i.e., fountain darter and Texas wild-rice) or that occupy spring orifice and interstitial ground water habitats (i.e., San Marcos and Comal Springs salamander, Peck's Cave amphipod, Comal Springs dryopid beetle) are presumed to be affected first as flows decrease. Those that reside solely within the aquifer (i.e., Edwards Aquifer diving beetle, Texas troglobitic water slater and Texas blind salamander) are presumed to be affected subsequently.

MAINTENANCE—Organisms collected during salvage operations would be maintained at the SMARC for a limited duration (up to one-year) or until their disposition is determined. Research may be suspended or terminated if space is required for salvaged organisms. Research may also be suspended if personnel are directed to collection and maintain salvage stocks.

PROPAGATION—Likewise, production of species would be limited to no more than two times during the 12-year period once species extirpation is determined. Species produced at the SMARC would be held for a limited time (up to one year) or less if stocking is required. Research activities may be suspended or terminated if space is required to house cultured species. Research may also be suspended if personnel are directed to reproduce, maintain, or stock salvage stocks or standing stock progeny.

Construction/Renovation/Infrastructure/Facility: The SMARC Center Director will develop and maintain a list of warranty problems during the 1-year warranty period, forwarding items, as they occur, to the Contracting Officer (CO) and the USFWS Project Manager (COR).

All reasonable and practical security measures will be instituted by SMARC and UNFH staff to safeguard EAA refugia facilities, equipment, and species.

Staffing/Labor/Personnel: The Supervisory Fish Biologists (SFBs) at both the SMARC and UNFH will continue in their duties including, but not limited to: supervising, mentoring, and training lower-graded employees, authorize purchases, oversee facility maintenance and repair, develop and implement budgets, and organize activities that relate to all contract activities. The SFBs will manage, and coordinate research, propagation, culture, and field activities related to the refugia. The SFBs are expected to provide proper and efficient use of facilities and staff resources. The SFBs will work with the Center Director to ensure that contractual obligations are met in a timely manner. In coordination with the Center Director, they will prepare all the required written materials required for the reimbursable agreement reporting. Likewise, the SFBs will also prepare oral presentations to be used as briefing statements, outreach presentations, internal reports, work summaries, and technical presentations at professional meetings. The two SFBs will continue to work and communicate regularly with partners, Service personnel and other researchers to effectively meet Service and reimbursable agreement goals.

Under the management of a lead supervisory biologist at both facilities, it is expected that six Biological Science Technicians, three at each station, will continue to assist with the collection, daily upkeep, maintenance, propagation, and research efforts for the ten species at the SMARC and UNFH. This includes maintaining experimental and culture production systems, keeping records along with entering, filing, and collating data. The technicians will also generate basic summary statistics and graphic analyses of data and document program accomplishments through the composition of Standard Operating Procedures (SOPs), reports, and manuscripts.

PERMITTING: Both the UNFH and SMARC operate under the USFWS Southwest Region's Federal Fish and Wildlife Permit for Native, Endangered, and Threatened Species Recovery (number TE676811-3) and the Texas Parks and Wildlife Scientific Research Permits (UNFH SPR-1015-222, SMARC SPR-0616-153).

BIOSECURITY: Both the UNFH and SMARC operate under the SMARC BioSecurity Plan (2014) (Exhibit E of 16-822-HCP). Specimen Collection, Hazard Analysis Critical Control Points, Quarantine, & Specimen Transfer: San Marcos Aquatic Resources Center Standard Operating Procedure.

Target for 2020 Task 2. Research:

The Research Plan for 2020 will involve a series of activities ranging from increasing survival rates of various invertebrate species, virus transfer in darter, to reproduction of Texas blind salamanders. The following section describes the basic components of each of these proposed 2020 activities.

Project 1:

Title: Increasing survival rates of Peck's cave amphipod adults and F1 offspring

Species: *Stygobromus pecki*

Principal/Co-PI: Amelia Hunter, Makayla Blake, Dr. Lindsay Campbell

Overview: Different habitat enrichment items will be tried in holding containers for Peck's cave amphipods (PCA) to increase survival rates for wild stock adults. In addition, different food items will be added to test containers such as frozen tubifex worms or pellet foods, to see if they are a viable addition or alternative to fish flake that is currently given. Prototype holding containers for brooding females will be tested against the current brooding chambers employed for increased survival rates of F1 offspring.

Budget: $34,811.24

Benefit to the Refugia: Increased survival rates of PCA and continued refinement of propagation techniques.

Expected Results: The results of the study will be presented as a report to the EAA and if warranted an update to the PCA standard protocols.

Project 2:

Title: Increasing survival rates of Comal Springs dryopid beetle in captivity

Species: *Stygoparnus comalensis*

Principal/Co-PI: Makayla Blake, Mark Yost, Dr. Lindsay Campbell

Overview: Different holding containers and habitat enrichment items will be tested against the current holding environment of dryopid beetles for improved survival rates and egg production rates.

Budget: $42,939.20

Benefit to the Refugia: Increases survival rates of wild stock Comal Springs dryopid beetles in captivity.

Expected Results: The results of the study will be presented as a report to the EAA and if warranted an update to the Comal Springs dryopid beetle standard protocols.

Project 3:

Title: San Marcos salamander reproduction

Species: *Eurycea nana*

Principal: Kelsey Anderson, Rachel Wirick, Dr. Lindsay Campbell

Overview: We plan to follow up on the information learned during 2019 on San Marcos salamander reproduction. This would include a scale up of the pilot reproduction experiment conducted in 2019, if successful. Depending on the finding of the veterinary and pathology analysis of salamander samples in 2019, a treatment study might be warranted. If water quality analysis finds potential detrimental components, further filtration of water might be needed. All studies will be discussed with EAA Science Officer and the Science Review Committee.

Budget: $51,408.88

Benefit to the Refugia: Continued refinement of salamander reproduction and propagation. Information gained will inform reintroduction strategy.

Expected Results: The results of the study will be presented as a report to the EAA, an update to the reintroduction strategy, and update to the Eurycea sp. Propagation Manual.

Project 4:

Title: Comal Springs riffle beetle Pupation and Survivorship Research, continued

Species: *Heterelmis comalensis*

Principal: USFWS and potentially Subcontractor(s)

Overview: We plan to continue research from the knowledge gained during the research started in 2019 on increasing pupation rates. We would scale up successful treatments that increased pupation on a larger sample size of larvae to determine if the treatments continue to be successful. Further refinement of treatments might be needed to increase pupation rates. The fitness of F1 Comal Springs riffle beetles from the various treatments will also need to be assessed. Results from the nutrition treatments on increased survival will be scaled up to a larger sample size. Based on the information gathered on Comal Springs riffle beetle gut content analysis, we will design appropriate nutritional supplementation experiments.

Budget: $155,438.52

Benefit to the Refugia: Increased pupation and survival rates of Comal Springs riffle beetles.

Expected Results: Interim reports to USFWS and EAA on the successes and failures of various techniques tried and knowledge gained.

Target for 2020 Task 3. Species Propagation and Husbandry:

Development and refinement of SOPs for animal rearing and captive propagation: Continue to refine SOPs for all species as needed for updates to reflect new protocols that are instituted for each species throughout the year. As new information becomes available about genetic

management, further develop draft Captive Propagation Plans for all species.

Target for 2020 Task 4. Species Reintroduction:
Reintroduction Plan for term of contract: Continue to refine the Reintroduction Strategy as new information becomes available.

Reintroduction Plan for 2020: None

Any anticipated triggers being prepared for: Given current weather predictions, spring flows, and the Edwards Aquafer water level none are anticipated during the 2020 performance period.

Target for 2020 Task 5. Reporting:
Species specific Propagation plans (SOPs): Refine throughout year as needed.

Species specific Genetic Management plans: None during 2020.

Species specific Reintroduction plans: Refine as needed.

2020 EAHCP Annual Program reporting: USFWS will provide a year-end report of 2020 activities to the EAA no later than 1/31/2021.

Program reporting as required by ITP and TPWD: TPWD Scientific Research Permit Report will be conveyed to the EAA July 31, 2020.

Descriptions and photographs of procedures from collections to restocking: Photographs and documentation of collection and restocking will be included in the monthly report to the EAA CSO along with the year-end report.

Summaries of any data analyses, research, or genetic analyses: Research projects and results of collection efforts will be provided to the EAA in the monthly reports, year-end documentation, and stand-alone documents (agreed upon by the Center director and EAHCP CSO).

Description of terms and conditions of any permits received: As permits are received, their contents will be conveyed to the EAA.

Monthly electronic reports to EAHCP CSO: A monthly report of all activities will be provided to the EAHCP CSO. USFWS anticipates providing the report by the 10th of each month for the previous month's activities.

Target for 2020 Task 6. Meetings and Presentations:

- Planning or coordination meetings:
    - Yearly planning meeting with SMARC and UNFH staff

- Public meetings
    - EAA Board
        - End of year report
        - Present research results
    - Implementing Committee
        - End of year summary
    - Stakeholder Committee
        - End of year summary
    - Science Committee
        - Methods for research projects
        - Present research results

Monitoring:
Monitoring will be conducted through the use of progress reports and site visits to the refugia as well as through collaborative management by the EAHCP CSO.

Budget: Projected 2020 budget

U.S. Fish and Wildlife Service 2020				
	Task		**Task Budget Amount**	**Total Task Budget Amount**
1	**Refugia Operations**			**$ 612,537.31**
	SMARC Refugia & Quarantine Bldgs.			
	Equipment & Building Maintenance		$ 10,300.00	
	Utilities		$ 75,000.00	
	UNFH Refugia & Quarantine Bldgs.			
	Equipment & Building Maintenance		$ 10,300.00	
	Utilities		$ 70,000.00	
	SMARC Species Husbandry and Collection		$ 86,150.90	
	Fish Biologist (GS-12, 146 hrs)	$ 7,942.40		
	Fish Biologist (GS-07, 850 hrs)	$ 26,069.50		
	Fish Biologist (GS-07, 850 hrs)	$ 26,069.50		
	Fish Biologist (GS-07, 850 hrs)	$ 26,069.50		
	Weekend Walk Through		$ 7,500.00	
	Other Overtime		$ 2,000.00	
	UNFH Species Husbandry and Collection		$ 172,285.26	
	Fish Biologist (GS-11, 1125 hrs)	$ 48,982.50		
	Fish Biologist (GS-07, 1374 hrs)	$ 40,423.08		
	Fish Biologist (GS-07, 1374 hrs)	$ 41,439.84		
	Fish Biologist (GS-07, 1374 hrs)	$ 41,439.84		
	Weekend Walk Through		$ 7,500.00	
	Other Overtime		$ 2,000.00	
	Divers		$ 2,500.00	
	Fish Health		$ 8,000.00	
	SMARC Reimbursibles		$ 35,000.00	
	UNFH Reimbursibles		$ 35,000.00	
	Subtotal		*$ 523,536.16*	
	Admin Cost Subtotal		*$ 89,001.15*	
2	**Research**			**$ 444,176.00**
	Increasing Survival Rates of PCA		$ 34,811.24	
	Fish Biologist (GS-07, 520 hrs)	$ 15,948.40		
	Fish Biologist (GS-07, 452 hrs)	$ 13,862.84		
	Materials	$ 5,000.00		
	Increasing Survival Rates of Dryopids		$ 42,939.20	
	Fish Biologist (GS-11, 520 hrs)	$ 22,640.80		

	Fish Biologist (GS-07, 520 hrs)	$ 15,298.40		
	Materials	$ 5,000.00		
	San Marcos salamander reproduction		$ 51,408.88	
	Fish Biologist (GS-07, 904 hrs)	$ 27,725.68		
	Fish Biologist (GS-07, 520 hrs)	$ 15,298.40		
	Materials	$ 8,000.00		
	CSRB Pupation and Survival Research		$ 155,438.52	
	Fish Biologist (GS-07, 452 hrs)	$ 13,862.84		
	Fish Biologist (GS-07, 384 hrs)	$ 11,777.28		
	Fish Biologist (GS-07, 520 hrs)	$ 15,298.40		
	Subcontractor(s) if needed	$ 100,000.00		
	Materials	$ 14,500.00		
	Oversight and Research Development		$ 95,039.77	
	FWS Administrator (118 hrs)	$ 9,412.17		
	Fish Biologist (GS-12, 1494 hrs)	$ 81,273.60		
	Fish Biologist (GS-11, 100 hrs)	$ 4,354.00		
	Subtotal		*$ 379,637.61*	
	Admin costs for Task 2		*$ 64,538.39*	
3	**Species Propagation and Husbandry**		*$* -	**$** -
	Subtotal		*$* -	
4	**Species Reintroduction**		*$* -	**$** -
	Subtotal		*$* -	
5	**Reporting**			**$ 79,303.00**
	SMARC Staff		$ 40,501.20	
	FWS Administrator (24 hrs)	$ 1,883.52		
	Staff (GS-11, 88 hrs)	$ 4,136.12		
	Fish Biologist (GS-12, 370 hrs)	$ 20,128.00		
	Fish Biologist (GS-07, 156 hrs)	$ 4,784.52		
	Fish Biologist (GS-07, 156 hrs)	$ 4,784.52		
	Fish Biologist (GS-07, 156 hrs)	$ 4,784.52		
	UNFH Staff		$ 27,279.14	
	Fish Biologist (GS-11, 305 hrs)	$ 13,279.70		
	Fish Biologist (GS-07, 156 hrs)	$ 4,589.52		
	Fish Biologist (GS-07, 156 hrs)	$ 4,704.96		
	Fish Biologist (GS-07, 156 hrs)	$ 4,704.96		
	Subtotal		*$ 67,780.34*	
	Admin costs for Task 5		*$ 11,522.66*	
6	**Meetings and Presentations**			**$ 15,641.00**
	SMARC staff		$ 9,369.98	

	FWS Administrator (31 hrs)	$ 2,433.64		
	Fish Biologist (GS-12, 70 hrs)	$ 3,808.00		
	Fish Biologist (GS-07, 34 hrs)	$ 1,042.78		
	Fish Biologist (GS-07, 34 hrs)	$ 1,042.78		
	Fish Biologist (GS-07, 34 hrs)	$ 1,042.78		
	UNFH Staff		$ 3,998.40	
	Fish Biologist (GS-11, 30 hrs)	$ 1,306.20		
	Fish Biologist (GS-07, 30 hrs)	$ 882.60		
	Fish Biologist (GS-07, 30 hrs)	$ 904.80		
	Fish Biologist (GS-07, 30 hrs)	$ 904.80		
	Subtotal		*$ 13,368.38*	
	Admin costs for Task 6		*$ 2,272.62*	
		TOTAL	**$1,151,657.30**	

Total Projected (2020) Budget Summarized by Task:

Task 1: $612,538
Task 2: $444,176
Task 3: $0
Task 4: $0
Task 5: $79,303
Task 6: $15,641

Projected (2020) Subcontractor Expenses Summarized by Task:

Task 1: Southwest Regional Fish Health Unit, Dexter, NM $8,000 (Health Diagnostics)
Task 2: Comal Springs riffle beetle research $100,000
Task 3: $0
Task 4: $0
Task 5: $0
Task 6: $0

2020 available budget:
$1,151,682

Estimated 2020 budget:
$1,151,682

Timeline of 2020 Milestones

(List major deliverables)

January	Continue with species collection
	Subcontract research awards executed
	2020 Specific Research Study Plans finalized
July	Submit and renew TPWD permit
September to December	Draft Research Reports
	Draft Annual Report

Literature Cited

AFS-FHS (American Fisheries Society-Fish Health Section). 2005. Model Quality Assurance/Quality Control Program For Fish Health Laboratories, 2016 edition. Accessible at: http://afs-fhs.org/bluebook/bluebook-index.php.

Cantu, V., J. N. Fries, and T. A. Ryan. 2009. An apparatus for separating live amphipods from debris. North American Journal of Aquaculture 71:6-9.

Crawford, D. M., and D. C. Tarter (1979) Observations on the life history of the freshwater amphipod, *Crangonyx forbesi* (Hubricht and Mackin), in a spring-fed cistern in West Virginia. American Midland Naturalist 2: 320-325.

Culver DC, T Pipan (2009) The biology of caves and other subterranean habitats. Oxford University Press, New York.

Hall, R (Edwards Aquifer Authority). 2016. 2016 Comal Springs Riffle Beetle SOP Work Group: Attachment 2: Existing CSRB Cotton Lure SOP. Available at: http://www.eahcp.org/index.php/administration/work_groups/2016_comal_springs_riffle_beetle_sop_work_group

Wilson, W. D., J. T. Hutchinson, K. G. Ostrand. 2016. Genetic diversity assessment of in situ and ex situ Texas wild rice (*Zizania texana*) populations, an endangered plant. Aquatic Botany 136:212-219.

Ulrich, G. W (1986) The larvae and pupae of *Helichus suturalis* Leconte and *Helichus productus* Leconte (Coleoptera: Dryopidae). The Coleopterist Bulletin 40: 325-334.

USFWS and AFS-FHS (U.S. Fish and Wildlife Service and American Fisheries Society-Fish Health Section). 2016. Standard procedures for aquatic animal health inspections. *In* AFS-FHS. FHS blue book: suggested procedures for the detection and identification of certain finfish and shellfish pathogens, 2016 edition. Accessible at: http://afs-fhs.org/bluebook/bluebook-index.php.

FMA § 2.2 EAHCP Program Management

Section 2.2 of the Funding and Management Agreement (FMA) assigns "general management and oversight" of the Edwards Aquifer Habitat Conservation Plan (EAHCP) to the Edwards Aquifer Authority (EAA). Section 5.6.5 of the FMA allows the EAA to use EAHCP funds for administrative costs and employee salaries, so long as all incurred costs and salaries are 100% related to "general management and oversight" of the EAHCP.

Long-term Objectives:

To manage and oversee day-to-day operations and administration, in coordination with the Applicants, of the EAHCP; resulting in a valid and continued Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS) for designated Covered Activities. Additionally, to prepare for, gather information to be used in, and implement the Strategic Adaptive Management decision-making process.

Program Management: In 2020, EAHCP staff will continue to coordinate and monitor the work outlined in the Conservation Measures consistent with the Phase II Work Plan including the Biological Monitoring, Water Quality Monitoring, ASR, and VISPO described in this work plan. The Chief Science Officer and Environmental Scientist will oversee the continued development and operations of the Refugia Program which will also include all Refugia research activities. In 2020, the EAHCP staff will also continue to update the EAHCP biological and water quality monitoring databases.

EAHCP staff will also continue the following activities in 2020:

Program Manager: The EAHCP Program Manager will execute duties as assigned in the FMA and:

- Serve on the ASR Advisory Committee,
- Facilitate the Adaptive Management Process (AMP) for all Routine, Nonroutine and Strategic AMP decisions,
- Facilitate and coordinate all meetings of the EAHCP Implementing, Science and Stakeholder committees and possible Subcommittees and Work Groups as created by the Implementing, Science and Stakeholder committees.

EAHCP Staff: The EAHCP staff will continue the following activities:

- Prepare for all meetings of the EAHCP Implementing, Science, and Stakeholder committees, (and possible Subcommittees and Work Groups as created by the Implementing, Science and Stakeholder committees);
- Prepare materials for all AMP activities;
- Procure and execute contracts;
- Oversee contract tracking and compliance;
- Process and pay all contractor's invoices;
- Oversee the City of New Braunfels and San Marcos/Texas State University work plan activities;
- Coordinate 2020 Work Plan amendments and the development of 2021 Work Plans and Funding Applications;

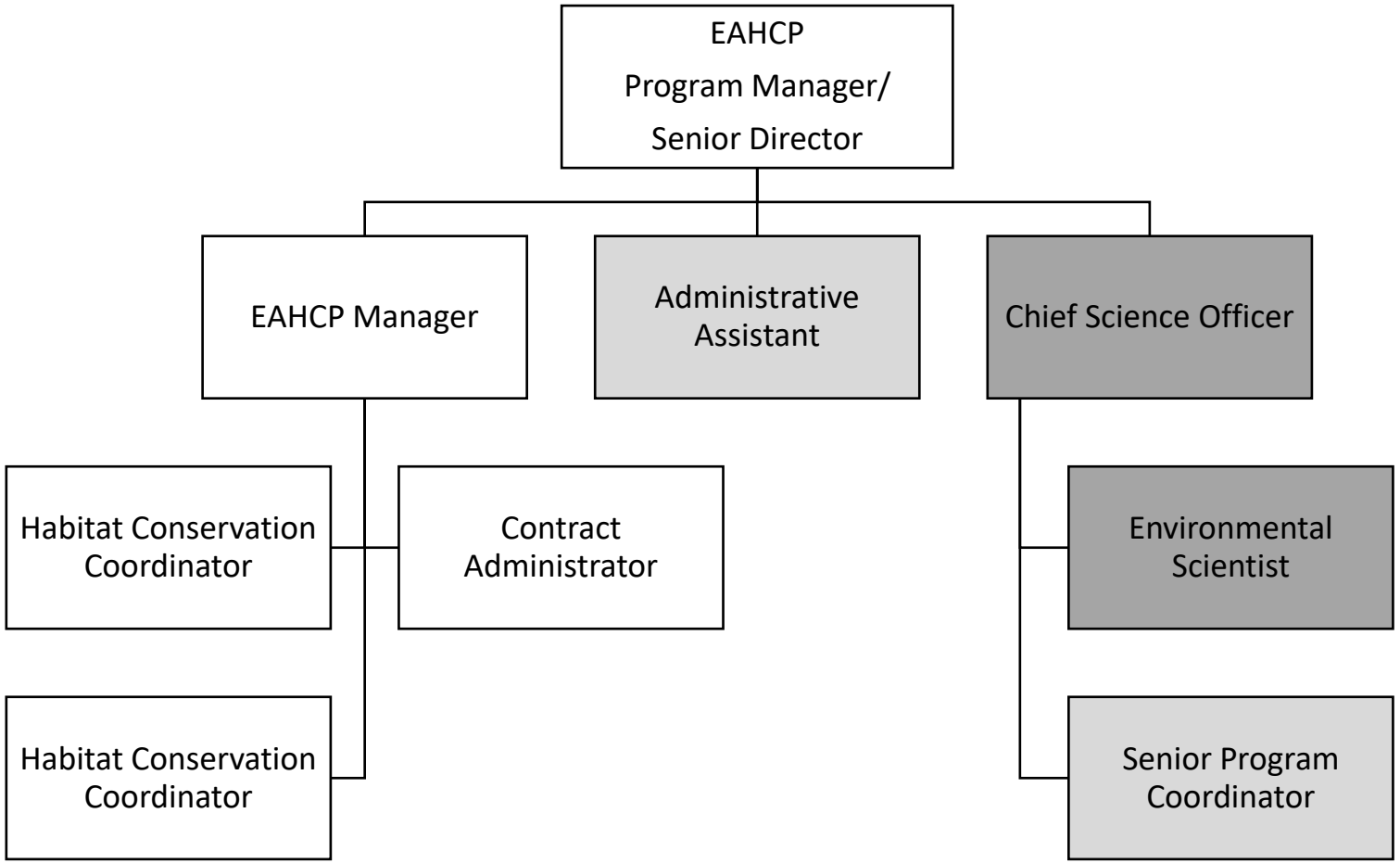
- Draft and submit to the USFWS the informational memorandums, clarifications, and amendments to the ITP and EAHCP;
- Participate in public outreach initiatives;
- Publish the EAHCP Steward newsletter;
- Enhance the EAHCP.org website;
- Prepare and compile all Permittees' information for the annual report to USFWS; and
- Track and assist EAHCP Permittees with maintaining compliance with secondary implementation permits, such as: U.S. Army Corps of Engineers, Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, General Land Office, and Texas Historical Commission permits.

Adaptive Management Process (AMP): EAHCP staff, under direction of the Program Manager, will manage the AMP as defined in the FMA. Specifically, Article 7 defines the procedures for the AMP. EAHCP staff will also serve as a liaison to USFWS in the AMP.

EAHCP Implementing, Science and Stakeholder committees and Work Groups and Subcommittees: EAHCP staff, under the direction of the Program Manager, will continue to manage the meetings and activities of all EAHCP Committees and any Subcommittees or Work Groups. The Implementing and Science committees will meet according to approved schedules and the Stakeholder Committee will meet quarterly unless otherwise convened for the AMP.

Staffing in 2020:
the EAHCP staff consists of the Program Manager, EAHCP Manager, Contract Administrator, and two EAHCP Coordinators. EAA funds the Chief Science Officer and the Environmental Scientist staff positions. Two positions remained vacant during the development of this work plan, but both could be filled in 2020. The structure of the existing EAHCP staff positions and EAA-funded positions – **the Threatened and Endangered Species Team -** are illustrated in the chart on the next page.

Threatened and Endangered Species Team



Positions Paid from EAA General Budget
Vacant Positions

Budget:
The following table summarizes the estimated EAHCP Program Management budget for 2020.

EAHCP Program Management budget for 2020

Description of Expense	Estimated 2020 Budget
Salaries and Fringe Benefits	$ 655,435
Office Supplies	$ 1,500
Non-Capital Furniture and Equipment	$ 1,500
Computer Hardware	$ 3,000
Computer Software	$ 1,500
Meeting Expenses	$ 20,000
Conferences, Seminars, and Training	$ 27,500
Memberships	$ 2,000
Printing	$ 8,000
Professional Contracted Services	
Annual Report	$ 47,000
Historical/Archeological Consultation	$ 19,000
Permit Oversight	$ 33,000
Outreach/Newsletter	$ 44,000
Science Committee Compensation	$ 25,000
AMP Support	$ 35,000
Other	$ 110,000
Estimated 2020 Total	**$ 1,033,435**

2020 available budget:
$750,000

Estimated 2020 budget:
$1,033,435