APPENDIX I
USFWS DOCUMENTS

Appendix I1 – Minor amendment request to USFWS regarding Voluntary Irrigation Suspension Option Program flow protection conservation measure in the EAHCP

Appendix I2 – USFWS response to Voluntary Irrigation Suspension Option Program springflow protection measure minor amendment request

Appendix I3 – Letter to USFWS regarding EAHCP Comprehensive Phase II Work Plan and Resolution 05-10-001

Appendix I4 – USFWS Recovery Plan Amendments for Eleven Southwest Species (December 6, 2019)

Appendix I1
USFWS DOCUMENTS
Minor amendment request to USFWS regarding
Voluntary Irrigation Suspension Option Program
flow protection conservation measure in the EAHCP

EDWARDS AQUIFER
AUTHORITY

June 7, 2019

Mr. Adam Zerrenner
United States Fish and Wildlife Service
Austin Ecological Services Field Office
107011 Burnet Road, Suite 200
Austin, Texas 78758

RE: Minor amendment to the Voluntary Irrigation Suspension Program Option (EAHCP § 5.1.2.1) flow protection conservation measure of the Edwards Aquifer Habitat Conservation Plan.

Dear Mr. Zerrenner:

On behalf of the City of New Braunfels (CoNB), the City of San Marcos (CoSM), Edwards Aquifer Authority (EAA), the San Antonio Water System (SAWS), and Texas State University (collectively the Permittees of the Incidental Take Permit #TE-63663A-1), I am providing a minor amendment to the *Edwards Aquifer Habitat Conservation Plan* (EAHCP) for your review and approval to modify forbearance rates in the Voluntary Irrigation Suspension Program Option (VISPO) flow protection Conservation Measure (EAHCP § 5.1.2) from 40,000 acre-feet/year (ac-ft/yr) to 41,795 ac-ft/yr. This letter is submitted pursuant to EAHCP § 9.2.1.

The VISPO Conservation Measure operates to minimize and mitigate the impacts of low springflow by suspending the authorized withdrawal of Edwards Aquifer (Aquifer) water from EAA irrigation permit-holders during certain prescribed drought conditions. Irrigation permit-holders that participate in VISPO are financially compensated both to participate in the program (standby fees) and during their time of suspended Aquifer pumping (forbearance payments). Currently, the VISPO forbearance rate is to suspend 40,000 ac-ft/yr of Aquifer water from authorized pumping during the prescribed periods of drought. Aquifer pumping is suspended the following year when the J-17 index well water level is at or below 635 feet-mean sea level (MSL) on an annual trigger date of October 1 (EAHCP § 5.1.2.2).

The amendment to EAHCP § 5.1.2.1 increases the VISPO forbearance rate from 40,000 ac-ft/yr to 41,795 ac-ft/yr (Exhibit 1). Groundwater modeling indicates that this volume increase, in conjunction with the implementation of the three other springflow protection measures (RWCP, SAWS ASR and CPMP Stage V), ensures a modelled 30 cubic feet per second (cfs) daily average of minimum springflow in the Comal Springs system during a repeat of the drought-of-record scenario. EAHCP Table 4-2 defines the long-term average and minimum total Comal discharge management objectives (EAHCP § 4.1.1.1). The minimum total Comal discharge is 30 cfs daily average. Additional details on the groundwater model simulations can be found in the Scientific Evaluation Report (SER) (Exhibit 3).

The Permittees responded to the Strategic Adaptive Management Process set out in Sections 7.13 and 14 of the EAHCP by performing a Nonroutine Adaptive Management Process (Nonroutine AMP) for VISPO in accordance with the Funding and Management (FMA) § 7.12. The request for an additional 1,795 ac-ft/yr of Aquifer water in VISPO was presented in a Nonroutine AMP proposal from the Program Manager to the Science Committee on March 27, 2019 (Exhibit 2). The Science Committee evaluated the proposal and documented their recommendations in a SER dated April 12, 2019 and delivered to the Stakeholder Committee electronically May 1, 2019 (Exhibit 3). The Stakeholder Committee provided their comments and report at a joint meeting with the Implementing Committee May 23, 2019 (Exhibit 4). The May 23, 2019 joint meeting also provided the public the opportunity to comment on this amendment to further ensure transparent implementation of the EAHCP. The Implementing Committee responded by approving the Nonroutine AMP proposal and directing the Program Manager to submit the necessary documentation to the U.S. Fish and Wildlife Service consistent with FMA § 7.12.4.c. All meeting agendas and minutes from this process have been provided herein (Exhibit 5).

The Nonroutine AMP resulted in this request to amend EAHCP § 5.1.2.1 of the. This minor amendment does not modify in any way the Biological Goals or Objectives contained in the EAHCP. Rather, this minor amendment (in conjunction with the other springflow protection measures) ensures the modelled 30 cfs minimum total daily average Comal discharge during a drought-of-record scenario.

The Permittees seek your formal acceptance of this minor amendment request to allow amendments to pages 5-3 and 5-5 of the EAHCP as set out in Exhibit 1 to modify forbearance rates in the VISPO flow projection conservation measure described in EAHCP § 5.1.2 from 40,000 ac-ft/yr to 41,795 ac-ft/yr Your approval of this minor amendment will allow the Permittees to improve the implementation of this critical aspect of the EAHCP. We look forward to your formal acceptance of this minor amendment and appreciate your consideration and response.

Respectfully,

Scott D. Storment
Program Manager
Edwards Aquifer Habitat Conservation Plan

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

Exhibit 1
Proposed changes to EAHCP p. 5-3

objectives, while recognizing the uncertainty associated with those objectives, Applicants commit to implement a "presumptive" measure that is adequate to achieve the flow-related objectives for attaining the biological goals. If needed, the use of the expanded capacity of the SAWS ASR will be the "presumptive" additional measure to meet the biological objectives with critical period reductions in Stage V beyond those in Phase I, if necessary. (*See* Section 5.5.2).

Applicants will include in the Annual Report a description of the status of implementation of the minimization and mitigation measures and an evaluation of the effectiveness of those measures.

5.1 Edwards Aquifer Authority

5.1.1 Refugia[1]

The EAA will support and coordinate with the USFWS on a series of off-site refugia at USFWS's San Marcos, Uvalde, and Inks Dam facilities. (*See* Section 6.4). The limited geographic distribution of these species leaves the populations vulnerable to extirpation throughout all or a significant part of their range. A series of refugia, with back-up populations at other facilities, will preserve the capacity for these species to be re-established in the event of the loss of population due to a catastrophic event such as the unexpected loss of springflow or a chemical spill.

The support of the refugia will augment the existing financial and physical resources of the Service, and provide supplementary resources for appropriate research activities, as necessary, to house and protect adequate populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques. The use of this support will be limited to the Covered Species in this HCP.

5.1.2 Voluntary Irrigation Suspension Program Option

The EAA will administer the Voluntary Irrigation Suspension Program Option (VISPO) program. As discussed below in Section 5.8, VISPO is intended to minimize and mitigate the impacts of incidental take from low springflows by suspending the use of Aquifer water for irrigation purposes during drought.

The use of Aquifer water for irrigation accounts for over 30 percent of the annual pumping. This use typically occurs between January and July. The concentrated use of the Aquifer can contribute to substantial drawdown in Aquifer levels. This measure will require EAA irrigation permit-holders who voluntarily participate in the program to suspend the use of Aquifer water for irrigation purposes during drought to maintain springflow.

5.1.2.1 Target Volume, Distribution & Eligible Permits

The volume goal for the VISPO program is ~~40,000~~ 41,795 ac-ft/yr. Irrigation permit-holders in Atascosa, Bexar, Comal, and Hays counties will be approached for enrollment in the program first because these counties are closest to the springs where temporarily suspending pumping is

[1] Effective January 21, 2015. A minor administrative amendment to change the language of the EAHCP §5.1.1 and the ITP Condition K to all the development of a Refugia Program with contractors other than the Service.

Exhibit 1
Proposed changes to EAHCP p. 5-5

were held, one in Uvalde, Texas, on December 6, 2010, and one in Castroville, Texas, on December 7, 2010. Approximately 150 persons attended the meetings (approximately 35 in Uvalde and approximately 115 in Castroville).

Following the meetings, all irrigators were contacted again in January 2011 with a letter of inquiry, a list of Frequently Asked Questions and a schedule of payments for the five- and ten-year program options. (Attachment O) Irrigators were asked to indicate whether they were interested in participating in the VISPO program and, if so, whether they were likely to opt for the 5- or 10-year program.

The EARIP received positive written expressions of interest from irrigators in enrolling 17,226 ac-ft of water as indicated in Table 5-2. This level of response is higher than what has been received for similar surveys, particularly when the responses were solicited so far in advance of a commitment to go forward with the VISPO. Additionally, other irrigators contacted the EAA after the requested response deadline to express interest in the program. The positive responses indicate a reasonable likelihood of enrolling the full volume of permits once funding is available and contracted enrollment begins.

TABLE 5-2
ACRE-FEET OF INTEREST IN VISPO BY COUNTY

	Atascosa County	Comal County	Bexar County	Medina County	Uvalde County	Total
		Acre-feet of interest				
5-Yr. Base	200	242	1,186	933	6,258	8,819
5-Yr. Unrestricted	400		527	535	1,664	3,126
						0
10-Yr. Base		40	353	3,354	693	4,440
10-Yr. Unrestricted			266	376	200	842
TOTAL	600	282	2,332	5,197	8,815	17,226

Based on the responses and public input and the financial incentives offered to enrollees, the Applicants believe that: (1) the ~~40,000 ac-ft~~ volume goal will be fully subscribed; and (2) the irrigators who initially opt for the five-year option will continue their participation in the program and that the full ~~40,000 feet~~ volume goal will be subscribed over the requested 15-year term of the ITP. To the extent that the program is not fully subscribed, the Adaptive Management Process will be used to identify alternative measures, perhaps additional pumping cuts, achieve the full springflow protection anticipated from the VISPO program and those measures will be implemented.

5.1.3 Regional Water Conservation Program

Some communities and industries in the Edwards Aquifer region have demonstrated a commitment to water conservation. However, water conservation programs have not been implemented across the region or developed to target exempt domestic wells. The Regional Water Conservation Program will minimize and mitigate the impacts of pumping from the

Exhibit 2

Edwards Aquifer Habitat Conservation Plan
Nonroutine Adaptive Management Proposal
VISPO

To: **EAHCP Committees**
From: **Scott Storment, EAHCP Program Manager**
Date: **March 14, 2019**
Re: **Voluntary Irrigation Suspension Program Option Enrollment Volume Changes**

EAHCP Flow Protection Measures

The EAHCP calls for four Flow Protection Measures to meet short-term and long-term flow objectives for the Comal and San Marcos Springs complexes. The four measures include the Voluntary Irrigation Suspension Program Option (VISPO) (EAHCP § 5.1.2), Regional Water Conservation Program (EAHCP § 5.1.3), SAWS ASR (EAHCP § 5.5.1), and Critical Period Management – Stage V (EAHCP § 5.1.4). These four water management tools layered together are referred to as the "Bottom-Up" package.

The "Bottom-Up" package was originally evaluated by HDR to understand whether the Flow Protection Measures could meet EAHCP flow objectives (HDR 2011 – Appendix K EAHCP). The analysis was conducted by simulating spring discharge using the MODFLOW groundwater model. The minimum flow objective was examined by simulating the period from 1947-1960 which included the Drought of Record (DOR). The long-term flow objective was examined by simulating the period from 1947- 2000. Since the Flow Protection Measures composing the "Bottom-Up" package were still in development, HDR made assumptions regarding geographic distribution of enrolled water in the various programs. Results from the HDR analysis indicated the Phase I Flow Protection Measures were not adequate to meet minimum and long-term average flow objectives in the Comal system. However, minimum and long-term average flow objectives were achieved in the San Marcos system.

Over the course of implementing Phase I of the EAHCP, the original MODFLOW model used by HDR was reconstructed by EAA staff with several improvements (herein referred to as EAA model). Changes made to the model along with calibration and validation results are described in detail by Liu et al. (2017). Additionally, further comment on model construction and its use can be found in the review by the Groundwater Model Advisory Panel (Appendix - Liu et al. 2017), the National Academies of Sciences (NAS) Reports 1-3 covering the EAHCP (NAS 2015; NAS 2017; NAS 2018), Strategic Adaptive Management Process Model Runs Inputs and Assumptions by Pence (2018a), and technical presentations delivered to the NAS Panel and EAHCP Science Committee (www.eahcp.org).

National Academies of Sciences Review of EAHCP Springflow Protection

The model and its outputs were reviewed by the NAS to make their determination on whether the EAHCP Flow Protection Measures would be adequate to achieve the EAHCP minimum flow objectives. The model runs the panel evaluated to make its determination were essentially HDR's DOR inputs run with the updated EAA model. The minimum flow in the Comal system from this model run was 29.7 cfs. Minimum flow objectives were met for the San Marcos system. Despite not meeting 30.0 cfs, the NAS panel concluded the Flow Protection Measures would be "effective" at meeting the minimum flow related objectives citing the conservative nature of the low flow estimates during calibration and validation (modeled values at low flows were mostly lower than measured values), empirical evidence from the 2014 drought, and overall model performance during calibration and validation runs.

Final Phase I Model Runs

Modeling efforts continued after the NAS consensus report to understand the level of Flow Protection Measure expansion required to achieve a minimum modeled value of 30.0 cfs in the Comal during a repeat of the DOR. Following the process outlined by Pence (2018b), the EAA model was used to simulate the DOR scenario with Flow Protection Measures represented in the model "as-implemented" over the first six years of the program. The pumping and springflow protection forbearance specifics (location and volume) are found in Pence (2018a). Model runs using "as-implemented" programs represented in the EAA model produced minimum flow values of 29.1 cfs in the Comal system.

The 29.1 cfs model run assumed 40,000 ac·ft yr^{-1} are forborne during a year that VISPO is triggered. This is the annual number represented in the EAHCP. Actual enrollment in the VISPO during 2019 is 40,921 ac·ft yr^{-1}. When this actual enrollment volume of water was included in the model runs, minimum flows in the Comal were 29.6 cfs. VISPO forbearance was increased until minimum flows at the Comal system were equal to 30.0 cfs. The VISPO forbearance number that achieved this minimum flow rate was 41,795 ac·ft yr^{-1}.

Edwards Aquifer Habitat Conservation Plan
Nonroutine Adaptive Management Proposal
VISPO

Nonroutine Adaptive Management Proposal

This proposal seeks to change VISPO forbearance from 40,000 ac·ft yr^{-1} to 41,795 ac·ft yr^{-1}. This is the only change to this EAHCP Program. All other stipulations regarding the program are as previously implemented.

This Nonroutine AMP proposal relates to the following sections of the EAHCP

This proposal affects Section 5.1.2 of the EAHCP.

Fiscal Impact

Table 1 displays the financial impact of the proposed changes assuming VISPO triggers three times between 2020 – 2028.

Table 1. Proposed costs of VISPO Adaptive Management with three trigger events.

VISPO Program	Rate	Acre-feet	Standby and Trigger Years (2020-2028)	Cost
Standby	$54	1,795.00	9	$872,370
Forbearance	$160	1,795.00	3	$861,600
				$1,733,970

Edwards Aquifer Habitat Conservation Plan
Nonroutine Adaptive Management Proposal
VISPO

References

Liu, A, N Troshanov, J Winterle, A Zhang, S Eason, 2017. Updates to the MODFLOW Groundwater Model of the San Antonio Segment of the Edwards Aquifer. Available at: https://data.edwardsaquifer.org/documents/2017_Liu-etal_UpdatestotheMODFLOWGroundwaterModeloftheSanAntonioSegmentoftheEdwardsAquifer.pdf.pdf

HDR, 2011. Evaluation of Water Management Programs and Alternatives for Springflow Protection of Endangered Species at Comal and San Marcos Springs. Available at: http://eahcp.org/wp-content/uploads/2019/02/Appendix-K.pdf

NAS, 2015. Review of the Edwards Aquifer Habitat Conservation Plan Report 1. Available at: http://eaahcp.org/administration/science-review-panel/

NAS, 2016. Review of the Edwards Aquifer Habitat Conservation Plan Report 2. Available at: http://eaahcp.org/administration/science-review-panel/

NAS, 2018. Review of the Edwards Aquifer Habitat Conservation Plan Consensus Report. Available at: http://eaahcp.org/administration/science-review-panel/

Pence, 2018a. SAMP Model Runs Inputs and Assumptions. Memo to EAHCP Committees, June 21, 2018.

Pence, 2018b. EAHCP Strategic Adaptive Management Process. Memo to EAHCP Committees, May 11, 2018.

Exhibit 3

Science Committee of the
Edwards Aquifer Habitat Conservation Plan

Scientific Evaluation Report:
Nonroutine Adaptive Management Proposal for the EAHCP VISPO

April 12, 2019

Introduction

According to the Funding and Management Agreement, the Adaptive Management Science Committee (Science Committee) is tasked with evaluation of all Nonroutine Adaptive Management (AMP) proposals. These evaluations result in a "Scientific Evaluation Report" (SER) for presentation to the Stakeholder Committee. The Stakeholder Committee considers this report in their decision whether to recommend the Nonroutine AMP proposal to the Implementing Committee for final approval.

This SER is issued in response to the Nonroutine AMP proposal submitted by the Program Manager, dated March 14, 2019 related to the EAHCP Voluntary Irrigation Suspension Program Option (VISPO).

The SER was discussed and developed at the March 27, 2019 Science Committee meeting. EAHCP staff will seek approval of this SER shortly after and the report will be presented to the Stakeholder Committee at its meeting on May 23, 2019.

Nonroutine Adaptive Management Proposal

On March 14, 2019 the EAHCP Program Manager submitted a Nonroutine AMP Proposal to the Science, Stakeholder and Implementing Committees. It involves modifications to the EAHCP VISPO.

Scientific Evaluation of the Nonroutine Adaptive Management Proposal

The purpose of this report is to provide the Science Committee's evaluation of the proposed modifications to the EAHCP VISPO to meet EAHCP flow objectives. The EAHCP calls for four Flow Protection Measures to meet short-term and long-term flow objectives for the Comal and San Marcos springs complexes. The four measures include the VISPO, Regional Water Conservation Program, SAWS Aquifer Storage and Recovery (ASR), and Critical Period Management – Stage V.

The modeling analysis of these four Flow Protection Measures to support the EAHCP was performed using a layered approach to consecutively evaluate addition of each conservation measure on springflows. This layered approach is referred to as the "Bottom-Up" package. Table 1 describes the maximum amount of water conserved through each of the Flow Protection Measures for a given year. Details of these measures can be found in the HCP, its appendices, and other associated documents (Table 1).

Tables 2 and 3 show the minimum and long-term average flow related objectives included in the EAHCP.

Table 1. Maximum annual volume (ac·ft yr^{-1}) of groundwater that can be conserved with EAHCP Flow Protection Measures.

Flow Protection Measure	Maximum Annual Volume Conserved	EAHCP Section
VISPO	40,000	5.1.2
RWCP	10,000	5.1.3
SAWS ASR FORBEARANCE	46,300	5.5.1
EAA FORBEARANCE OF SAWS ASR LEASES	50,000	5.5.1
STAGE I - V	44% Permit Reduction	5.1.4

Table 2. Long-term average and minimum total Comal discharge management objectives (Table 4-2 of EAHCP)

Description	Total Comal Discharge (cfs)[a]	Time-step
Long-term average	225	Daily average
Minimum	30[b]	Daily average

[a]Assumes a minimum of a 50-year modeling period that includes the drought of record
[b]Not to exceed six months in duration followed by 80 cfs (daily average) flows for 3 months

Table 3. Long-term average and minimum total San Marcos discharge management objectives (Table 4-13 of EAHCP)

Description	Total San Marcos Discharge (cfs)[a]	Time-step
Long-term average	140	Daily average
Minimum	45[b]	Daily average

[a]Assumes a minimum of a 50-year modeling period that includes the drought of record
[b]Not to exceed six months in duration followed by 80 cfs (daily average) flows for 3 months

The “Bottom-Up” package was originally evaluated by HDR to understand whether the Flow Protection Measures could meet EAHCP flow objectives (HDR 2011 – Appendix K EAHCP). The HDR Bottom-up analysis was conducted by simulating spring discharge over the period of 1947-2000 using the MODFLOW groundwater model developed by Lindgren et al. (2004). These model results indicated the Phase I Flow Protection Measures were not adequate to meet minimum and long-term average springflows in the Comal system. However, minimum and long-term average flow objectives were achieved in the San Marcos system.

During Phase I of the EAHCP, the original MODFLOW model used by HDR was reconstructed with several significant improvements (herein referred to as EAA model). Changes made during model construction along with calibration and validation results are described in detail by Liu et al. (2017). Additionally, further comment on model construction and its use can be found in the review by the EAA-appointed Groundwater Model Advisory Panel (Appendix Liu et al. 2017), the National Academies of Sciences (NAS) Reports 1-3 covering the EAHCP (NAS 2015; NAS 2017; NAS 2018), SAMP model inputs and assumptions by Pence (2018), and technical presentations delivered to the NAS panel and EAHCP Science Committee (www.eachp.org).

The EAA model and its outputs were reviewed by the NAS panel to make their determination on whether the EAHCP Flow Protection Measures would be adequate to achieve the EAHCP flow objectives. The panel concluded the measures would be "effective" at meeting the flow objectives citing the conservative nature of the low flow estimates, empirical evidence from the 2014 drought, and the EAA model's ability to match observations during validation runs – especially during periods of low flow.

During Phase I, the EAA model was also used by EAA staff to reconstruct a Bottom-Up analysis using the same inputs and assumptions as the original HDR (2011) analysis. A difficulty encountered in reconstructing the Bottom-Up analysis is that the original analysis was conducted under the Edwards Aquifer Recovery Implementation Program (EARIP) prior to EAA taking on project management of the EAHCP and the original model files were not archived. Fortunately, EAA staff were able to obtain the archived files from a more recent Bottom-Up analysis by HDR (2015), which included a baseline analysis of the original 2011 model with a table of pumping rates for baseline conditions and for each of the Bottom-Up layers. Using this table of specified pumping reductions for each Bottom-Up layer, EAA staff was able to repeat the analysis and obtain minimum flow estimates for Comal and San Marcos Springs that were very similar to those reported in the original HDR (2011) report.

The next use of the Bottom-Up package by EAA staff was to conduct the Nonroutine Adaptive Management Model Runs described in the following section. For this analysis, the pumping assumptions were specified in the Pence (2018) memorandum. This process required EAA staff to reconstruct the baseline pumping and each of Bottom-Up layer pumping input files from scratch. During this process, it was discovered that the previous EAA Bottom-Up analysis that was intended to use the HDR (2011) pumping assumptions did not include 6,000 acre-feet of exempt federal pumping. Adding federal pumping to the analysis caused the estimated minimum flow for Comal Springs to drop by 6 cfs compared to the earlier analysis. Further analysis showed that adjustments to the schedule for SAWS ASR pumping forbearance, as described below, could be used to increase the estimated minimum flow at Comal Springs by the same amount as was lost by the addition of exempt federal pumping.

Nonroutine Adaptive Management Model Runs

Minimum Flow Objectives

The EAA MODFLOW model was executed with pumping and flow protection conservation measures previously described in Pence (2018). Briefly, geographic location and volume of forborne water via Flow Protection Measures are based on actual program enrollments, according to county and type of use. The annual base case pumping prior to any stage restrictions is 592,454 ac·ft yr^{-1} and is distributed geographically in the same manner as the HDR runs.

During development and testing of the model, it became apparent that a modified schedule of the SAWS ASR forbearance could increase minimum computed springflows during Drought of Record (DOR) simulations. In the HDR model runs, SAWS ASR pumping forbearance were guided by a schedule included in the Interlocal Agreement between EAA and SAWS for use of the ASR facility for springflow protection. This schedule was adjusted to maximize springflow benefit in accordance with SAWS guidance regarding the amount of Edwards water that could reasonably be forborne during any monthly stress period in a DOR scenario.

Limitations on monthly forbearance rates stem from the total pipeline capacity and the fact that forbearance cannot exceed what normal demand for Edwards water would be from the four pumping stations where the forbearance schedule is implemented. The first limitation is that total forbearance in any calendar year cannot exceed 46,300 ac·ft yr^{-1}. The limitation of monthly demand varies by month. The maximum reasonable forbearance rate for January is 3,500 acre-feet but this can be gradually increased to a maximum of 5,600 acre-feet for the high demand months of May through September. Revisions from the original schedule made in the current model scenario increase forbearance rates at the beginning of the year 1956, leading up to the period of minimum flow in August 1956, and decrease rates after September when the springflows start to recover. Table 4 displays changes to the SAWS forbearance schedule for the model runs discussed below.

Table 4. SAWS ASR forbearance representation in MODFLOW Drought of Record simulations.

Month In 1956	HDR (2011) (ac·ft)	Nonroutine AMP Runs (ac·ft)
January	1700	3200
February	1400	3500
March	1100	4500
April	2200	4500
May	3800	5600
June	5600	5600
July	5600	5600
August	5600	5600
September	5600	3000
October	5200	2000
November	4700	1700
December	3800	1500

Figure 1 displays MODFLOW model output for San Marcos and Comal springs with all Flow Protection Measures applied, minimum flow objectives for both systems, and modeled SAWS ASR forbearance. Minimum flows from the model simulation were 29.1 cfs in Comal and 48.1 cfs in San Marcos, both during the month of August 1956.

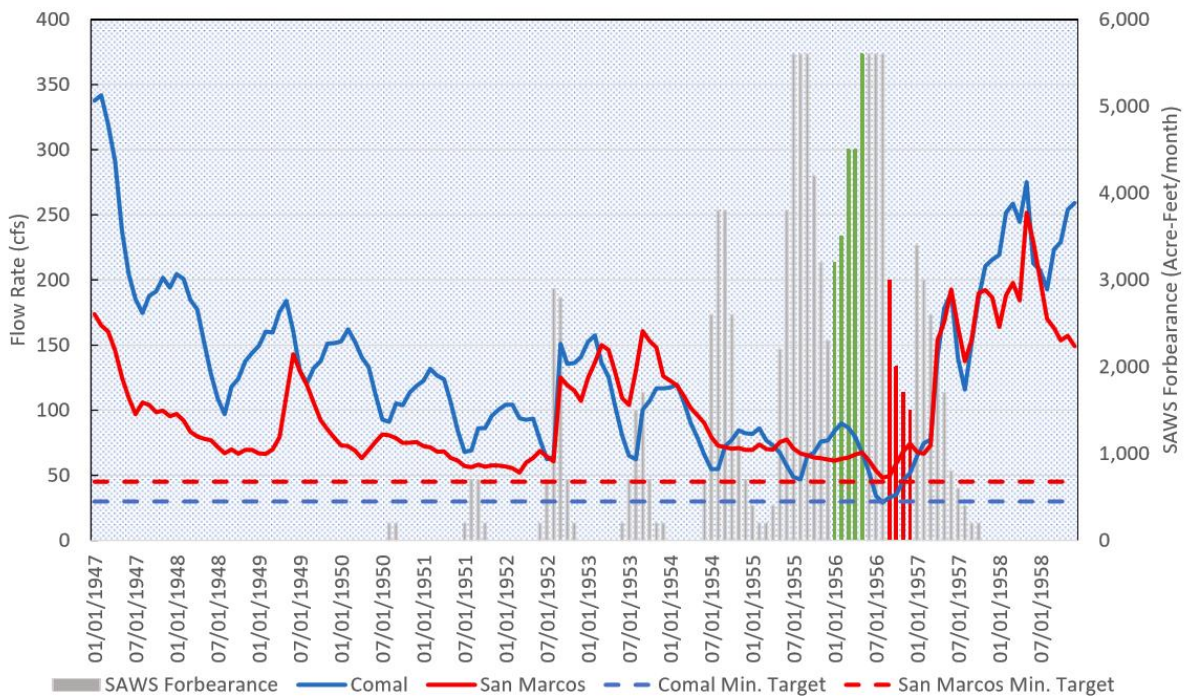

Figure 1. MODFLOW output for Drought of Record simulations at San Marcos and Comal springs. The green bars represent SAWS forbearance in excess of the original forbearance amounts shown in the Interlocal Agreement between EAA and SAWS for use of the ASR facility for the purpose of springflow protection. The red bars represent SAWS forbearance less than the original forbearance amounts shown in the contract.

To evaluate how much additional forbearance was needed to achieve the 30.0 cfs minimum flow objective at Comal Springs, forbearance through the VISPO was increased in the MODFLOW simulation from 40,000 ac·ft yr^{-1} until the flow objective was met. VISPO forbearance of 41,795 ac·ft yr^{-1} achieves the desired minimum of 30.0 cfs. Minimum flows for the San Marcos system with the adjusted VISPO number are 48.3 cfs. Results for the increased VISPO scenario are shown in Figure 2.

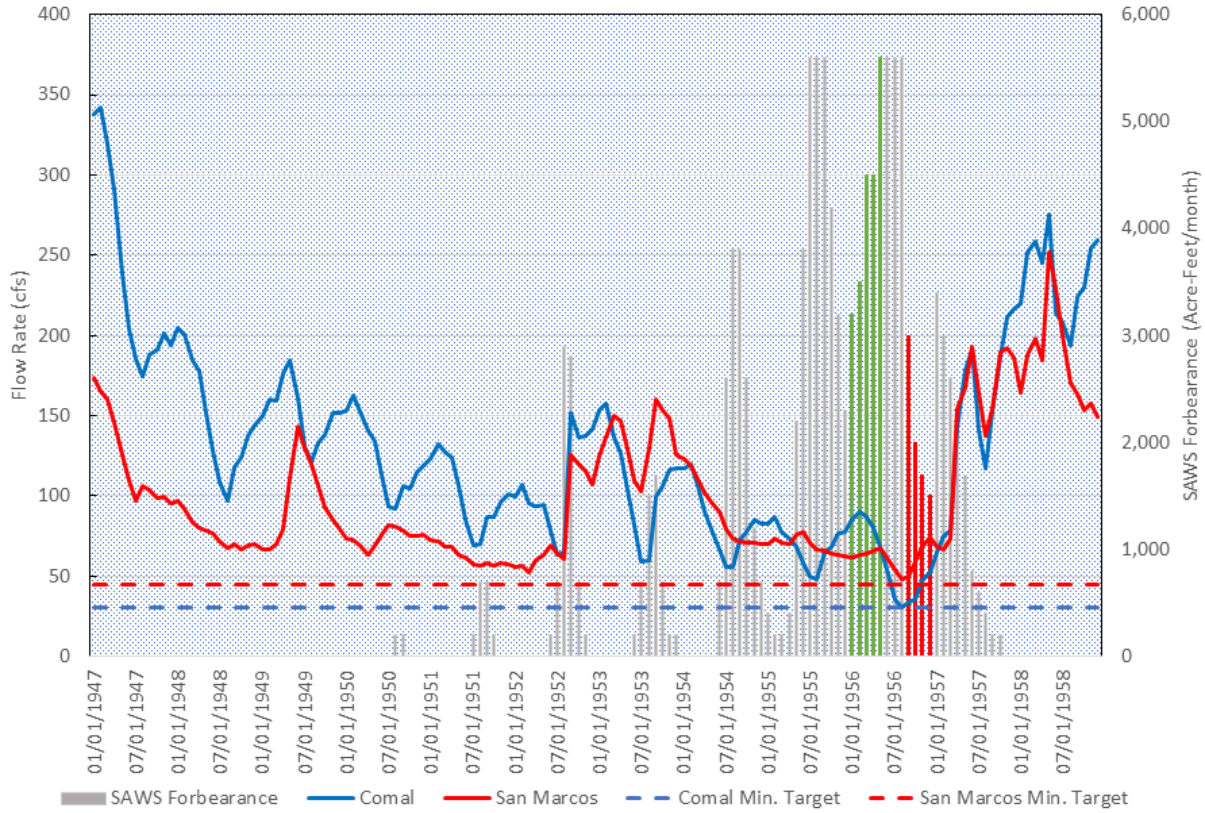

Figure 2. Same as Figure 1 with VISPO adjusted to 41,795 ac·ft yr^{-1}.

Long-Term Average Flow Objectives

HDR evaluated the ability of the Flow Protection Measures to meet the long-term average flow objective by modeling the period of 1947-2000 assuming an annual base case pumping of 593,240 ac·ft yr^{-1} prior to application of any conservation measures (see Pence 2018 or HDR 2011 for a description of HDR total pumping). Results from HDR indicated long-term average flow of 196 cfs in the Comal system, a 29 cfs deficit from the 225 cfs objective. The same analysis in San Marcos indicated a long-term average of 155 cfs exceeding the long-term flow objective of 140 cfs.

The 1947-2000 model period was not simulated with the EAA model for two primary reasons. First, unlike the HDR model, the EAA model was not calibrated to the 1947-2000 time period. The EAA model used a much more recent hydrologic record (2001-2011) for parameterization and calibration and was specifically built to accurately predict periods of low flows at Comal and San Marcos springs. It would not be expected to perform a multi-decade simulation as well as the HDR model calibrated over the time period in question. Second, using the total annual pumping offered in the HDR analysis dictates the long-term flow objectives are unachievable regardless of the model selected.

Examining the model from a mass balance perspective:

$$Recharge - Pumping - Springflow = \Delta Storage \qquad 1$$

If we consider a sufficiently long time period such that change in storage is negligible:

$$Recharge = Pumping + Springflow \qquad 2$$

If we insert the long-term average flow objectives (Comal: 225 cfs = 163,000 ac·ft yr^{-1}; San Marcos: 140 cfs = 101,355 ac·ft yr^{-1}), estimated long-term average outflow from other minor springs (80,000 ac·ft yr^{-1} - see Liu et al. 2017), and long-term average recharge (779,000 ac·ft yr^{-1}) into the above equation, the amount available for long-term average pumping is approximately 434,000 ac·ft yr^{-1} (Liu et al. 2017; EAA 2018a; EAA 2018b). By assuming 592,454 ac·ft yr^{-1} of annual pumping as the base case (before any permit restrictions) in the long-term simulation, the long-term average flow objectives cannot be reached.

To understand the ability to meet EAHCP long-term flow objectives over the remainder of the ITP, empirical data were examined. Using Equation 2 and fixing total springflow (San Marcos + Comal + minor springs) at the long-term averages discussed above (344,355 ac·ft yr^{-1}), recharge will equal pumping plus 344,355 ac·ft yr^{-1}. Given there are nine years remaining on the current ITP, we can examine the previous 41 years of the empirical hydrologic record and make conservative assumptions about the next nine years to estimate the fifty-year long-term average.

Recharge, including estimated interformational flows (estimated at 75,000 ac·ft yr^{-1}), over the past 41 years has been slightly over the long-term average at 908,000 ac·ft yr^{-1} (EAA 2018a; Liu et al. 2017). Over the same time period, total pumping estimates have averaged 410,000 ac·ft yr^{-1} (EAA 2018b). If we assume the following nine years are simultaneously the highest nine years of pumping ever recorded (none of which have occurred under management of the EAA) and the lowest 9 years of recharge ever recorded, the fifty-year average recharge would still exceed average total pumping plus long-term flow objectives (EAA 2018a, EAA 2018b).

It is important to note this synthetic combination of extreme pumping and recharge could not occur under EAA stage restrictions and EAHCP Flow Protection Measures. There appears to be no present threat of violating long-term springflow averages written into the EAHCP. However, more realistic terms should be constructed in future evaluations of these goals.

80 cfs footnote

Both springflow objective tables found in the EAHCP (Tables 1 and 2) contain a footnote on the minimum daily average flow objective that states “Not to exceed six months in duration followed by 80 cfs (daily average) flows for 3 months”.

The purpose of the flow pulse requirement was two fold: 1) an attempt to return flow to Spring Run 3 for macroinvertebrates and salamanders, which does not occur at flows less than 80 cfs according to data and the HCP, and 2) to accommodate another Fountain Darter spawn in the Old Channel ERPA by increasing flows and thereby maintaining suitable temperatures for a spawn to occur.

Under the proposed AMP, flows would not go below the minimum daily average flow objectives or “maintain” it for six-months. However, both systems would experience varying amounts of time between the minimum objective and the 80 cfs threshold identified.

Figures 3 and 4 display the DOR MODFLOW simulation for Comal and San Marcos springs, respectively, as shown in Figure 2 with total system flow (blue line), time steps with flow under 80 cfs (bar graph), and six-month moving averages when instantaneous flow was under 80 cfs (red lines). In the Comal during the ten-year DOR simulation, there are six instances where flow dips below and recovers above 80 cfs. The first three instances occur for 2 to 3 months and 6-month average flows remain over 80 cfs. The latter three instances have flows under 80 cfs for 6-11 months and 6-month average flows dip as low as 40 cfs.

In San Marcos during the ten-year DOR simulation, there are four instances where flow dips below and recovers above 80 cfs. The instances are lengthier (7-33 months) than the Comal and all four result in 6 month moving averages less than 80 cfs.

Figure 5 displays frequency graphs of maximum consecutive months under flows from 30 – 100 cfs for both spring systems. At Comal Springs, the lowest prolonged flows for 6 consecutive months is 53 cfs and under. For San Marcos, the lowest flows experienced for 6 consecutive months is 58 cfs and under. This proposed flow regime does not trigger the 80 cfs pulse requirement.

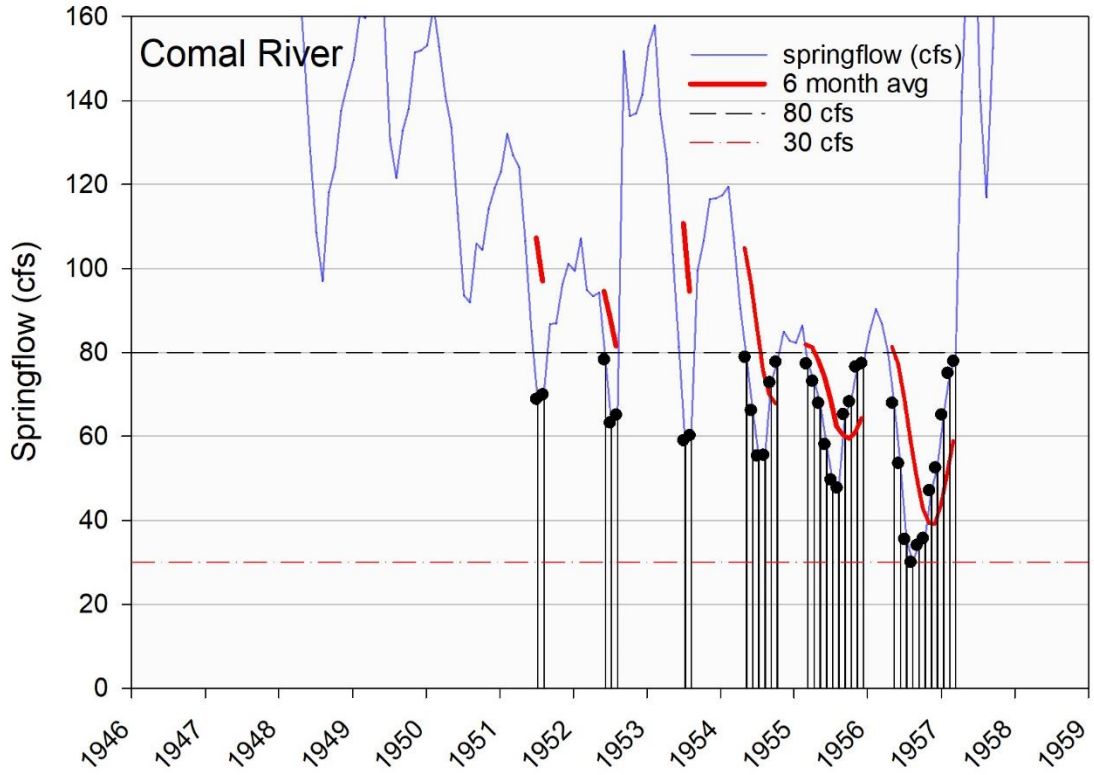

Figure 3. Comal Springs Drought of Record MODFLOW simulation shown in Figure 2 with periods of less than 80 cfs shown with bars. Other selected thresholds and statistics are shown.

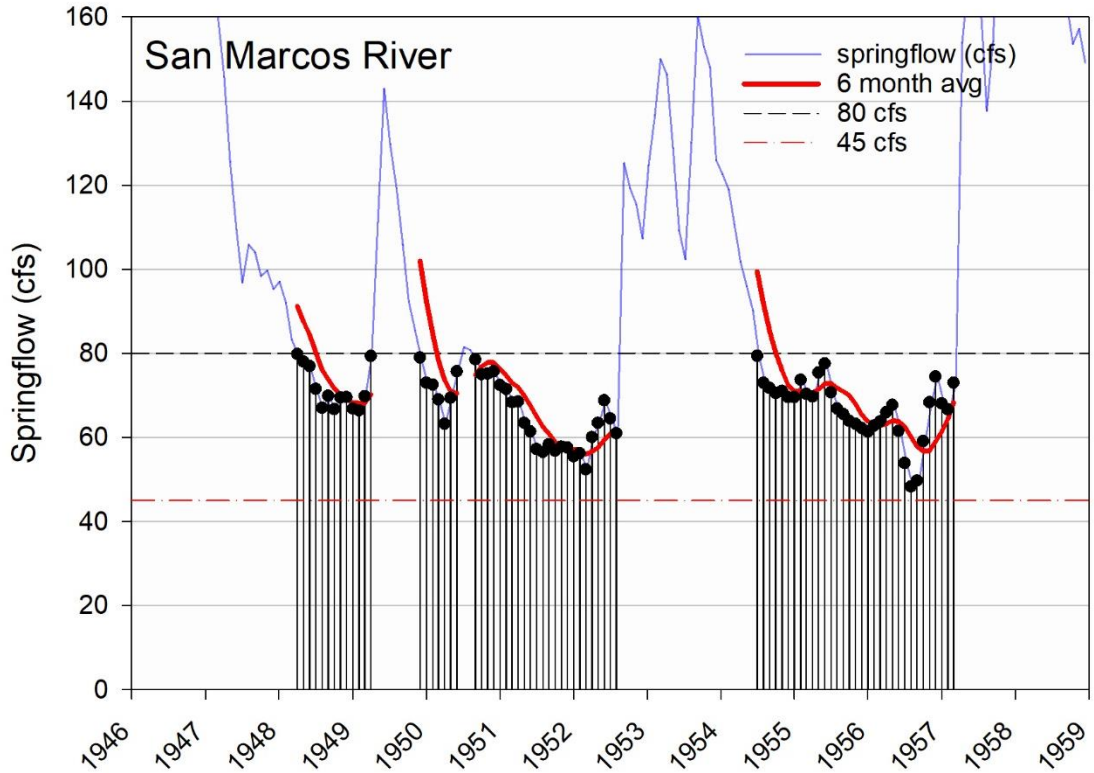

Figure 4. San Marcos Springs Drought of Record MODFLOW simulation shown in Figure 2 with periods of less than 80 cfs shown with bars. Other selected thresholds and statistics are shown.

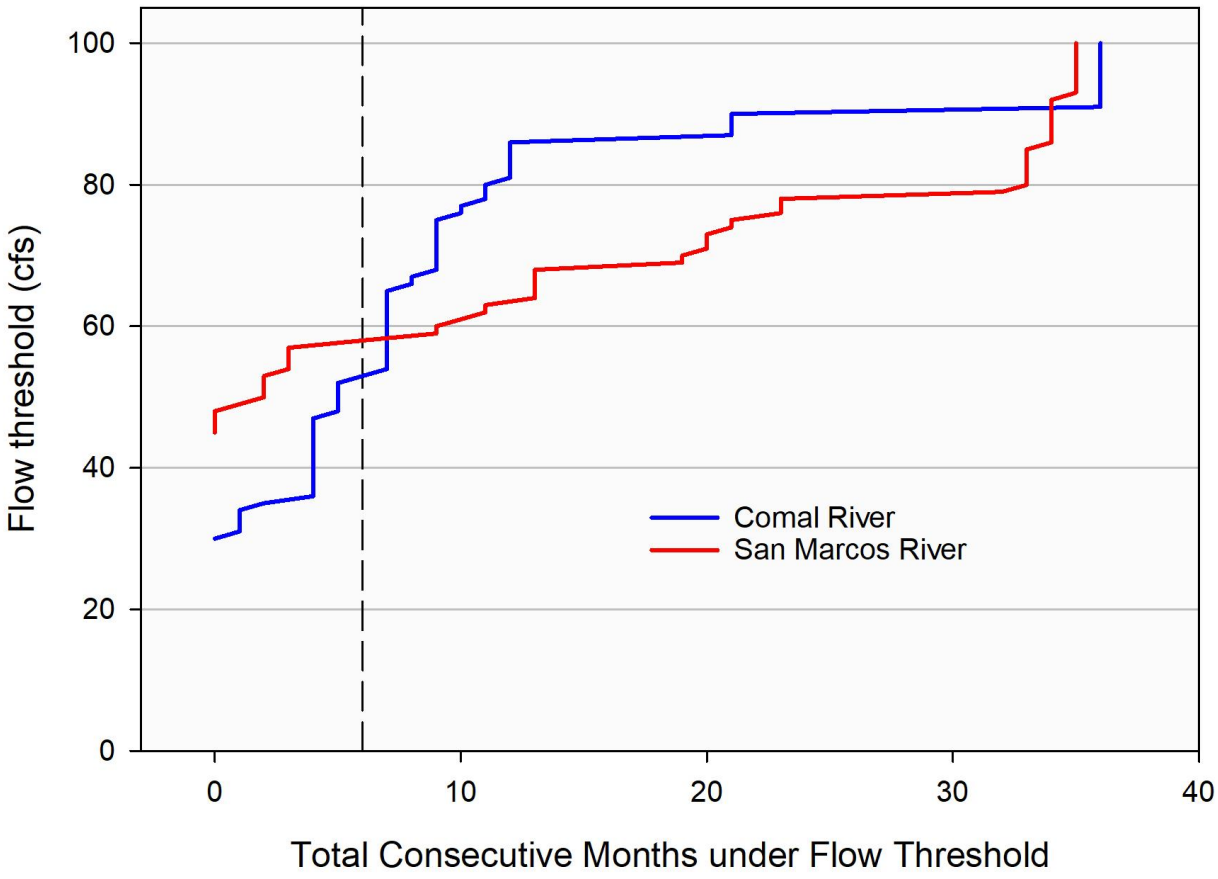

Figure 5. Frequency distributions displaying consecutive months less than flow thresholds. The vertical line is placed at 6 consecutive months.

Citations

Lindgren, R, A Dutton, S Hovorka, S Worthington, and S Painter. 2004. Conceptualization and simulation of the Edwards Aquifer, San Antonio Region, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5277, 143 p.

Liu, A, N Troshanov, J Winterle, A Zhang, S Eason, 2017. Updates to the MODFLOW Groundwater Model of the San Antonio Segment of the Edwards Aquifer. Available at: https://data.edwardsaquifer.org/documents/2017_Liu-etal_UpdatestotheMODFLOWGroundwaterModeloftheSanAntonioSegmentoftheEdwardsAquifer.pdf.pdf

HDR, 2011. Evaluation of Water Management Programs and Alternatives for Springflow Protection of Endangered Species at Comal and San Marcos Springs. Available at: http://eahcp.org/wp-content/uploads/2019/02/Appendix-K.pdf

EAA, 2018a. 2017 Groundwater Recharge. Available at: https://www.edwardsaquifer.org/science-and-maps/research-and-scientific-reports/hydrologic-data-reports

EAA, 2018b. 2017 Groundwater Discharge and Usage. Available at: https://www.edwardsaquifer.org/science-and-maps/research-and-scientific-reports/hydrologic-data-reports

NAS, 2015. Review of the Edwards Aquifer Habitat Conservation Plan Report 1. Available at: http://eaahcp.org/administration/science-review-panel/

NAS, 2016. Review of the Edwards Aquifer Habitat Conservation Plan Report 2. Available at: http://eaahcp.org/administration/science-review-panel/

NAS, 2018. Review of the Edwards Aquifer Habitat Conservation Plan Consensus Report. Available at: http://eaahcp.org/administration/science-review-panel/

Pence, 2018. SAMP Model Runs Inputs and Assumptions. Memo to EAHCP Committees, June 21, 2018.

Summary of Science Committee Discussion of the Proposal

Overview

At the March 27, 2019 Science Committee, EAHCP Chief Science Officer Chad Furl provided a comprehensive presentation, *Nonroutine Adaptive Management: VISPO Flow Protection Measure* to the Science Committee. This presentation covered (1) the background to the AMP built into the EAHCP, (2) the history of Springflow Protection Measures and Flow Objectives, (3) the findings of MODFLOW output; and finally, (4) the elements of the Nonroutine AMP proposal itself.

The following sections provide a summary of the Science Committee's discussion of the Nonroutine AMP proposal, organized according to the main themes that emerged over the course of the discussion. This section concludes with the final motions (including associated final recommendations) made by the Science Committee concerning the Nonroutine AMP proposal and this Scientific Evaluation Report.

At the end of this section, are written comments submitted April 4, 2019 by Dr. Conrad Lamon of the Science Committee.

Science Committee Discussion

<u>Public Comment:</u>

Myron Hess, EAHCP Stakeholder Committee Chair, advised the Science Committee to expand the title of the VISPO proposal to include language that expresses that the effort to modify the flow protection measure is within the context of Phase II of the EAHCP and is intended to maintain compliance for the remainder of the program. Additionally, Mr. Hess recommended that a portion of the proposal include more information on ASR program and the changes that have been made by providing the process to which the modeling results were used and analyzed.

<u>VISPO Nonroutine AMP</u>

Dr. Chad Furl provided the Committee an overview of the Nonroutine AMP proposal and process to approve the modifications to VISPO. Dr. Furl reminded the Committee that the overall intent of the proposal is to achieve the minimum flow objective of 30.0 cfs at Comal Springs written into the HCP.

Dr. Charles Kreitler questioned if the updated SAMP DOR model run takes into account the modifications to both the VISPO and ASR Program. Dr. Furl confirmed that the latest model run includes both program updates, "as-implemented" forbearance measures, and 6,000 acre-feet per year of federal pumping to achieve 30.0 cfs at Comal Springs.

Dr. Jack Sharp asked, considering the additional 1,795 acre-feet in VISPO forbearance, how sensitive is the model to actual pumping locations. Mr. Jim Winterle responded that

there is some sensitivity to locations. For example, the springs respond quickly from the effects of forbearance in Bexar County. This response is delayed from forbearance in Uvalde County.

Dr. Sharp asked how the increase in VISPO forbearance was determined. Mr. Winterle explained that the change in forbearance results in an almost linear rate of increase in springflow. The forbearance number was simply adjusted until the minimum flow objectives were met. Increasing ASR forbearance rather than VISPO was considered but was determined to be too expensive.

Dr. Conrad Lamon asked if there has been any attempt to run the model with actual inputs rather than assumed scenarios. Dr. Furl explained that the model was calibrated in 2011 with the most recent hydrologic data at that time and then validated with hydrologic data from 2011-2015. Mr. Winterle added that the model was also validated with DOR data. The Liu et.al report captures the results of those model runs. Dr. Lamon expressed concerns over the lack of an uncertainty analysis conducted in development of the model. Mr. Winterle explained that the program is engaged with the USGS to conduct more formal uncertainty analysis, but the results of the uncertainty analysis will not be available until the end of the year. Dr. Lamon advocated that the results on the uncertainty analysis would provide a financial benefit to the program.

Dr. Jacquelyn Duke asked if refinements and adjustments can be made after the proposed modifications have already been approved. Dr. Furl clarified that the proposal is a solution for Phase II and the modifications will stay for the reminder of the permit. However, efforts to update models and review flow protection measures will continue.

Dr. Lamon further commented on details surrounding uncertainty analysis in the MODFLOW model.

Dr. Tom Arsuffi commented that the current issue regarding flow protection can be solved using the best available scientific data. Hopefully, further research and the product of the uncertainty analysis can provide information to help refine the model.

Dr. Kreitler commented that the EAA agreed to have a minimum flow of 30.0 cfs as a USFWS requirement. The modifications proposed will achieve the obligation.

Chad Norris asked if the additional VISPO water is currently under contract with EAA. Dr. Furl clarified that 40,000 acre-feet is what was stated in the EAHCP, and the 40,921 acre-feet is the amount currently under contract.

Dr. Duke added that the proposal is a very conservative effort to resolve the concerns regarding 30.0 cfs in Comal Springs.

Dr. Furl presented the long-term flow objectives and results from the empirical hydrologic record.

Chad Norris asked for clarification that although the models indicated that the long-term flow objectives will not be achieved, Dr. Furl was suggesting the mass balance equations

confirm that it is likely that the objectives will be met. Dr. Furl clarified that, based on the springflow data provided by the USGS, it is very likely that the objectives will be achieved using the mass balance equations. Mr. Winterle added that developing a model to analyze the long-term flow objectives was considered, however, the most realistic scenario isn't what was used in the model but rather, what actually occurred. Historical data will illustrate that the long-term flow objectives have been achieved.

Dr. Kreitler clarified that by using the model the long-term flow objectives will not be achieved, however, if you use observed data in a mass balance equation, the objectives will be met.

Dr. Kreitler raised the issue of the increase population in the I35 corridor and the effects it can have on water demand.

Dr. Furl discussed the 80 cfs flow objective and the referenced six month low flow time period footnote included in the EAHCP. Dr. Furl noted that the proposed AMP would authorize fluctuating flow rates between the minimum objective and the 80 cfs threshold without triggering the 80 cfs requirement.

Chad Norris commented that the purpose of the 80 cfs pulse flow requirement and six month minimum springflow time duration was included in the EAHCP with the intent to not subject the invertebrates to drought of record conditions for longer than six months.

Dr. Sharp asked Mr. Winterle the anticipated issues to arise and what, if any, should the models address. Mr. Winterle answered, in regard to applying for a 30-50 year ITP, the models should be prepared for the effects of climate change. Additionally, the primary concern today is the uncertainty of VISPO and maintaining compliance with the springflow protection requirements for the remainder of the ITP. Many of the long-term concerns will be addressed after Phase II and during the rollover period to the second ITP.

Final Motions by the Committee

Dr. Arsuffi made a motion to recommend the Nonroutine AMP proposal as presented. Dr. Sharp seconded. Dr. Conrad Lamon and Doyle Mosier abstained from voting. There were no further comments. All those not abstaining were in favor. Motion passed.

Dr. Weckerly made a motion to endorse the process to prepare and submit this Nonroutine AMP Scientific Evaluation Report via the Science Committee Chair and Vice-Chair to the Stakeholder Committee by May 23, 2019. Dr. Sharp seconded. All were in favor. Motion passed.

This draft of the Scientific Evaluation Report was approved by the Chair and Vice-Chair of the Science Committee for submission to the Stakeholder Committee on April 12, 2019.

EAA MODFLOW model updates

Lamon

March 27, 2019

"Validation results for Comal Springs (Figure 37) are similar in every respect to those of index well J17, which is expected given the strong correlation between observations at the two locations. The model underestimates flow by approximately 30 to 40 cubic feet per second (cfs) for most of the validation period, but does a good job to match the lowest observed flow in August 2014." -Liu et al, 2017, Uncertainty Analysis section, page 54

Unfortunately, that's not how we determine prediction error. We estimate measures of model fit for a calibrated model, using data that were held out of consideration during the calibration process. We don't chose a point on the validation simulation run where fit was "good" and use that as our estimate. We take a measure that represents the aggregate fit over the entire validation run.

We have three MODFLOW runs to evaluate, two done by the EAA staff with their model (Liu et al, 2017) and one by HDR (HDR, 2011).

```
forbearance<-c(40000,40921,41795)
springflow<-c(29.1,29.6,30)
plot(springflow~forbearance)
abline(lm(springflow~forbearance))
```

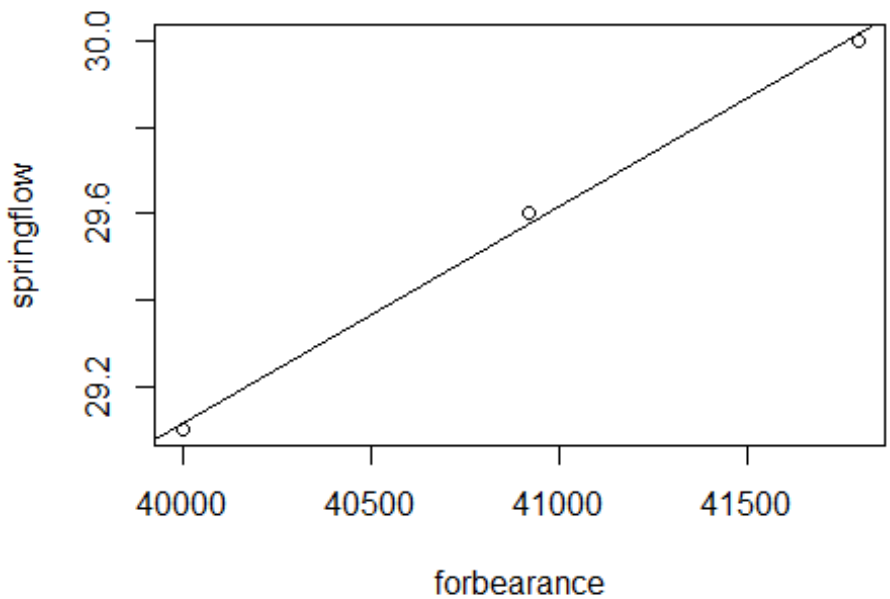

Figure 1 - What we are tempted by the limited data to see with default settings. Change looks big if the y-axis range is small.

So we have three different forbearances that produce three springflow forecasts. Forecast standard deviation is about 8 cfs, sample size is 3 so d.f.= 2. Replot with 90% CI.

```
plot(springflow~forbearance,ylim=c(0,60), xlim=c(39500,42000))
points(x=forbearance,y=springflow+qt(c(0.95),2)*(8/sqrt(2)),pch="?")
points(x=forbearance,y=springflow+qt(c(0.05),2)*(8/sqrt(2)),pch="?")
abline(lm(springflow~forbearance))
```

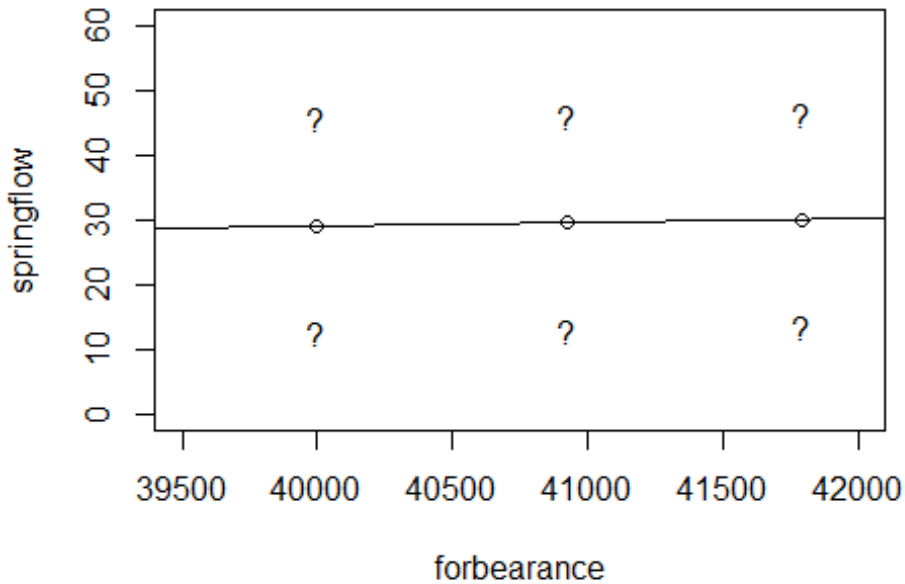

*Figure 2 - Now with the **90%** CI based on a t distribution with 2 d.f and se=8 cfs/. Last time I saw a table it seems the actual sd was higher than the 8 cfs used here. (Jim Winterle said "around ten" in the meeting March 27,2019.)*

Calculate the p(x <= 30|model 2). The probability p(x <= 30|model3)=0.5 because 30 is the center point of the forecast. Use these probabilities to form a ratio p(x <= 30|model3)/p(x <=30|model2). The calculations indicate only a small increase in the probability that mean spring flow during DOR is >= 30. Further, the actions under the third model will only lower the probability from 0.525 to 0.50.

```
pt((30-29.6)/(8/sqrt(2)),2)

## [1] 0.5249688

pt((30-29.6)/(8/sqrt(2)),2)/0.5

## [1] 1.049938
```

Maybe the error distribution of the EAA MODFLOW model is not a *t* distribution, as the quote above mentions a considerable bias. Maybe we shouldn't settle for a 50% probability of "success", but that's for another day.

Question

Regarding the work plan for MODFLOW in Liu et al., in which you plan to run the DOR model for each of the parameter realizations in the ensemble (i.e. if the ensemble has 500 members, this would require 500 model runs):

How many parameters per set in the ensemble? (Winterle:"perhaps a thousand?""") Well, 500 "samples" in 1000 dimensions isn't very many at all.

You use the terminology of a Bayesian analysis in the work plan, but subvert the spirit of the Bayesian approach. It's better to model each parameter independently. What EAA has described, though, is developing a sampling distribution for mean springflow resulting from DOR conditions, **given** (i.e, *conditional on*) the parameter sets in the ensemble. By modeling a "small" number of realizations of predetermined ensembles of parameters we severely limit the parameter space. Space is big. Further we loose the opportunity to learn about covariance matrix, and the correlation between parameters. Taking advantage of the correlation structure of the parameters lets the data do the talking while serving to confine the parameter space , a goal of using the ensembles , I suppose, since it shortens convergence times. Without a fully Bayesian approach, we have no idea of the likely distributions of each parameter, or indeed if the best set was in the ensemble.

The fully Bayesian approach

The fully Bayesian approach requires (perhaps vague) prior distributions on each model parameter, generating a parameters set from the parameter priors, forecast based on the priors chosen, observing the data and evaluating the likelihood of the parameters (collectively the model likelihood), given the data, and using the likelihood to update the prior distributions of the parameters to posterior (to the data observation) distributions. Posterior parameter distributions are then used as priors to select the second set of independent realizations of the parameters, and process of drawing parameters sets, forecasting with those sets, observing data and updating the parameter priors (using Bayes theorem). Repeat.

A Bayesian alternative to MODFLOW

It may be impractical to run the MODFLOW model enough times to have multiple MCMC chains converge, a problem that gets worse as the number of parameters increases. It is possible (Lamon, 2015) to take advantage of the relationship between flow and J-17 elevation to develop the desired sampling distribution for the mean springflow resulting from DOR conditions. Such a *probability network model* could be used with the DOR scenario inputs for this purpose.

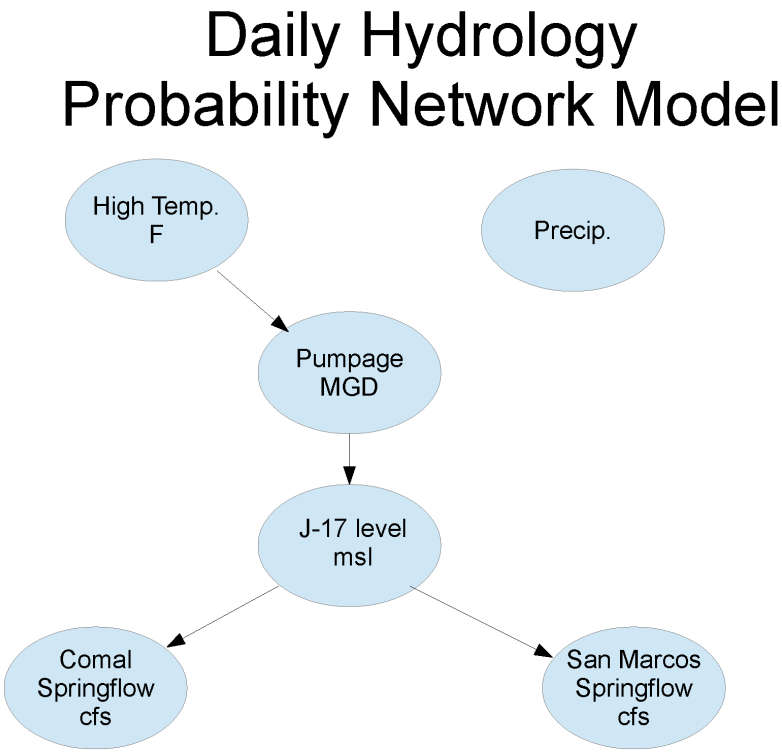

Figure 3 - The Daily Hydrology Probability Network Model of Lamon, 2015. Arrows represent Dynamic Linear Models the afferent node (predictor variable) to the efferent node (response variable). Daily maximum temperature predicts Pumpage, which predicts J-17 level, which then predicts the springflows. Ovals are "nodes", representing probability distributions, conditional on the variables afferent (opposite the arrow point), such that Spring flows are conditional on J-17 level, etc. The time step is daily.

Daily Hydrology Probability Network Model

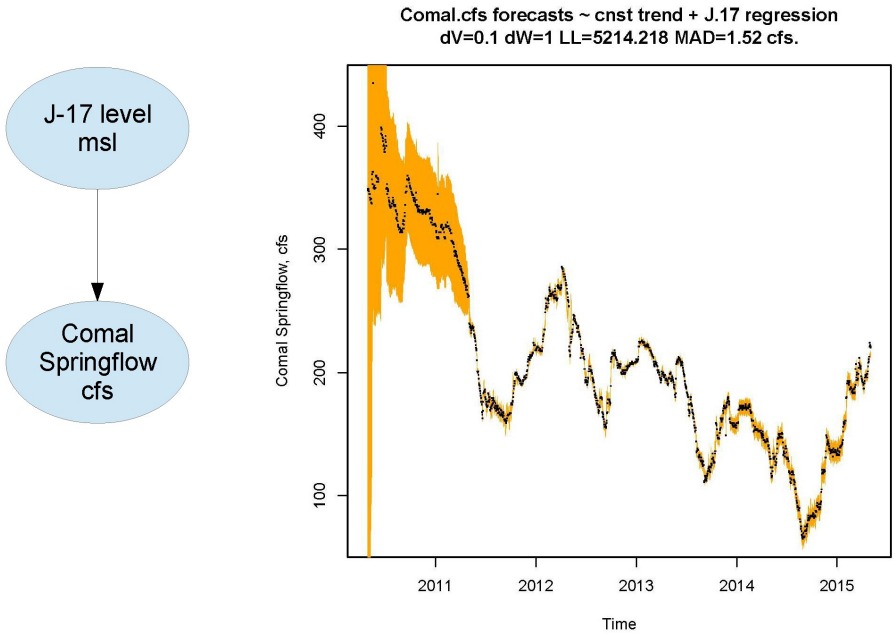

Figure 4 - Dynamic Linear Model predicting daily average Comal springflow as a function of a constant trend and daily average J-17 elevation predictor variable, from Lamon, 2015. This model has a median absolute deviation (MAD) of 1.52 cfs.

Statement

With millions in VISPO payments at stake riding on differences in forecast means of less than 1 cfs, and long term investments in modeling to develop those forecasts, it seems as if we'd be closer to a finished decision tool than a 30-40 cfs bias and 8 cfs mean squared error indicates. This is not meant as an argument against the changes to VISPO. Rather it is meant as an argument for investment in quantification and reduction of uncertainty in the springflow forecasts, and to offer my opinion on a logical course of action by which it may be achieved.

References

Lamon, EC, 2015. Daily Hydrology Probability Network Model, pdf.

Liu, A, N Troshanov, J Winterle, A Zhang, S Eason, 2017. Updates to the MODFLOW Groundwater Model of the San Antonio Segment of the Edwards Aquifer. Available at: https://data.edwardsaquifer.org/documents/2017_Liuetal_UpdatestotheMODFLOWGroundwaterModeloftheSanAntonioSegmentoftheEdwardsAquifer.pdf.

HDR, 2011. Evaluation of Water Management Programs and Alternatives for Springflow Protection of Endangered Species at Comal and San Marcos Springs. Available at: http://eahcp.org/wpcontent/uploads/2019/02/Appendix-K.pdf

Exhibit 4

Adaptive Management Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan

Adaptive Management Stakeholder Committee Report: Nonroutine Adaptive Management Proposal for the EAHCP VISPO

May 23, 2019

PREAMBLE

This Adaptive Management Stakeholder Committee Report[1] is issued in response to the Nonroutine Adaptive Management (AMP) proposal ("Proposal") submitted by the Program Manager of the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan ("EAHCP;" EARIP, 2012), dated March 14, 2019. Having considered the attached Scientific Evaluation Report issued by the Adaptive Management Science Committee ("Science Committee") regarding the Proposal, this report presents the final recommendation of the Adaptive Management Stakeholder Committee ("Stakeholder Committee") concerning the proposed Nonroutine AMP action.

SUMMARY OF THE NONROUTINE AMP PROPOSAL

On March 14, 2019, the Program Manager submitted the attached Proposal to the Science, Stakeholder, and Implementing Committees. The Proposal calls for modifications to the Voluntary Irrigation Suspension Program Option (EAHCP § 5.2.1) to ensure compliance with the EAHCP Phase II flow targets, especially for Comal Springs.

SUMMARY OF STAKEHOLDER COMMITTEE DISCUSSION

At the May 23, 2019 Stakeholder Committee meeting, Chief Science Officer Chad Furl provided a comprehensive presentation, *Proposed Nonroutine Adaptive Management Process Proposal as the mechanism for ensuring compliance with the EAHCP Phase II flow targets,* to the Committee. This presentation covered (1) the AMP process; (2) EAHCP Flow Objectives and Protection Measures (3) MODFLOW modeling and SAMP DOR model run; and (4) the Scientific Evaluation Report issued by the Science Committee in response to the Proposal. Following this presentation, the Stakeholder Committee discussed the merits of the proposal.

This section provides a brief summary of the Stakeholder Committee's discussion of the proposed Nonroutine AMP action, organized by themes that emerged over the course of the Stakeholders' discussion. It also includes the final motions taken by the Committee.

Introduction to Nonroutine AMP

Mr. Myron Hess described the procedure of Nonroutine AMP as it is dictated in the Stakeholder Program Operational Rules and Funding and Management Agreement.

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[1] Per the Funding & Management Agreement (2012), the Adaptive Management Stakeholder Committee is responsible for the reviewing of, and making recommendations to the Implementing Committee concerning, proposals submitted through the Nonroutine Adaptive Management Process (AMP).

Presentation on Nonroutine AMP Proposal

Dr. Chad Furl provided the Committee an overview of the Nonroutine AMP proposal and supporting information. Dr. Furl reminded the Stakeholder Committee of Nathan Pence's SAMP Whitepaper that was submitted in 2018 which thoroughly described the process for adaptive management and has served as the guidelines for the nonroutine adaptive management process that is being presented to the committees to date. In summation, the proposal involves a modification to the VISPO Conservation Measure (EAHCP § 5.1.2) to ensure compliance with the EAHCP Phase II flow targets, specifically the 30 cfs minimum flow objectives for the Comal Spring systems. This proposal seeks to change VISPO forbearance from 40,000 ac-ft/yr to 41,795 ac-ft/yr.

Minimum Flows
The modeling for DOR conditions is conservative because still account for 592,000 permitted pumping (assuming permittees pump to max amount) except as limited by critical period pumping limits.

80cfs Pulse
The intent of the 80 cfs pulse was to provide flow relief to the covered species during drought conditions, however multiple model iterations have shown that this flow rate is difficult to attain during DOR. Hess identified the challenge and acknowledged the lack of ability to achieve those 80 cfs flows.

Facilitation of discussion

Myron Hess nominated Doris Cooksey to facilitate the Stakeholder Discussion. There was consensus among the Committee.

Mr. Hess had concerns primarily with the 80 cfs flow rate and how to resolve the issues from either a program management perspective and/or a species protection perspective. Mr. Hess had reservations approving 30 cfs without further addressing 80 cfs throughout Phase II.

Mr. Hess commented that renegotiating flow rates are not a direction that the committee is looking to take. The 80 cfs rate was intended to provide relief to the spring systems and the species. Mr. Hess recommends a process to look at the predicted spring flow regimes as they relate to the species. The primary concern is not resolving issues related to the 80 cfs while moving forward with Phase II flow issues.

Final motions by the Committee
- The Stakeholder Committee recommends that the Implementing Committee approve the March 14, 2019 Nonroutine Adaptive Management Proposal VISPO, create a Work Group to address spring-flow related issues raised in the discussion document circulated to the Stakeholder Committee members by Myron Hess on May 22 (for issues not related to federal exempt pumping), and that the

Implementing Committee support the evaluation process and any recommended studies that come out of the Work Group.

- Nathan Pence motioned to recommend the Nonroutine Adaptive Management proposal to the Implementing Committee; Gary Middleton seconded the motion. There was no opposition.

- An expedited process whereby this report on the Stakeholder Committee recommendation on the Nonroutine AMP Proposal would be finalized by the Chair and Vice-Chair of the Stakeholder Committee was presented to the Committee for their consideration. Myron Hess moved approval of that expedited process; Jim Bower seconded the motion. There was no opposition.

NATURE OF STAKEHOLDER COMMITTEE DECISION

Twenty-two members were present at the time of the motion. Votes for both Committee actions concerning the Proposal were by consensus; there were no competing positions.

STAKEHOLDER RECOMMENDATION

By consensus, the Stakeholder Committee recommends the Nonroutine AMP proposal to the Implementing Committee for approval and adoption.

REFERENCES

- Edwards Aquifer Authority, City of New Braunfels, City of San Marcos, City of San Antonio, acting by and through its San Antonio Water System Board of Trustees, and Texas State University – San Marcos. 2012. *Funding and Management Agreement…to Fund and Manage the Habitat Conservation Plan for the Edwards Aquifer Recovery Implementation Program*. http://www.eahcp.org/files/uploads/Funding_and_Management_Agreement_(Appendix_R).pdf

- Edwards Aquifer Recovery Implementation Program (EARIP). 2012. *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan*. http://www.eahcp.org/files/uploads/ Final%20HCP %20November%202012.pdf

ATTACHMENTS

- Attachment 1: Nonroutine Adaptive Management Proposal

- Attachment 2: *Scientific Evaluation Report: Nonroutine Adaptive Management Proposal*

- Attachment 3: Meeting minutes to be approved at the October 3, 2019 Stakeholder Committee Meeting. A draft will be included in this report TBD.

- Attachment 4: *May 22, 2019 Possible Components of Stakeholder Committee Recommendation from Myron Hess.*

NOTICE OF OPEN MEETING

Available at eahcp.org

As required by Section 7.9.3 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA), a meeting of the **Science Committee** for the Edwards Aquifer Habitat Conservation Plan is scheduled for **Wednesday, March 27, 2019 at 9:00 a.m. at the San Marcos Rec Hall** (near Lions Club)**,** 170 Charles Austin Drive, San Marcos, TX 78666**.** Lunch will be provided. All attendees are encouraged to please RSVP to ktolman@edwardsaquifer.org by Friday, March 22nd.

Members of this committee include: Tom Arsuffi, Janis Bush, Jacquelyn Duke, Charles Kreitler, Conrad Lamon, Glenn Longley, Doyle Mosier, Chad Norris, Jackie Poole, Floyd Weckerly and Jack Sharp.

At this meeting, the following business may be considered and recommended for committee action:

1. Call to order.

2. Public comment.

3. Approval of the minutes from the November 11th Science Committee meeting (Attachment 1).

4. Receive report from the Program Manager.
   - Hydrologic update
   - June 27 meeting location update
   - Comal Springs riffle beetle Work Group update
   - Phase II update

5. Discussion and possible action to elect the nomination for the Science Committee Vice-Chair for 2019.

   Purpose: To elect the nomination for the Science Committee Vice-Chair for 2019.
   Action: To possibly elect the Science Committee Vice-Chair for 2019.

6. Presentation, discussion, and possible recommendation of the Nonroutine Adaptive Management proposal related to the VISPO Flow Protection Measure (Attachment 2).

Purpose: To provide the opportunity for the Science Committee to discuss and possibly recommend the Nonroutine Adaptive Management proposal related to the VISPO program to the Stakeholder Committee.

Action: To possibly recommend the Nonroutine Adaptive Management proposal to the Stakeholder Committee.

7. Presentation and possible endorsement of an expedited process to prepare and allow Committee Chairs to submit the Nonroutine Adaptive Management Scientific Evaluation Report to the Stakeholder Committee.

Purpose: To provide the opportunity for the Science Committee to discuss and possibly endorse a process to prepare and allow Committee Chairs to submit the Nonroutine Adaptive Management Scientific Evaluation Report to the Stakeholder Committee

Action: To possibly endorse a process to prepare and allow Committee Chairs to submit the Nonroutine Adaptive Management Scientific Evaluation Report to the Stakeholder Committee.

8. Presentation and discussion of components of the 2020 Edwards Aquifer Authority Work Plan.

Purpose: To provide the Science Committee with the opportunity to comment on scientific components of the 2020 Edwards Aquifer Authority Work Plan.

Action: To obtain input from the Science Committee on the scientific components of the 2020 Edwards Aquifer Authority Work Plan.

9. Presentation and discussion of components of the 2020 City of New Braunfels Work Plan.

Purpose: To provide the Science Committee with the opportunity to comment on scientific components of the 2020 City of New Braunfels Work Plan.

Action: To obtain input from the Science Committee on the scientific components of the 2020 City of New Braunfels Work Plan.

10. Presentation and discussion of components of the 2020 City of San Marcos Work Plan.

Purpose: To provide the Science Committee with the opportunity to comment on scientific components of the 2020 City of San Marcos Work Plan.

Action: To obtain input from the Science Committee on the scientific components of the 2020 City of San Marcos Work Plan.

11. Presentation on the aquatic plant boom assessment in Spring Lake.

Purpose: To provide the Science Committee with the opportunity to review and discuss the proposed methodology for this study.

Action: No action required.

12. Consider future meetings, dates, locations, and agendas.

- Thursday, June 27, 2019 at 9 a.m. at the USFWS San Marcos Aquatic Resources Center (500 E McCarty Ln, San Marcos)

EXHIBIT 5b

Edwards Aquifer Authority

900 E. Quincy
San Antonio, TX 78215
EdwardsAquifer.org

NOTICE OF OPEN MEETING

EAHCP Stakeholder Committee

Myron Hess - Chairman
The EAHCP Stakeholder Committee consists of 27 individuals representing diverse interests throughout the region.
Scott Storment - EAHCP Program Manager

Thursday, May 23, 2019 | **10:00 AM** | **City of New Braunfels - City Hall**

A meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan will be held on the date, time, and location stated above.

AGENDA

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements

3.1

- Recognition of Con Mims, EAHCP Stakeholder Committee Member
- Hydrologic Update
- SAWS ASR
- Budget Reports
- EAHCP Program Management
- Spring Communities Update

4. Approval of Minutes

4.1 **Approval of previous committee meeting minutes - January 24, 2019**

5. Reports

6. Individual Consideration

6.1 **Consider staff recommendation to approve the EAHCP Nonroutine Adaptive Management Process Proposal as the mechanism for ensuring compliance with EAHCP Phase II flow targets.**

6.2 **Consider staff recommendation to approve the Nonroutine Adaptive Management Process Stakeholder Report and its submission to the Implementing Committee.**

7. Future Meetings

8. Questions from the Public

9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

This meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan complies with Section 7.8.4 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA).

EXHIBIT 5c

Edwards Aquifer Authority

900 E. Quincy
San Antonio, TX 78215
EdwardsAquifer.org

NOTICE OF OPEN MEETING

EAHCP Implementing Committee

Mark Enders (New Braunfels), Chairman
Robert Mace (Texas State University), Nathan Pence (GBRA), Roland Ruiz (EAA), Tom Taggart (San Marcos), and Darren Thompson (SAWS)
Scott Storment - EAHCP Program Manager

Thursday, May 23, 2019 | **10:00 AM** | **City of New Braunfels - City Hall**

A meeting of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan will be held on the date, time, and location stated above.

AGENDA

1. Call to Order

2. Public Comment

3. Approval of Minutes

3.1 Approval of previous committee meeting minutes
- March 21, 2019

4. Reports

4.1 Receive report from Chuck Ahrens, Edwards Aquifer Authority, on 2018 Edwards Aquifer authorized pumping withdrawals.

4.2 Receive report from Scott Storment, EAHCP Program Manager, on Joint Base San Antonio's use of the Edwards Aquifer and the impact on the EAHCP.

5. Individual Consideration

5.1 Consider staff recommendation to approve the EAHCP Comprehensive Phase II Work Plan.

5.2 Consider staff recommendation to approve EAHCP Resolution No. 05-19-001.

5.3 Consider staff recommendation to approve the EAHCP Nonroutine Adaptive Management Process Proposal.

5.4 **Consider recommendation to direct EAHCP Program Manager to submit the necessary documentation regarding the approved Nonroutine Adaptive Management Process Proposal to the U.S. Fish and Wildlife Service on behalf of the Implementing Committee.**

5.5 **Consider staff recommendation to approve the 2020 City of New Braunfels EAHCP Work Plan.**

5.6 **Consider staff recommendation to approve the 2020 City of San Marcos/Texas State University Work Plan.**

5.7 **Consider staff recommendation to approve the 2020 Edwards Aquifer Authority Work Plan.**

5.8 **Consider staff recommendation to approve amendments to the 2019 City of New Braunfels Work Plan and Funding Application.**

6. Future Meetings

7. Questions from the Public

8. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

This meeting of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan complies with Section 7.7.4 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA).

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1. Article Addressed to:

MR. ADAM ZERRENNER
USFWS-Ecological SVCS.
107011 BURNET RD., Ste. 200
AUSTIN, TX 78758

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☐ Agent
☐ Addressee

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Appendix I2
USFWS DOCUMENTS
USFWS response to Voluntary Irrigation Suspension Option Program springflow protection measure minor amendment request

United States Department of the Interior

FISH AND WILDLIFE SERVICE

10711 Burnet Road, Suite 200
Austin, Texas 78758-4460
512 490-0057
FAX 490-0974

JUN 2 6 2019

Mr. Scott Storment, Program Manager
Edwards Aquifer Authority Habitat Conservation Plan
Edwards Aquifer Authority
900 E Quincy, San Antonio, Texas 78215

Dear Mr. Storment:

We received your request to amend the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan (EAHCP) on June 13, 2019. The amendment requested by you on behalf of the five Permittees is to increase the volume of water that groundwater irrigators enrolled in the Voluntary Irrigation Suspension Program Option (VISPO) will forgo pumping during periods of drought from 40,000 acre-feet to 41,795 acre-feet per year. The VISPO enrollment requirements are described in section 5.1 the EAHCP.

The Covered Species need clean and flowing water for their survival and reproduction. The EAHCP relies on several water conservation programs that function together to maintain spring flows during times of drought at the Comal and San Marcos springs complexes. During the development of the EAHCP, the combined effectiveness of the water conservation programs to meet the minimum flow objectives during a repeat of the drought of record was predicted using a hydrologic model. The model predicted that the EAHCP would fall short of achieving the minimum flow target of 30 cfs at Comal Springs.

The Service and the Permittees agreed to execute the groundwater conservation and flow protection programs during the first phase of the permit term and later to reevaluate with an updated hydrologic model making adjustments to the water conservation programs as needed to meet the flow objectives. The Permittees have updated the hydrologic model and reanalyzed the predicted minimum spring flows. The model was then used to determine the amount of VISPO forbearance that will result in attaining the 30 cfs minimum flow target. The EAHCP and the April 12, 2019, Scientific Evaluation Report: Nonroutine Adaptive Management Proposal for the EAHCP VISPO, and other documents cited in the report provide details on the model, the underlying assumptions, and its appropriate application.

We have reviewed the information that you have provided for consistency with the EAHCP, incidental take permit (TE63663A-1), and our biological opinion. By increasing the VISPO forbearance goal, the Permittees are increasing the likelihood that under extreme drought

conditions the springs will continue to flow and the Covered Species would survive. We accept and approve the amendments to the EAHCP as provided in your June 13, 2019, letter.

We thank the Permittees for their continued support of the rare and unique species in the Edwards Aquifer. We also recognize the commitment of time and other resources dedicated to the preservation of our native species by the Edwards Aquifer stakeholders.

Sincerely,

Adam Zerrenner

Appendix I3
USFWS DOCUMENTS
Letter to USFWS regarding EAHCP Comprehensive Phase II Work Plan and Resolution 05-10-001

EDWARDS AQUIFER
AUTHORITY

June 5, 2019

Mr. Adam Zerrenner
United States Fish and Wildlife Service
Austin Ecological Services Field Office
107011 Burnet Road, Suite 200
Austin, Texas 78758

Dear Mr. Zerrenner:

Please find enclosed the Edwards Aquifer Habitat Conservation Plan Comprehensive Phase II Work Plan and Resolution No. 05-19-001. Pursuant to the Funding and Management Agreement §§ 4.3; 7.13.7, these documents are required to procure the transition from Phase I to Phase II of Incidental Take Permit (#TE-63663A-1).

Please feel free to contact me if you have any questions or concerns.

Respectfully,

Scott D. Storment
Program Manager
Edwards Aquifer Habitat Conservation Plan

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

Enclosure

COMPREHENSIVE PHASE II WORK PLAN

Section 4.3 of the Funding and Management Agreement ("FMA") requires the Implementing Committee to develop a Comprehensive Phase II Work Plan (the "Comprehensive Plan"). The Comprehensive Plan must include descriptions, schedules, and cost estimates for ongoing Phase I Conservation Measures, Phase II Conservation Measures, and all Edwards Aquifer Habitat Conservation Plan ("EAHCP") Program activities conducted or managed by the Parties and Program Manager that are to be funded from the EAHCP Program ("Program") Account for the Phase II period from January 1, 2020 until the expiration of the Incidental Take Permit #TE63663A-1 ("Permit" or "ITP"). This document is intended to satisfy that requirement. The description, schedules, and cost estimates contained herein are taken largely from Chapters 5, 6, and 7 of the EAHCP and are a continuation of Phase I Conservation Measures. Conservation Measures that were completed during Phase I or determined not pertinent to Phase II implementation, were not included in this Comprehensive Plan. The 2018 Phase II Work Plan Work Group Report details the development of this Comprehensive Plan and provides a description of the updates that were applied to this document. The description of the measures is not intended to reiterate all details in the EAHCP. To the extent this Comprehensive Plan conflicts with the EAHCP, the EAHCP controls.

I. Conservation Measures

A. Edwards Aquifer Authority

1. San Marcos Aquatic Resources Center and Uvalde National Fish Hatchery – Refugia (§ 5.1.1)

Edwards Aquifer Authority (EAA) will continue to support and coordinate the work of the U.S Fish and Wildlife Service (USFWS) operation and maintenance of a series of off-site refugia at the San Marcos Aquatic Resources Center and the Uvalde National Fish Hatchery. As constructed in contract 16-822-HCP between the EAA and USFWS, a series of refugia will preserve the capacity for the Covered Species identified in the EAHCP and ITP to be re-established in the event of the loss of population due to a catastrophic event such as the unexpected loss of springflow or a chemical spill.

EAA's support of the refugia will augment the existing financial and physical resources of these facilities, and provide resources for appropriate research activities, as necessary, to house and protect adequate

populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques.

The use of this support is limited to the Covered Species in the EAHCP.

2. Voluntary Irrigation Suspension Program Option (§ 5.1.2)

The Voluntary Irrigation Suspension Program Option (VISPO) is intended to minimize and mitigate the impacts of incidental take from low springflows by suspending the withdrawal of Edwards Aquifer (Aquifer) water for irrigation purposes during drought. This measure will require EAA irrigation permit-holders who voluntarily participate in the program to suspend the use of Aquifer water for irrigation purposes during drought to maintain springflow.

The volume goal for VISPO is to remove 40,000 ac-ft/yr from pumping during periods of drought.

If an irrigation permit-holder desires to enroll less than its full permitted volume, their withdrawals may be monitored by real time automated meters installed by the EAA. The suspension of pumping by the participants in the program will be triggered if the J-17 index well in Bexar County is at or below 635 feet-Mean Sea Level (ft-MSL) on the annual trigger date of October 1.

In 2018, the EAHCP was clarified to reflect that future VISPO payments will be flexible and based on market conditions. Therefore, for Phase II, the five-year agreements will contain the following payment schedule (which will not include a price escalator):

- A standby fee of $54/acre-foot per year will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and

- A fee of $160/acre-foot per year will be paid for each year when temporary pumping suspensions are required.

3. Regional Water Conservation Program (§ 5.1.3)

The Regional Water Conservation Program has been fully implemented through agreements with the San Antonio Water System, the City of San Marcos, the City of New Braunfels, and the City of Uvalde. No additional agreements are anticipated during Phase II.

4. Critical Period Management – Stage V (§ 5.1.4)

The EAA's Critical Period Management Program includes an emergency Stage V reduction of 44 percent applicable in both the San Antonio and Uvalde pools. For the San Antonio Pool, Stage V is triggered by a 10 day average of J-17 levels below 625 feet or springflows of either 45 cubic feet per second (cfs) based on a ten-day rolling average at Comal Springs or 40 cfs based on a three-day rolling average. The Uvalde Pool would trigger Stage V using the Uvalde County Index Well (J-27) water level of 840 ft-MSL.

5. Expanded Water Quality Monitoring (§ 5.7.2)

The EAA will continue to manage and oversee the expanded monitoring of water quality around Landa Lake and the Comal River, and Spring Lake and the San Marcos River. Presently, the Water Quality Monitoring Program contains the following components:

- Stormwater runoff sampling
- Surface water passive diffusive sampling
- Fish tissue sampling
- Real-time water quality sampling

6. Recharge Monitoring (§ 6.2.3)

In accordance to Phase I efforts, the EAA will continue to measure the amount of water (in acre-feet) recharging the Edwards Aquifer in the area described in Section 1.2 of the EAHCP. The EAA maintains partnership with the U.S Geological Survey (USGS) to collect and provide recharge estimates from major drainage basins with streams that flow to the Aquifer. EAA will publish this measurement no later than

June 1 of each year for the purposes of guiding the activities in Section 5.5.1 of the EAHCP. EAA will continue to maintain this information for an appropriate publication.

7. Biological Monitoring (§ 6.3.1)

A biological monitoring plan (Variable Flow Study) was established by the EAA in 2000 to gather baseline and critical period data to fill important gaps in the ecological condition of the Comal and San Marcos springs and river ecosystems. The EAA will continue this comprehensive sampling plan in the Biological Monitoring Program for the term of the ITP. Additionally, biological monitoring will provide a means of examining changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities described in the ITP. Presently, the Biological Monitoring Program contains the following components:

- Aquatic vegetation mapping for select reaches
- Fountain darter sampling
- San Marcos salamander sampling
- Texas wild-rice physical observations and annual mapping
- Comal Springs riffle beetle monitoring
- Comal invertebrate sampling
- Comal Springs salamander sampling
- Invasive species monitoring

Monitoring may increase in magnitude, including increased frequency and number of parameters examined, as discharge falls to specific levels.

In addition to long-term monitoring efforts that increase intensity in response to the specified trigger events, a critical period monitoring component is incorporated into the Biological Monitoring Program that initiates full-scale sample efforts at specified trigger levels.

The scope of the Biological Monitoring Program can be modified on a yearly basis through adaptive management, as provided in Article 7 of the FMA with agreement with the USFWS, as may be appropriate.

The National Academies of Sciences' Consensus report was unable to determine whether riparian management related Conservation Measures will contribute to achieving the Biological Objectives of the Comal Springs riffle beetle (CSRB). This finding was directly related to the lack of quantitative population and aquatic sedimentation monitoring undertaken as part of the Biological Monitoring Program. In 2018, the EAHCP formed the Comal Springs Riffle Beetle Work Group to examine the methodology surrounding the CSRB biological monitoring in addition to other CSRB management issues. The Work Group is anticipated to conclude in 2019, and the final product will likely result in changes to the monitoring methodology of the CSRB conducted during biological monitoring surveys.

8. Coal Tar Sealants (§ 5.7.6)

The EAA will continue to regulate the use of coal tar sealants in Comal and Hays counties as directed by Chapter H Section 713.703 Prohibition on the Use of Coal Tar-Based Pavement Sealant Products of the EAA rules.

B. City of New Braunfels

1. Flow-Split Management in the Old and New Channel (§ 5.2.1)

City of New Braunfels staff will continue to manage the valves and culverts to the Old Channel and New Channel of the Comal River for the protection of existing and restored native aquatic vegetation that was established during Phase I. Additionally, staff will continue to monitor real-time streamflow conditions at USGS gauges in the Comal River system and adjust the flow-control gates to meet streamflow targets. A flow-split management schedule of the Old and New Channels is provided in Table 5-3 of the *Submerged Aquatic Vegetation Analysis and Recommendations Report* (BIO-WEST, Watershed Systems Group, Inc, 2016). Maintenance activities to exercise the system will be conducted, as necessary, to ensure operability of the flow-control gate. Under Section 5.2.10 Litter and Floating Vegetation Management of the EAHCP, floating vegetation will be dislodged from the intake structure, as necessary.

Table 5-3. Flow-Split Management Schedule of the Old and New Channels of the Comal River

TABLE 5-3
FLOW-SPLIT MANAGEMENT FOR OLD AND NEW CHANNELS

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

2. Native Aquatic Vegetation Restoration and Maintenance (§§ 5.2.2; 6.3.4.3)

Phase II implementation of native aquatic vegetation restoration within key reaches of the Comal River will continue to include planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal. In 2016, the EAHCP implemented nonroutine adaptive management of submerged aquatic vegetation maintenance to modify specific planting goals used to achieve native aquatic vegetation restoration within the Comal River (BIO-WEST, Watershed Systems Group, Inc, 2016).

The quantity and location of areas restored in this program are provided in Table 26 of the *Submerged Aquatic Vegetation Analysis and Recommendations Report* (BIO-WEST and Watershed Systems Group, Inc, 2016) are a guideline for plantings. Specific species by location are determined by site specific conditions and vegetation planting success. To sustain the restored native aquatic vegetation within the Comal system, the City of New Braunfels will continue to conduct yearly maintenance of restoration sites in Landa Lake and the Old Channel.

Table 26. Native Aquatic Vegetation Restoration Timeline in the Comal System.

REACHES	SPECIES	Meters squared of aquatic vegetation (m^2)			HCP TERM TIMELINE *											TOTAL
		Current (2016)	Goal	Needed	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
LTBG Reaches																
Landa Lake	*Ludwigia*	474	900	426	75	75	75	105	35	35	50					450
	Cabomba	240	500	260	50	50	50	30	30	25	25					260
	Sagittaria	2,759	2,250	0												0
	Vallisneria	12,012	12,500	488	100	100	75	75	75	50	15					490
	Potamogeton	0	25	25	5	5	5	5	5							25
Old Channel	*Ludwigia*	7	425	418	75	75	75	75	50	50	20					420
	Cabomba	0	180	180	50	30	30	25	15	15	15					180
	Sagittaria	0	450	450	150	75	75	50	50	25	25					450
New Channel	*Ludwigia*	31	100	69		15	15	15	15	5	5					70
	Cabomba	2,397	2,500	103		20	20	20	20	15	10					105
	Sagittaria	0	0	0												0
Upper Spring Run	*Ludwigia*	1	25	24		5	5	5	5	5						25
	Cabomba	2	25	23		5	5	5	5	5						25
	Sagittaria	825	850	25		5	5	5	5	5						25
Restoration Reaches																
Landa Upper	*Ludwigia*	0	25	25			25									25
	Cabomba	150	250	100			25	35	20	10	10					100
	Sagittaria	50	250	200			50	50	50	25	25					200
Landa Lake Lower	*Ludwigia*	5	50	45			15	10	10	5	5					45
	Cabomba	100	125	25			10	10	5							25
	Sagittaria	7	100	93			25	25	25	10	10					95
	Vallisneria	24,500	22,500	0												0
Old Channel ERPA	*Ludwigia*	618	850	232	100	75			30	15	15					235
	Cabomba	119	200	81	25	25			25	10	5					90
	Sagittaria	591	750	159	75	25			35	15	10					160
	Vallisneria	715	750	0												0
	Potamogeton	73	100	27	10	10			5	5						30

* Light grey shaded boxes with no numbers will still require aquatic gardening, plant propagation and supplemental plantings to support maintaining the goals and management objective over time. It is estimated that approximately 1.2 of the HCP annual budget for this mitigation measure would be needed each year to maintain these conditions from 2024 through 2027.

ASSUMPTIONS:

1) Restoration efforts will proceed smoothly with no major setbacks or resets such as floods, culvert repairs, etc.

2) Anthropogenic factors such as recreational disturbances (swimming, wading and paddle boats), turbidity from swimming pools and urban runoff can be managed to provide the suitable water quality for aquatic plant growth.

3) Concurrent aquatic plant propagation, gardening, and maintenance will occur throughout the HCP timeline.

4) Non-native vegetation removal (and replacement with natives) will occur in certain areas (i.e. spring fed swimming pool, confluence with Blieder's creek, etc.) outside of the LTBG and Restoration reaches in order to assure that non-native plants don't reestablish.

5) Riparian restoration in the Old Channel is mandatory to accomplish the proposed goals.

6) No significant interruptions due to HCP Provision M.

7) Mapping to compare against goals will be conducted annually each Fall.

City of New Braunfels staff will continue to monitor and maintain planted stands of native aquatic vegetation. Temporal monitoring includes a quantitative measurement system to assess whether plantings are increasing, decreasing, or remaining stable. Additionally, intensive non-native aquatic vegetation removal in the adjacent areas will continue to be implemented until the native vegetation is well-established. This includes additional activities following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism. Anytime a disturbance is observed, the monitoring and maintenance schedule will be modified temporarily to provide stability for the native vegetation re-establishment.

3. Management of Public Recreational Use of Comal Springs and River Ecosystems (§ 5.2.3)

Phase II efforts to minimize and mitigate the impacts of recreation will continue to include the management of recreational use of the Comal Springs and Comal River ecosystem by the City of New Braunfels through two methods:

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce local regulations, including:

    a. Limiting recreation on Landa Lake to Paddle Boats;
    b. Prohibiting recreational access to the Spring Runs in Landa Park and to the Wading Pool in Spring Run 2; and
    c. Prohibiting on water recreation on the Old Channel, with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Resolution and Order No. 08-12-001 adopted by the Implementing Committee on August 16, 2012, the City of New Braunfels will issue, on a volunteer basis, Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in Section 5.2.3 of the EAHCP.

4. Decaying Vegetation Removal and Dissolved Oxygen Management (§ 5.2.4)

In 2017, the City of New Braunfels adopted the *Landa Lake and Dissolved Oxygen Management Plan* to be implemented during low-flow conditions (<100cfs) and/or when dissolved oxygen data indicates a potential threat to fountain darter populations (AquaStrategies, BIO-WEST, 2017). Dissolved oxygen (DO) management strategies include continuous monitoring of DO concentrations during low-flow conditions and displacement and/ or removal of decaying vegetation and algal mats within Landa Lake. During low-flow conditions, nine additional DO sensors will be installed throughout Landa Lake, Upper Spring Run, Old Channel Environmental Restoration and Protection Area (ERPA) and near Spring Island to collect continuous DO data. Additionally, floating vegetation, decaying vegetation and algal mats will be removed, as necessary, to prevent vegetation impacts on fountain darter habitat.

5. Control of Harmful Non-Native Animal Species (§ 5.2.5)

In accordance to Phase I efforts, the City of New Braunfels will continue to implement various methods of removal to reduce and control non-native animal species populations within the Comal River system on an annual basis. Methods of removal include gill nets, fyke nets, spearfishing and box traps.

The targeted non-native animal species include, but are not limited to, the suckermouth catfish, tilapia, nutria and ramshorn snail.

Routine biological monitoring will be conducted by EAA and EAHCP contractors (EAHCP § 6.3.1) to monitor and assess the distribution of new or existing harmful non-native and invasive species. If a threat is identified, EAHCP staff will work with the contractor to identify areas of concern and potential methods for removal.

6. Monitoring and Reduction of Gill Parasites (§ 5.2.6)

Research indicates that gill parasites (*C. formosanus*) are not a significant threat to fountain darter populations (BIO-WEST, 2017). Pursuant to the EAHCP, the City of New Braunfels will continue to conduct water column concentration monitoring of the gill parasite cercariae within the Comal River system.

During low-flow conditions (<100 cfs), water column monitoring for gill parasite cercariae will be implemented at three established transect sampling locations within Landa Lake, the Old Channel and New Channel.

7. Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries (§ 5.2.7)

In accordance to Phase I efforts, the City of New Braunfels will continue to restrict the transportation of hazardous materials on routes that cross the Comal River and its tributaries. This effort may include legislation, City of New Braunfels ordinances, additional signage, and Texas Department of Transportation (TxDOT) approval.

8. Native Riparian Habitat Restoration (Comal Springs riffle beetle) (§ 5.2.8)

The City of New Braunfels will continue to restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). Methods for riparian zone establishment include the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and other riparian vegetation with extensive root systems are given preference to create maximum riffle beetle habitat. In coordination with the Texas Parks and Wildlife Department (TPWD), fine sediment covering springs will also be removed, as necessary. The riparian zones will be monitored (at least annually) for continued success and removal of reestablished non-native vegetation.

Additionally, the City of New Braunfels will continue to monitor and maintain riparian habitat zones established during Phase I and work to establish new riparian habitat zones within the Comal watershed for the benefit of the Comal Springs riffle beetle.

9. Reduction of Non-Native Species Introduction and Live Bait Prohibition (§ 5.2.9)

In accordance to Phase I efforts, the City of New Braunfels will continue to undertake measures to stop or substantially reduce the introduction of non-native species from aquarium dumps and prohibit the use of live bait species.

Additionally, the City of New Braunfels will continue to prohibit, by Ordinance, the introduction of domestic and non-native aquatic organisms, targeting specifically bait species and aquarium trade species into the Comal system. This action may include outreach, education and signage at key entrance points to parks on Landa Lake and the Comal River.

10. Litter Collection and Floating Vegetation Management (§ 5.2.10)

The City of New Braunfels will continue to remove litter and dislodge floating vegetation mats from the Comal Springs, Landa Lake, and Old and New Channels of the Comal River. Litter found within floating vegetation mats will be removed before dislodging. In the event of low-flow conditions, increased efforts to dislodge floating vegetation mats will be implemented. Collection and removal of litter and debris may include diving within the Comal River and Landa Lake.

11. Management of Golf Course Diversions and Operations (§ 5.2.11)

The City of New Braunfels will continue to implement a golf course management plan that will document current practices following their Integrated Pest Management Plan (IPMP) for the Landa Park Golf Course. The golf course management plan and IPMP incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the Covered Species. Additionally, the IPMP is reviewed annually and revised as needed. Expanded water quality sampling targeted at golf course operations will continue to be conducted per Section of 5.7.2 of the EAHCP.

12. Management of Household Hazardous Wastes (§ 5.7.5)

To reduce the potential of water quality pollution, the City of New Braunfels will continue the Household Hazardous Waste Program established in Phase I. The City of New Braunfels, in collaboration with Comal County and New Braunfels Utilities, will continue to collect household hazardous wastes and unwanted medications that will be disposed of at four collection events held throughout the year.

13. Impervious Cover/Water Quality Protection (§ 5.7.6)

The City of New Braunfels will continue to implement the strategies for impervious cover and water quality management identified in the 2017 *Water Quality Protection Plan (WQPP): Phase I* report. Utilizing low impact development and best management practices, the WQPP recommends seven potential water quality retrofit projects to be established within the Comal River watershed. Potential impervious cover and water quality protection projects include the design and installation of bioretention basins, an underground storm drain vault, rain gardens and permeable pavers. These measures, in addition to the City of New Braunfels' Municipal Separate Storm Sewer System (MS4) and Stormwater Management programs, will aid in reducing pollutant contributions to the Comal River system.

14. Native Riparian Habitat Restoration (§ 5.7.1)

The City of New Braunfels will continue the efforts achieved in Phase I to increase the area of the riparian zone along Landa Lake and the Old Channel. Plans to increase coverage and density of native vegetation include removal of non-native riparian vegetation, planting of native vegetation and maintenance of restoration zones to prevent re-establishment of non-natives and promote growth of native vegetation. Candidate riparian species are selected based on the success of previous restoration efforts.

If non-native riparian vegetation treatment is needed on private property, the City of New Braunfels will work with private landowners to coordinate methods for removal and planting of native species. Participation and coordination with private landowners will occur on a volunteer basis. Areas that need more riparian planting will be planted with drought-tolerant, native species, as needed.

C. City of San Marcos and Texas State University

1. Texas Wild-Rice Enhancement and Restoration (§§ 5.3.1, 5.4.1)

Phase II implementation for Texas wild-rice enhancement and restoration will continue to include activities such as removal of non-native aquatic plant species, propagation of Texas wild-rice plants, and planting of Texas wild-rice plants. The quantity and location of areas restored in this program are provided in Table 34 of the *Submerged Aquatic Vegetation Analysis and Recommendations Report* (BIO-WEST and Watershed Systems Group, Inc, 2016) are a guideline for plantings. Specific species by location are determined by site specific conditions and vegetation planting success.

Table 34. Native Aquatic Vegetation Restoration Timeline in the San Marcos System.

Reaches	Species	Meters squared of aquatic vegetation (m^2)			HCP Term Timeline*												Total
		Current (Dec 2015)	Goal	Needed	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
LTBG Reaches																	
Spring Lake Dam	*Ludwigia*	0	100	100	10	10	10	10	10	10	10	10	10	5	5		100
	Cabomba	0	50	50	5	5	5	5	5	5	5	5	5	5			50
	Potamogeton	0	200	200	25	25	25	25	25	15	15	15	15	10	5		200
	Sagittaria	7	200	193	25	20	20	20	20	20	20	20	20	5	5		195
	Hydrocotyle	7	50	43			5	5	5	5	5	5	5	5	5		45
	Zizania	598	700	102	25	25	15	15	15	10							105
City Park	*Ludwigia*	1	150	149	25	25	20	20	10	10	10	10	10	5	5		150
	Cabomba	0	90	90	5	5	10	10	10	10	10	10	10	10			90
	Potamogeton	54	1,450	1,396	150	100	100	100	100	100	100	125	125	125	125	150	1400
	Sagittaria	92	300	208	15	15	15	15	25	25	25	25	25	15	10		210
	Hydrocotyle	0	10	10									5	5			10
	Zizania	1,261	1,750	489	40	75	75	75	75	50	50	50					490
I35	*Ludwigia*	0	50	50	5	5	5	5	5	5	5	5	5	5			50
	Cabomba	0	50	50	5	5	5	5	5	5	5	5	5	5			50
	Potamogeton	0	250	250	25	25	25	25	25	25	25	25	25	15	10		250
	Sagittaria	0	150	150	30	10	10	10	10	10	10	10	25	15	10		150
	Hydrocotyle	0	50	50			10	5	5	5	5	5	5	5	5		50
	Zizania	28	600	572	75	75	75	75	75	75	75	50					575

* Light grey shaded boxes with no numbers will still require aquatic gardening, plant propagation and supplemental plantings to support maintaining the LTBG reach goals over time.

Additionally, the ENTIRE HCP BUDGET for this mitigation measure is anticipated to be use each year to strive towards accomplishing the proportional expansion goal as it is presently undefined.

Reaches	Species	Meters squared of aquatic vegetation (m^2)			HCP Term Timeline*												Total
		Current (Dec 2015)	Goal	Needed	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Restoration Reaches																	
Sewell Park	*Ludwigia*	0	25	25												25	25
	Cabomba	14	25	11												15	15
	Potamogeton	116	150	34	40												40
	Sagittaria	2	25	23						10	15						25
	Hydrocotyle	0	10	10						5	5						10
	Zizania	1,169	1,100	0													0
Below Sewell to City Park	*Ludwigia*	0	50	50								35	15	15	5		50
	Cabomba	0	50	50								15	15	15	5		50
	Potamogeton	172	500	328								50	75	75	75	55	330
	Sagittaria	727	700	0													0
	Hydrocotyle	5	20	15								5	5	5			15
	Zizania	2,247	2,300	53								25		15	15		55
Hopkins St - Snake Island	*Ludwigia*	0	50	50									10	10	15	15	50
	Cabomba	0	50	50									10	10	15	15	50
	Potamogeton	269	475	206	50								20	20	55	65	210
	Sagittaria	620	750	130	50								20	20	20	20	130
	Hydrocotyle	0	10	10									5	5			10
	Zizania	693	950	257	35						50	35	35	35	35	35	260
Cypress Island - Rio Vista Dam	*Ludwigia*	0	50	50	10	10	10	10	10								50
	Cabomba	0	50	50	10	5	5	5	5	5	5	5	5				50
	Potamogeton	0	150	150	15	10	10	25	10	20	20			25	15		150
	Sagittaria	5	50	45	15	5	5	5	5	5	5						45
	Hydrocotyle	0	0	0													0
	Zizania	122	350	228	50	50	50	25	25	25	5						230
I35 expanded	*Ludwigia*	8	50	42		10	10	10	12								42
	Cabomba	33	100	67		25	25	10	10								70
	Potamogeton	0	250	250		30	25	25	25	50	20			25	25	25	250
	Sagittaria	355	450	95		25	25	10	10	10	15						95
	Hydrocotyle	0	50	50					10	10	5			10	10	5	50
	Zizania	57	450	393		50	50	50	50	50	50	50	45				395
Additional Texas wild-rice Reaches																	
Spring Lake	*Zizania*	31	1,000	969	50	100	100	100	100	100	100	100	100	100	20		970
Below I35	*Zizania*	0	280	280		20	20	30	30	30	30	30	30	30	30		280

* Light grey shaded boxes with no numbers will still require aquatic gardening, plant propagation and supplemental plantings to support maintaining the goals over time.

ASSUMPTIONS:

1) Restoration efforts will proceed smoothly with no major setbacks or resets such as floods, dam repairs, etc.
2) Anthropogenic factors such as recreational disturbances and urban runoff are managed.
3) Concurrent aquatic plant propagation, gardening, and maintenance will occur throughout the HCP timeline.
4) Non-native vegetation removal (and replacement with natives) will occur in certain areas outside of the LTBG and Restoration reaches in order to mitigate reestablishment of non-natives.
5) No significant interruptions due to HCP Provision M.
6) Propagation rates remain sufficient to replace denuded area of non-native aquatic vegetation
7) Mapping to compare against goals will be conducted annually each Fall.

2. Management of Recreation in Key Areas (§§ 5.3.2, 5.4.2)

Texas State University and the City of San Marcos will continue to control access and recreation in Spring Lake and the San Marcos River.

To minimize the impacts from recreation, Texas State University restricts access to Spring Lake to authorized and permitted activities and may establish and manage recreation access points on the west bank of the San Marcos River between Spring Lake Dam and the Aquarena Drive bridge, or other areas, as needed. Riparian areas between access points will be maintained with dense vegetation to discourage streamside access.

The City of San Marcos has established and will continue to manage permanent access points along the San Marcos River. Permanent access point locations include portions of the banks of the San Marcos River across from Lions Club Tube Rental (City Park), an area downstream of the first pedestrian bridge connecting San Marcos Plaza and City Park, beneath the Hopkins Street bridge, Bicentennial Park, Rio Vista Park, and Ramon Lucio Park (EAHCP § 5.3.7). Riparian areas between access points have undergone native vegetation restoration and will be maintained to discourage streamside access.

To support the TPWD's creation of a State Scientific Area in the San Marcos River (EAHCP § 5.6.1), the City of San Marcos and Texas State University will establish exclusion zones in critical areas to protect Texas wild-rice and San Marcos salamander habitat from recreational impacts, as well as continue to maintain kiosks at key areas along the river that locate access points, exclusion zones, and associated educational components at key locations.

The City of San Marcos will continue to employ a group called the Conservation Crew to help educate visitors, monitor recreational use, and other activities, as needed, in the San Marcos River. Activities include, but are not limited to, collecting trash, educating recreationists about the threatened and endangered species that inhabit the river, installing and maintaining exclusion barriers, as well as monitoring vulnerable stands of Texas wild-rice and San Marcos salamander habitat to reduce adverse impacts from recreation.

3. Native Riparian Habitat Restoration (§ 5.7.1)

The City of San Marcos will continue to undertake a program to increase and maintain the area of the riparian zone on public lands along the banks of the river using native vegetation. Texas State University will continue to restore the riparian zone with native vegetation in upper Sewell Park and Spring Lake. Phase I activities focused on non-native removal and planting of native riparian species. While some areas may require new riparian plants over time, Phase II riparian activities will be focused more on non-native removal and maintenance. If non-native plant treatment is needed on riparian private property, the City of San Marcos will work with private landowners, on a voluntary basis, to coordinate methods for removal and planting of native species. Areas that need more riparian planting will be planted with drought-tolerant, native species, as needed.

4. Control of Non-Native Plant Species (§§ 5.3.8, 5.4.12)

Texas State University and the City of San Marcos will continue to implement a non-native plant replacement program from Spring Lake to the city limits. Non-native species of aquatic, littoral, and small caliper riparian plants (less than four inches) will be replaced with native species to enhance Covered Species habitat. The quantity and location of areas restored in this program are provided in Table 34 of the *Submerged Aquatic Vegetation Analysis and Recommendations Report* (BIO-WEST and Watershed Systems Group, Inc, 2016) are a guideline for plantings. Specific species by location are determined by site specific conditions and vegetation planting success. The non-native aquatic plants will be shaken, checked for aquatic fauna, and transported to the Texas State University composting facility. Aquatic fauna that are recovered will be documented and returned to the system. Areas will be "weeded" until the area is suitable to plant native aquatic vegetation.

5. Control of Harmful Non-Native and Predator Species (§§ 5.3.9, 5.4.13)

In accordance to Phase I efforts, the City of San Marcos and Texas State University will continue to implement non-native and predator species control for the San Marcos River and Spring Lake on a periodic basis with expanded effort of control, if needed, at low flows. The targeted species include, but are not limited to, suckermouth catfish, tilapia, nutria, zebra mussels, ramshorn and red-rimmed melania snails.

Routine biological monitoring will be conducted by EAA and EAHCP contractors (EAHCP § 6.3.1) to monitor and assess the distribution of new or existing harmful non-native and invasive species. If a threat is identified, EAHCP staff will work with the contractor to identify areas of concern and potential methods for removal.

6. Reduction of Non-Native Species Introduction (§§ 5.3.5, 5.4.11)

Dumping aquariums into the San Marcos River and its tributaries will continue to be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. The City of San Marcos will continue to operate a fish drop-off pond at their Discovery Center where residents can donate unwanted fish and aquatic animals. Outreach efforts will continue through education events, flyers, advertisements, and partnering with Texas State University to educate current and future students.

7. Sediment Removal below Sewell Park (§§ 5.3.6, 5.4.4)

The removal of sediment in support of native aquatic planting activities has proved to be both unnecessary and overly expensive. In Fall 2017, a non-routine adaptive management proposal to amend this conservation measure in the EAHCP was approved. The Sediment Removal (EAHCP §§ 5.3.6, 5.4.4) and Impervious Cover/Water Quality Protection (EAHCP § 5.7.6) are combined into one conservation measure that addresses sediment control within the upper San Marcos River watershed to minimize sediment and contaminated runoff. The primary focus is the Sessom Creek watershed, which contributes loads of sediment during rain events and increases sediment deposition on Texas wild-rice stands and other native plant stands near the Sessom Creek confluence to City Park. The City of San Marcos and Texas State University will oversee the design and construction of best management practices that control erosion, minimize sedimentation, and reduce pollutants in the San Marcos River watershed.

D. City of San Marcos

1. Minimizing Impacts of Contaminated Runoff (§ 5.7.4)

In Spring 2017, this conservation measure was revised through non-routine adaptive management to cover two new sedimentation ponds as identified by City of San Marcos staff and the San Marcos Water Quality Protection Plan staff (John Gleason LLC, 2017).

The first pond, located adjacent to the City Park, was designed to remove sediment and street pollutants from runoff prior to entering the river. The size, shape, and depth were determined based on an analysis of the volume of water discharging from the storm drains. The City Park biofiltration pond was completed in 2018. The City of San Marcos will undertake required maintenance of the sedimentation pond on a regular basis.

The second pond, located next to C.M. Allen Street parking lot near the San Marcos Plaza, is referred to as the Downtown Pond. The City of San Marcos is updating the Downtown Pond as part of a larger Capital Improvements Project under construction in 2019. Upon completion of the Downtown sediment retention pond, the City of San Marcos will assume financial responsibility of maintenance of the both ponds, as this measure is no longer funded as part of Phase II.

2. Management of Public Recreational Use of San Marcos Springs and River Ecosystem (§ 5.3.2.1)

Public recreational use of the San Marcos Spring and River ecosystems include, but are not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving, snorkeling and fishing. In accordance to Phase I efforts, the City of San Marcos will continue to implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix P of the EAHCP). In addition, pursuant to Resolution and Order No. 08-12-001 adopted by the Implementing Committee on August 16, 2012, the City of San Marcos will issue COIs to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River) (Outfitters) that comply with the requirements of the COI program established in Section 5.3.2.1 of the EAHCP.

3. Management of Aquatic Vegetation and Litter below Sewell Park (§ 5.3.3)

In accordance to Phase I efforts, the City of San Marcos will continue to perform activities to manage floating vegetation and litter to enhance habitats for the Covered Species. Management activities include removal of vegetation mats that form on top of the water surface as well as on top of Texas wild-rice and native plants, particularly during low flows, and litter removal.

The City of San Marcos will continue to dislodge, monitor and remove floating vegetation near and/or on top of any Texas wild-rice and native aquatic plant stands in the San Marcos River.

Inorganic litter will continue to be removed from the San Marcos River from City Park to IH-35 during the recreational season (May through September) and less often during offseason.

4. Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (§ 5.3.4)

Hazardous materials transported by truck across the watershed of the San Marcos River and its tributaries present the possibility of accidental spills or releases into the environment. The limited geographic distribution of the endangered species at San Marcos Springs could cause the species to be highly impacted by such a spill.

The City of San Marcos will continue to coordinate with TxDOT to designate hazardous materials routes which minimize the potential for spills entering the San Marcos River. This effort may include legislation, if necessary, and additional signage.

5. Designation of Permanent Access Points/Bank Stabilization (§ 5.3.7)

To minimize the impacts of recreation, permanent access points were established in an effort to increase bank stabilization at various locations along the San Marcos River during Phase I. Access points serve as

entry and exit ways that are intended to be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks and preventing erosion along riparian restoration reaches.

Permanent access point locations include portions of the banks of the San Marcos River across from City Park, an area downstream of the first pedestrian bridge connecting Plaza Park and City Park, beneath the Hopkins Street bridge, Bicentennial Park, Rio Vista Park, and Ramon Lucio Park.

Natural rocks were used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation was planted in areas adjacent to the access/stabilization areas to discourage river users from entering the river in places other than the access point. Phase II activities will include upkeep of these access points. If additional repairs or maintenance are needed, the City of San Marcos will cover the financial responsibilities of construction costs.

6. Septic System Registration and Permitting Program (§ 5.7.3)

The City of San Marcos will continue the septic system registration and permitting program to prevent subsurface pollutant loadings from potentially being introduced to the San Marcos Springs ecosystem within its city limits.

7. Management of Household Hazardous Wastes (§ 5.7.5)

In accordance to Phase I efforts, the City of San Marcos will continue to maintain a Household Hazardous Waste (HHW) Program that involves the periodic collection of HHW and its disposal.

8. Impervious Cover/Water Quality Protection (§ 5.7.6)

In 2017, the City of San Marcos approved the San Marcos Water Quality Protection Plan (WQPP), a comprehensive program to protect water quality and reduce the impacts of impervious cover (John Gleason LLC., 2017). Criteria and incentives for the program were based upon the WQPP and the EAHCP LID/Water Quality Work Group Final Report (Appendix Q of the EAHCP) recommendations for implementation strategies and best management practices. The WQPP has identified Sessom Creek tributary as a priority watershed (John Gleason LLC, 2017). Erosion prevention and stormwater

management designs will be implemented in this watershed during Phase II. Efficacy of the erosion prevention and stormwater management designs may be assessed through water quality sampling, funded through grants and other sources.

E. Texas State University

1. Management of Submerged and Floating Aquatic Vegetation in Spring Lake (§ 5.4.3.1)

Texas State University will continue to manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake. Vegetation restoration activities around the spring openings will be monitored by trained divers and documented through various methods.

Each week, hand cutting of vegetation around five springs within Spring Lake will occur. Routine maintenance will occur every two to three weeks following initial vegetation maintenance. During summer algal blooms, the springs will be managed more frequently (up to four springs per day), but mostly to remove algae. Texas State employees and supervised volunteers clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe, when needed. Over the next 1.5-meter radius around the spring opening, they will shear vegetation to a height of 30 centimeters, and then to one meter over the following three-meter radius. Plant material will be collected and removed from the site or downstream. Cumulatively, about six meters of vegetation around each spring opening will be modified. Mosses will not be cut. The volume of plant material to be removed will vary by the amount of time between cuttings, and season.

The harvester boat will remove a range of 15-to-20 boatloads of plant material a month from Spring Lake. The harvester will clear the top meter of the water column, cutting vegetation from sections one, two, and three once a week. The harvested vegetation will be visually checked by driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake, if appropriate. Texas State University employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science Program and avoid contact with them.

The Spring Lake Area Supervisor will continue to schedule cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants will be collected by hand and shaken prior to removal from the river to dislodge any aquatic species caught in the plant. The plants will be deposited into dump trucks and taken to the Texas State University compost area.

2. Management of Aquatic Vegetation from Sewell Park to City Park (§ 5.4.3.2)

In accordance to Phase I efforts, Texas State University will continue to dislodge and remove floating vegetation on any Texas wild-rice and native aquatic plants. Inorganic litter will be picked up weekly from the San Marcos River from Sewell Park to City Park during the recreational season (Memorial Day to Labor Day) and monthly during offseason.

Texas State University will continue to monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation.

Texas State University employees or others will be trained to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. Texas State University employees will dislodge and remove the floating material from the top of the Texas wild-rice stands. Downstream accumulations of plant material will be removed to avoid impacts to Texas wild-rice further downstream.

3. Diversion of Surface Water (§ 5.4.5)

Under TCEQ Certificates 18-3865 and 18-3866, Texas State University's total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs. The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs. To minimize the impacts of these diversions, when flow at the USGS gauge #08170500 reach 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, i.e., to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam to maximize the benefits to salamanders, Texas wild-rice, and other aquatic resources in the San Marcos River below Spring Lake Dam. Texas State University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will

be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 49 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when springflow reaches 45 cfs.

The reductions in Texas State University's total diversion rate for consumptive use is summarized in Table 5-4.

Table 5-4. Texas State University's Surface Water Diversion Rates by Streamflow

Streamflow (cfs)	Spring Lake Diversions (cfs) Cert. No. 18-3865	San Marcos River Diversions (cfs) Cert. No. 18-3866	Total Diversion Rate (cfs)
>80	4.88	3.22	8.1
80 – 60	2.9	3.2	6.1
60 – 49	0.9	3.2	4.1
49-45	1.0	0	1.0
<45	0	0	0

To avoid or minimize the impacts of the surface water diversions, Texas State University will routinely monitor the screens to determine if any entrainment occurs and will make any necessary modifications to the screens to minimize any incidental take from the operation of the diversions.

4. Diving Classes in Spring Lake (§ 5.4.7)

a. The Diving for Science Program

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks

such as finning spring areas covered with algae and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates and supervises all volunteer diving. No more than 20 volunteer divers will be allowed in the lake per day, with no more than ten at one time.

Any individual diving outside of the Dive Training Area must have completed the Diving for Science Program.

b. Texas State University Continuing Education

Texas State University Continuing Education classes for check-out dives will continue to be conducted in the Dive Training Area. Class sizes will be limited to 12 students and no more than three classes will be conducted per day to minimize impacts to Covered Species habitat.

c. Texas State University SCUBA Classes

Texas State University SCUBA classes will continue to be conducted in the Dive Training Area. Class sizes will be limited to 12 students and no more than three classes will be conducted per day to minimize impacts to Covered Species habitat.

5. Research Programs in Spring Lake (§ 5.4.8)

In accordance to Phase I efforts, all proposals to conduct research in Spring Lake will continue to be reviewed by the Meadows Center for Water and the Environment at Texas State University to ensure there is no impact on Covered Species or their habitat. If incidental take cannot be avoided, it will be minimized by educating the researchers as to the area where the listed species are located and by requiring measures to minimize any potential impacts. All diving in support of a research study will be provided by individuals who have completed the Diving for Science Program.

6. Boating in Spring Lake and Sewell Park (§ 5.4.10)

In accordance to Phase I efforts, boats and stand up paddleboards in Spring Lake and Sewell Park will continue to be confined to areas that are mowed by the harvester, thereby not impacting vegetation and specifically avoiding Texas wild-rice stands. Individuals will enter and exit boats and paddleboards at specified access points to avoid impacting the flora and fauna along the bank. All boats and paddleboards launched into Spring Lake will undergo a USFWS-approved process for cleaning.

Further, canoeing/kayaking/paddleboard classes in the lake will be limited to no more than four classes per day and each class will be in the water no more than one hour. Classes will have a maximum of ten students (with two students per canoe). All classes will be supervised.

To minimize the impacts of boating on the Covered Species' habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will continue to be confined to the region between Sewell Park and Rio Vista dam. Students will enter and exit canoes/kayaks/paddleboards at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of ten students. All classes will be supervised by Meadows Center for Water and the Environment at Texas State University.

F. San Antonio Water System

1. Use of the SAWS ASR for Springflow Protection (§ 5.5.1)

The San Antonio Water System (SAWS) Aquifer Storage Recovery (ASR) facility will continue to be used to store and deliver Edwards Aquifer water acquired by the EAA in exchange for actions outlined in an Interlocal Contract between the EAA and SAWS for the purposes of springflow protection. When triggers are reached, SAWS will forbear usage in its northeast service area's large primary groundwater pumping facilities. These facilities, from a regional perspective, are considered nearest to the springs and provide groundwater pumping relief during extreme drought. As described below, an amount equivalent to the water recovered from the ASR may be used by SAWS to offset SAWS's forbearance of its Edwards Aquifer demands.

EAA will continue to acquire, through a combination of leases and forbearance agreements, 50,000 ac-ft/yr of EAA-issued groundwater withdrawal permits. The leases will be used to fill, idle, and maintain a portion of the capacity of the SAWS ASR facility for subsequent use to protect springflows.

The program is comprised of two components. The first will lease approximately 16,667 acre-feet of permits, that will be used for storage in the ASR and ultimately for forbearance purposes. The remaining 33,333 acre-feet will be enrolled into forbearance agreements. Forbearance will be required in years after the ten-year moving annual average as Edwards Aquifer recharge is equal to or less than 500,000 ac-ft/yr, as determined by the EAA.

Trigger levels for implementation of the SAWS forbearance component of ASR management, in accordance with the EAHCP, will be 630 ft-MSL at the J-17 index well during an identified repeat of drought conditions similar to the drought of record as indicated by the ten-year rolling average of Edwards Aquifer recharge of 500,000 ac-ft, as determined by the EAA. When triggered, the ASR or other supplies capable of utilizing shared infrastructure may be activated by SAWS, at its discretion, to deliver up to 60 million gallons per day to SAWS distribution system during a repeat of drought of record-like conditions. When the monthly average groundwater levels at J-17 are below 630 ft-MSL and the ten-year rolling average of Edwards Aquifer recharge is 500,000 ac-ft or less, pumping of selected wells on the northeast side of SAWS water distribution system will be reduced (i.e. forborne) in an amount that on a monthly basis equals the amount of water stated in the applicable forbearance schedule only to the extent of the Edwards Aquifer water provided by the EAA for storage in the ASR. SAWS may use up to 100 percent of the conveyance capacity of existing SAWS ASR facilities to off-set SAWS's Edwards Aquifer demand.

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery and/or forbearance developed by HDR Engineering (HDR, 2011) as provided for in the presumptive forbearance schedule in Exhibit E of the Interlocal Contract between the EAA and SAWS, as such, the schedule may be amended under such contract. However, the actual pattern of delivery of water from the ASR program and/or forbearance may differ from what HDR used in its modeling simulations depending on the actual course of the drought.

The two agencies entered an Interlocal Contract for the use of the ASR capabilities to support springflow protection covering Phase I of the EAHCP Program. From time to time the Interlocal Contract is brought

up to date through the Staff Work Group processes contained therein or through adaptive management and/or necessary contractual amendments to continue to support protections throughout Phase II of the EAHCP Program.

The use of the SAWS ASR is predicated on an assumption informed by HDR Engineers' groundwater modeling that the SAWS ASR will be utilized to deliver approximately 126,000 ac-ft of Edwards Aquifer water during a decadal drought similar to the drought of record. It is further predicated on the assumption (HDR, 2011) that the maximum amount of EAHCP water that must be forborne in a given year is 46,300 ac-ft.

SAWS will make the day-to-day decisions necessary to fulfill the ASR commitment. A 12-person Regional Advisory Group consisting of four representatives of SAWS, the EAHCP Program Manager, and one representative each from EAA, EAA permit holder for irrigation purposes, small municipal pumpers, the Spring cities, environmental (including TPWD), industrial pumpers, and downstream interests will provide advice to SAWS regarding the implementation of the program. SAWS will organize and facilitate these annual meetings of the Regional Advisory Group, as needed.

G. Texas Parks and Wildlife Department

1. State Scientific Areas (§ 5.6)

Texas Parks and Wildlife Department (TPWD) has the authority to establish state "scientific areas" for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value (Texas Parks and Wildlife Code § 81.501). To minimize the impacts of recreation, TPWD will continue to pursue creation of State Scientific Areas in the San Marcos River. The scientific areas will be designed to protect Texas wild-rice by limiting recreation in these areas during low flow conditions. The regulations are intended to preserve at least 1,000 square-meters of Texas wild-rice.

Except for the eastern spillway immediately below Spring Lake Dam, none of the protected areas will extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river. The National Academies of Sciences 2018 *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* recommended controlling the footprint of

recreation in the 50-meter reach below Spring Lake Dam. San Marcos salamanders have been found in abundance in the eastern spillway, so the majority of the spillway may be excluded from recreation. Exclusion zones in the remainder of the 50m reach may be established primarily around the Texas wild-rice stands.

Interlocal Agreements between the City of San Marcos, TPWD and Texas State University will be pursued, if necessary, for local in-water enforcement of the protected zones.

In order to protect existing and restored fountain darter habitat, TPWD may pursue the creation of a State Scientific Area in the Comal Springs system. An Interlocal Agreement between the City of New Braunfels and TPWD will be pursued, if necessary, for local in-water enforcement of the protected zones.

II. Costs

The estimated cost of the EAHCP and the schedule by which those costs are expected to be realized are set out in Table 7.1 of the EAHCP and are hereby incorporated by reference in this Comprehensive Plan.

References:

BIO-WEST, Watershed Systems, Group, 2016. *Submerged Aquatic Vegetation Analysis and Recommendations Report.* Prepared for the Edwards Aquifer Authority.

AquaStrategies, BIO-WEST, 2017. *Landa Lake and Dissolved Oxygen Management Plan.* Prepared for the City of New Braunfels

BIO-WEST, 2017. *Gill Parasite Monitoring in the Comal River 2017 Final Report.* Prepared for the City of New Braunfels

John Gleason LLC, 2017. Water Quality Protection Plan for the City of San Marcos and Texas State University. Edwards Aquifer Authority Contract deliverable for EAHCP § 5.7.6

RESOLUTION NO. 05-19-001

OF THE IMPLEMENTING COMMITTEE OF THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN PROGRAM RELATIVE TO ACTION ON THE SCIENCE REVIEW PANEL'S DETERMINATIONS PURSUANT TO SUBSECTION 7.13.7 OF THE FUNDING AND MANAGEMENT AGREEMENT.

WHEREAS, on March 18, 2013, the U.S. Fish and Wildlife Service ("Service") issued Incidental Take Permit No. TE-63663A-1 ("ITP"), as amended, for a fifteen (15) year term, to the Edwards Aquifer Authority, the City of New Braunfels, the City of San Marcos, the City of San Antonio, acting by and through its San Antonio Water System, and Texas State University ("Permittees"), under Section 10(a) (16 U.S.C. § 1539(a)) of the federal Endangered Species Act of 1973; and

WHEREAS, Paragraph E of the ITP provides that the ITP is "subject to full and complete compliance with, and implementation of, the EARIP HCP ..."; and

WHEREAS, the EARIP HCP document as approved by the Service is entitled *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan* (Nov. 2012) (prepared by RECON Environmental, Inc., Hicks & Company, Zara Environmental LLC, and BIO-WEST) ("EAHCP"); and

WHEREAS, as described in Section 1.1.1 of the EAHCP, the EAHCP takes a 2-phase approach during the 15-year term of the ITP described as follows:

> "The approach taken in this HCP incorporates a two-phased implementation strategy. Phase I of the strategy will involve implementation of a package of minimization and mitigation measures that will be implemented very quickly upon issuance of the permit. These measures (described in Chapter 5) provide protection for the species covered by the ITP and their associated ecosystems. An Adaptive Management Process (AMP) (described in Chapter 6) will use information from monitoring data collected during Phase I, along with evaluation of technical and engineering alternatives and improved groundwater, biological and ecological models, to make appropriate modifications, if any are needed, to the Phase I program. Specified additional measures, if necessary to achieve the biological goals, will be implemented during Phase II."; and

WHEREAS, pursuant to Section 1.3.2 of the EAHCP and Recital E of the FMA, the period of Phase I is from March 18, 2013 through March 17, 2020, and the period of Phase II is from March 18, 2020 through March 31, 2028; and

WHEREAS, Section 9.1.1 of the EAHCP also provides for the development of a "funding and management agreement" between the Permittees with the purpose of such document being to "establish in greater detail the procedures and mutual commitments among the permittees for funding and management of the HCP and adaptive management process"; and

WHEREAS, the funding and management agreement as approved and executed by the Permittees is entitled *Funding and Management Agreement by and among the Edwards Aquifer Authority, the City of New Braunfels, the City of San Marcos, the City of San Antonio, acting by and through its San Antonio Water System Board of Trustees, and Texas State University – San Marcos to fund and manage the Habitat Conservation Plan for the Edwards Aquifer Recovery implementation Program* (eff. Jan. 1, 2012) ("FMA"); and

WHEREAS, Section 7.1 of the FMA provides that the purpose of the Adaptive Management Process ("AMP") is to "ensure the full implementation of species protection provided by the [EAHCP]" and that Article 7 of the FMA provides "the procedural steps and responsibilities of the Parties for making AMP decisions, the respective roles of the Implementing Committee, the Stakeholder Committee, the Science Committee, and the Science Review Panel in relation to AMP decisions, and the actions that will be taken as a result of such decisions"; and

WHEREAS, Section 7.3 of the FMA provides that the "AMP related to Phase II Conservation Measures will begin no later than January 31, 2019, and continue for the duration of the Permit Term [of the ITP]"; and

WHEREAS, Sections 7.3 and 7.6 of the FMA provide procedures for three levels of AMP decisions: (1) routine (2) nonroutine and (3) strategic, with Routine AMP Decisions involving ongoing, day-to-day matters related to the management and administration of the EAHCP Phase I Conservation Measures, Nonroutine AMP Decisions relating to Conservation Measures which are not Routine AMP Decisions or Strategic AMP Decisions, and Strategic AMP Decisions relating to the selection of Phase II Conservation Measures to be undertaken during Phase II of the ITP (2020-2028); and

WHEREAS, on December 10, 2013, pursuant to Section 7.10 of the FMA, the EAA Board of Directors approved a contract with the National Academies of the National Academy of Science to establish an independent Science Review Panel ("SRP") to, among other things, "upon request … definitively determine if the Scientific Record establishes each of the conclusions required in Subsection 7.13.7 [of the FMA] and explain its determinations"; and

WHEREAS, pursuant to Subsection 7.13.6 of the FMA, the Program Manager requested that the SRP make the determinations required by Subsection 7.13.7 of the FMA and that such determinations be provided in a written report; and

WHEREAS, pursuant to Subsection 7.13.6 of the FMA, on or about September 26, 2018, the SRP delivered to the Program Manager a "prepublication copy" of its report entitled *National Research Council of the National Academies, Review the Edwards Aquifer Habitat Conservation Plan Report 3* (2018) ("SRP Report 3") which contained the determinations required by Subsection 7.13.7 of the FMA, and on or about December 7, 2018, the SRP delivered the final of such report to the Program Manager; and

WHEREAS, pursuant to Subsection 7.13.6 of the FMA, on or about October 9, 2018, the Program Manager distributed the SRP report to the Implementing Committee, the Stakeholder

Committee, and the Science Committee; and

WHEREAS, the Program Manager has reviewed the SRP report and, on November 29 and December 5, 2018, presented the EAHCP staff findings and recommendations to the 2018 Comprehensive Phase II Work Plan Work Group ("Ph. II Work Group"); and

WHEREAS, the Phase II Work Group prepared a report evaluating the Comprehensive Phase II Work Plan, reviewing the SRP Report relative to the Subsection 7.13.7 issues, and making recommendations for possible future actions by the Implementing Committee in light thereof; and

WHEREAS, the Program Manager has prepared a memorandum (Exhibit A) evaluating the SRP report's issues and determinations relative to Subsection 7.13.7, the concerns regarding hydrologic modeling, and the Comprehensive Phase II Work Plan; and

WHEREAS, pursuant to Subsection 7.13.7 of the FMA, the Implementing Committee hereby desires to take the actions described below in this Resolution; and

WHEREAS, a regular meeting of the Implementing Committee was held on May 23, 2019, at 10:00 a.m., notice having been duly and properly posted in accordance with Subsection 7.7.4 of the FMA; and

WHEREAS, Implementing Committee Agenda Item 5.2 was listed for the following purpose:

> **"CONSIDER RECOMMENDATION TO ADOPT RESOLUTION NO. 05-19-001 OF THE IMPLEMENTING COMMITTEE OF THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN PROGRAM RELATIVE TO ACTION ON THE SCIENCE REVIEW PANEL'S DETERMINATIONS PURSUANT TO SUBSECTION 7.13.7 OF THE FUNDING AND MANAGEMENT AGREEMENT."**; and

WHEREAS, all members of the Implementing Committee were present and constituted a quorum; and

WHEREAS, the Implementing Committee considered the above Agenda Item that is the subject of this Resolution; and

WHEREAS, a unanimous vote of the Implementing Committee passed on, voted in favor of, and adopted this Resolution; and

WHEREAS, it is in the public interest that the Implementing Committee take the actions stated herein pursuant to Subsection 7.13.7 of the FMA.

NOW, THEREFORE, BE IT RESOLVED BY THE IMPLEMENTING COMMITTEE OF THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN PROGRAM THAT:

Section 1. The recitals set out above are found to be true and correct, and they are hereby adopted by the Implementing Committee and are made a part of this Resolution for all purposes.

Section 2. The Implementing Committee hereby makes the following findings and conclusions and directs the Program Manager to take the following actions:

2.1 FMA **Subsec. 7.13.7.a.**: The SRP did not determine that there were any Covered Species for which the Scientific Record established that any of the existing Biological Objectives were not necessary to meet any of the existing Biological Goals for such species. Accordingly, for Phase II of the ITP, the Program Manager is requested to take no action to propose the discontinuance of any of the existing Biological Objectives applicable to any of the Covered Species.

2.2 FMA **Subsec. 7.13.7.b.**: The SRP did not determine that there were any Covered Species for which the Scientific Record established that any of the existing Biological Objectives were not adequate to achieve any of the existing Biological Goals for such species. Accordingly, for Phase II of the ITP, the Program Manager is requested to take no action to propose any changes to any of the existing Biological Objectives applicable to any of the Covered Species.

2.3 FMA **Subsec. 7.13.7.c.**: The SRP did not determine that there were any existing Phase I Conservation Measures for which the Scientific Record established that any of such measures were not needed to achieve any of the existing Biological Objectives. Accordingly, for Phase II of the ITP, the Program Manager is requested to take no action to propose the discontinuance of any of the existing Phase I Conservation Measures.

2.4 FMA **Subsec. 7.13.7.d.**. Except as provided in Section 2.6, the SRP determined that the Scientific Record established that the existing Phase I Conservation Measures were achieving the Biological Objectives. Accordingly, except as provided in Section 2.6, for Phase II of the ITP, the Program Manager is requested to take no action to propose the Presumptive Phase II Conservation Measure, or any other new Phase II Conservation Measure. However, the Program Manger has proposed to the Science Committee changes to the Voluntary Irrigation Suspension Program Option (VISPO) (EAHCP § 5.1.2) as may be necessary for the modeled results of the implementation of such measures to demonstrate that they are sufficient to achieve the flow-related Biological Objective for springflow at Comal Springs of a minimum 30 cfs as stated in Section 4.1.1.1 on Table 4-2 of the EAHCP utilizing the procedures for a Nonroutine AMP Decision set forth in Section 7.12.

2.5 FMA **Subsec. 7.13.7.e.**: The SRP did not determine that the Scientific Record established that the existing Phase I Conservation Measures were not achieving the Biological Objectives as provided for in Subsection 7.13.7.d., it is unnecessary to consider any action to be taken under Subsection 7.13.7.e.

Accordingly, for Phase II of the ITP, the Program Manager is requested to take no action to propose any changes to the existing Phase I Conservation Measures other than that set out in Section 2.4 relative to VISPO.

2.6 FMA **Subsec. 7.13.7.f.**: The SRP determined that the Scientific Record was inconclusive about whether the following Phase I Conservation Measure – Native Riparian Habitat Restoration EAHCP § 5.2.8 – was achieving the following Biological Objectives, relative to the Comal Springs riffle beetle (*Heterelmis comalensis*), described in Chapter 4-12 of the EAHCP: 1) "Aquifer water quality should not exceed a 10 percent deviation (daily average) from historically recorded water quality conditions (long-term average) within the Edwards Aquifer as measured issuing from the spring openings at Comal Springs." 2) "Active restoration of riparian habitat adjacent to spring openings (Spring Run 3 and Western Shoreline) will be implemented to limit the sedimentation that is experienced following rainfall events." Accordingly, the Program Manager is requested to engage the Comal Springs Riffle Beetle Work Group in order to address issues raised by the SRP in the Scientific Record.

Section 3. The Program Manager is directed and authorized to submit this Resolution to the Service for its information and records, and to the governing bodies of the Permittees, the Science Committee, the Stakeholder Committee, and other interested parties requesting a copy.

Section 4. The terms and provisions of this Resolution shall be deemed severable and if the validity of any section, subsection, sentence, clause, or phrase of this Resolution should be declared invalid, the same shall not affect the validity of any other section, subsection, sentence, clause, or phrase of this Resolution.

Section 5. This Resolution shall become effective from and after its adoption.

PASSED AND APPROVED BY THE IMPLEMENTING COMMITTEE OF THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN PROGRAM THIS 23rd DAY OF MAY, 2019.

Mark Enders, City of New Braunfels
Chairman
EAHCP Implementing Committee

ATTEST:

Robert Mace, Texas State University
Secretary
EAHCP Implementing Committee

APPROVED AS TO FORM:

Darcy Alan Frownfelter
Implementing Committee Parliamentarian and
General Counsel to the Edwards Aquifer Authority

EXHIBIT A

MEMORANDUM

To: EAHCP Implementing Committee

From: Scott Storment, EAHCP Program Manager

Date: March 18, 2019

Subject: EAHCP National Academies of Sciences *Report 3* and Funding and Management Agreement § 7.13.7

Introduction:

The Edwards Aquifer Habitat Conservation Plan (EAHCP) is currently transitioning from Phase I (2013-2020) to Phase II (2020-2028) of the Incidental Take Permit (#TE-63663A-1). As described in Section 7.14 of the Funding and Management Agreement (FMA), the Strategic Adaptive Management Process defines this transition from Phase I to Phase II as a coordinated review period of the Phase I Conservation Measures and dictates the direction of the Phase II Conservation Measures and management activities.

The most critical component of this process is the evaluation of the EAHCP program and recommendations provided by the Science Review Panel (" National Academies of Sciences" or "NAS"), as required per FMA Section 7.10.

The purpose of this memorandum is to summarize the National Academies of Sciences' *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* findings and conclusions and to describe the actions required pursuant to Section 7.13.7 of the FMA relative to the third and final report.

National Academies of Sciences *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3*

To assist in the evaluation of Phase I Conservation Measures, the EAHCP requested the involvement of NAS to serve as the mandated "Science Review Panel" to review and advise on the minimization and mitigation activities used to implement restoration, conservation and environmental protection initiatives for the benefit of the threatened and endangered species listed in the Incidental Take Permit and their habitat. From 2014-2018, NAS produced three reports as a result of an in-depth study and evaluation of the EAHCP minimization and mitigation measures.

The third and final report, *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* (NAS *Report 3*), was submitted to the EAHCP in the fall of 2018 and provided an analysis on the effectiveness of the Conservation Measures in meeting the Biological Objectives; and the likelihood of the Biological Objectives achieving the Biological Goals for the Covered Species in the EAHCP.

Of the eight threatened and endangered species listed in the EAHCP, four are considered indicator species — fountain darter, Comal Springs riffle beetle, Texas wild-rice and the San Marcos salamander — and were used as representatives for the other listed species throughout NAS *Report 3*. These four species were selected based on their sensitivity to environmental changes, therefore, providing a guide to the health of the Spring systems and the success or failure of the conservation efforts of the EAHCP.

In reviewing the effectiveness of the Conservation Measures in meeting the Biological Objectives, NAS identified five major categories of the minimization and mitigation measures implemented in the EAHCP — flow protection, water quality protection, submerged aquatic vegetation management, recreation management and riparian restoration. NAS assessed the effectiveness of the five major Conservation Measure categories in achieving the Biological Objectives for the Covered Species, and provided four possible ratings: *highly effective, effective, somewhat effective* and *unable to determine*.

Based on scientific analysis and information provided, NAS determined the following (NAS *Report 3* pg. 7):

- The flow protection measures will be *effective* in meeting the flow component of the Biological Objectives for all listed species.
- The water quality protection measures, focusing primarily on stormwater control, will be *somewhat effective* in meeting the water quality component of the Biological Objectives for the fountain darter in the Comal and San Marcos stream systems.
- The submerged aquatic vegetation (SAV) restoration measures, including the replanting of Texas wild-rice, will be *effective* in meeting the habitat component of the Biological Objectives for Texas wild-rice and the fountain darter.
- The recreation management measures will be *effective* in meeting the habitat component of the Biological Objectives for the San Marcos salamander and Texas wild-rice.
- The Committee is *unable to determine* whether riparian management measures will contribute to achieving the Biological Objectives of the Comal Springs riffle beetle.

In assessing the likelihood of the Biological Objectives achieving the Biological Goals, NAS identified three similar components implemented within the objectives — flow, water quality and habitat. NAS reviewed the combined effects of the three predominant objectives to determine their likelihood of achieving the Biological Goals, in respect to the Covered Species, and provided four possible ratings: *highly likely, likely, somewhat likely* and *unlikely*.

Based on scientific analysis and information provided, the NAS determined the following (NAS *Report 3* pg. 5):

- It is *likely* that the Biological Objectives will meet the Biological Goals for the fountain darter.
- It is *likely* that the Biological Objectives will meet the Biological Goals for Texas wild-rice.
- It is *somewhat likely* that the Biological Objectives will meet the Biological Goals for the Comal Springs riffle beetle.
- It is *somewhat likely* that the Biological Objectives will meet the Biological Goals for the San Marcos salamander.

The findings and conclusions from the NAS *Report 3* are the most critical component to the EAHCP Strategic Adaptive Management Process and the development of the Comprehensive Phase II Work Plan. Section 7.13.7 of the FMA details the actions that may be taken to address the determinations provided in the NAS consensus report and identifies the actions that are to be implemented based on those determinations. Moreover, the required actions are determined by the following findings (FMA § 7.13.7 a-f): a) If Some Objectives Not Necessary; b) If Objectives Are Not Adequate; c) If Conservation Measures Not Needed; d) If Phase I Measures Are Achieving Objectives; e) if Phase I Measures Are Not Achieving Objectives; and f) If Review Fails or is Inconclusive.

Considering the conclusions of the NAS *Report 3* and Section 7.13.7 of the FMA, the following was determined:

1. The NAS *Report 3* did not find any:
    a. Biological Objectives not necessary to meet any of the Biological Goals for the indicator species (FMA § 7.13.7.a).
    b. Biological Objectives not adequate to meet any of the Biological Goals for the indicator species (FMA § 7.13.7.b).
    c. Existing Phase I Conservation Measures that were not needed to achieve any of the existing Biological Objectives (FMA § 7.13.7.c).
    d. Existing Phase I Conservation Measures that were not achieving any of the existing Biological Objectives (FMA § 7.13.7.e).

2. The NAS *Report 3* did find:
    a. That the existing Phase I Conservation Measures are achieving the Biological Objectives (FMA § 7.13.7.d).
    b. That the Scientific Record was inconclusive about whether the Phase I Conservation Measure – Native Riparian Habitat Restoration (EAHCP § 5.2.8) – was achieving the Biological Objectives relative to the Comal Springs riffle beetle (FMA § 7.13.7.f).

Hydrologic Modeling – Flow Protection Measures

During Phase I of EAHCP implementation and over the course of NAS program review, the EAA updated the MODFLOW model of the San Antonio segment of the Edwards Aquifer. Output from

this updated model was one of the primary tools used by NAS to make its determination on whether the Conservation Measures related to springflow protection were achieving the flow-related Biological Objectives. NAS *Report 3* determined that the flow protection measures[1] — as implemented — are "*effective*" in achieving the flow-related Biological Objectives relative to the Covered Species. The panel arrived at this conclusion largely based on the conservative nature of the updated MODFLOW model springflow estimates during periods of low discharge, empirical evidence from the 2014 drought, and the calibration and validation performance results from the model (NAS *Report 3* pg. 109).

The "*effective*" determination provided in NAS *Report 3* was based on model parameterization that reflected the flow protection programs as they were devised during the EARIP process (i.e. not actual implementation of springflow protection programs) (Appendix K EAHCP). Since the program's last meeting with NAS in January of 2018, the implementation of flow protection programs through the model has been updated to reflect realized geographical distribution of water enrolled in forbearance programs. A description of this update is included in Pence, 2018 "Strategic Adaptive Management Process Model Runs Inputs and Assumptions." Using actual Phase I implementation, model runs examining the flow protection programs' ability to meet the 30 cfs minimum flow objective in the Comal system indicated minimum flows less than 30 cfs in the Comal system.

Utilizing the Nonroutine Adaptive Management Process (AMP) Decision set forth in Section 7.12 of the FMA, the EAHCP Program Manager has proposed a Nonroutine AMP to change Voluntary Irrigation Suspension Program Option (VISPO) forbearance (EAHCP § 5.1.2.) to achieve minimum flow objectives for the Comal system. Modeled results indicate that increasing VISPO forbearance by 1,795 acre-feet is sufficient to achieve the flow-related Biological Objectives for springflow at Comal Springs of a minimum 30 cfs as stated in Section 4.1.1.1 on Table 4-2 of the EAHCP. The new forbearance amount under VISPO will be 41,795 acre-feet.

The Science Committee will review the Nonroutine AMP Proposal and produce a Scientific Evaluation Report (SER). The intent of the Science Committee's SER is to provide an assessment of the proposed modifications to VISPO to meet EAHCP flow Biological Objectives, to resolve any concerns regarding the effectiveness of the EAHCP flow protection measures for the San Marcos and Comal Spring systems, and to approve the Nonroutine AMP recommendation.

<u>FMA Section 7.13.7 (f) – Comal Springs Riffle Beetle</u>

Based on the data and information provided, NAS was unable to establish a determination on whether the Phase I Conservation Measure for riparian management – Native Riparian Habitat Restoration (EAHCP § 5.2.8) – was achieving the Biological Objectives relative to the Comal Springs riffle beetle (*Heterelmis comalensis*). Pursuant to Section 7.13.7 (f) of the FMA — if NAS is "unable to make a determination or determines that the Scientific Record is inconclusive about

[1] These flow protection measures are: Voluntary Irrigation Suspension Program Option (EAHCP § 5.1.2), the Regional Water Conservation Program (EAHCP § 5.1.3), Critical Period Management – Stage V (EAHCP § 5.1.4), and the SAWS ASR for Springflow Protection (EAHCP § 5.5.1).

whether the Phase I Conservation Measures are achieving the Biological Objectives" — the EAHCP Implementing Committee will coordinate with the U.S. Fish and Wildlife Service to initiate an effort to conclude whether the Presumptive Phase II Conservation Measure or another Phase II Conservation Measure is or is not necessary to achieve the Biological Objective relative to the inconclusive findings of the NAS *Report 3*.

EAHCP Comal Springs Riffle Beetle Work Group has been charged with evaluating the issues raised in the NAS *Report 3* and the concerns regarding the riparian management measures used to achieve the Biological Objectives for the Comal Springs riffle beetle. Specifically, the charge of the Work Group includes examining riffle beetle sampling methodology, field activities, and the EAHCP Long-Term Biological Goals for this species.

A report of their assessment will be generated as a product of the Comal Springs Riffle Beetle Work Group and will be provided to the EAHCP Implementing, Stakeholder and Science committees to review. This evaluation is intended to aid in the coordinated effort with the U.S. Fish and Wildlife Service to address the issues presented in NAS *Report 3* and provide recommendations to resolve the issues regarding the riparian management measure's ability to achieve the Biological Objectives for the Comal Springs riffle beetle.

Comprehensive Phase II Work Plan:

To initiate the Strategic Adaptive Management Process, a Phase II Work Plan Work Group (Phase II Work Group) convened to review an initial draft of the Comprehensive Phase II Work Plan as a precursor to the review required by the EAHCP Implementing Committee (FMA § 4.3). EAHCP staff and the Phase II Work Group utilized NAS *Report 3*, the EAA MODFLOW Drought of Record scenario, and the first six years of EAHCP monitoring and management experience to assess the Conservation Measures implemented throughout Phase I of the program.

As identified by the EAHCP Strategic Adaptive Management Process whitepaper (Pence, 2018), four potential outcomes guide the direction of the Phase II Conservation Measures.

1. Continuation of Phase I Conservation Measures without change.
2. Continuation of Phase I Conservation Measures with changes or expansion.
3. Continuation of Phase I Conservation Measures, plus new Phase II Conservation Measures.
4. Continuation of Phase I Conservation Measures with changes, plus a new Phase II Conservation Measure.

The members of the Phase II Work Group agreed by consensus that the Phase II Work Plan would be developed to continue the Phase I Conservation Measures with changes or expansion, the second potential outcome. An initial draft of the Comprehensive Phase II Work Plan was a product of the Phase II Work Group.

The 2018 Phase II Work Plan Work Group Report details the development of the Comprehensive Phase II Work Plan and provides a description of the updates that were applied to the draft document.

Conclusion:

Resolution No. 05-19-001 was developed to validate the transition from Phase I to Phase II of the EAHCP and to confirm the Conservation Measures to be implemented during Phase II. Moreover, this resolution addresses the inconclusive determination regarding the Comal Springs riffle beetle contained in NAS *Report 3* and clarifies the actions to be taken by the Implementing Committee pursuant to Section 7.13.7 of the FMA, consistent with the guidelines set forth in the Strategic Adaptive Management Process

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☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

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(*Transfer from service label*) 9214 8901 9403 8300 0084 3599 01

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Appendix I4
USFWS DOCUMENTS
USFWS Recovery Plan Amendments for Eleven Southwest Species (December 6, 2019)

RECOVERY PLAN AMENDMENTS FOR ELEVEN SOUTHWEST SPECIES

The U.S. Fish and Wildlife Service identified best available information indicating the need to amend the below species' recovery criteria. Each amendment is recognized as an addendum that supplements the existing recovery plan.

Black Lace Cactus (*Echinocereus reichenbachii* var. *albertii*) Recovery Plan	
Original Recovery Plan Approved:	March 18, 1987
Page(s) Superseded:	24
Little Colorado Spinedace (*Lepidomeda vittata*) Recovery Plan	
Original Recovery Plan Approved:	January 9, 1998
Page(s) Superseded:	8
Loach Minnow (*Tiaroga cobitis*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	20-22
Masked Bobwhite (*Colinus virginianus ridgwayi*) Recovery Plan	
Original Recovery Plan Approved:	April 21, 1995
Page(s) Superseded:	37
Mexican Long-Nosed Bat (*Leptonycteris nivalis*) Recovery Plan	
Original Recovery Plan Approved:	September 8, 1994
Page(s) Superseded:	33-35
Navajo Sedge (*Carex specuicola*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 1987
Page(s) Superseded:	10
Nichol's Turk's Head Cactus (*Echinocactus horizonthalonius* var. *nicholii*) Recovery Plan	
Original Recovery Plan Approved:	April 14, 1986
Page(s) Superseded:	None
San Marcos & Comal Springs & Associated Aquatic Ecosystems (Revised) Recovery Plan	
Original Recovery Plan Approved:	February 14, 1996
Page(s) Superseded:	54-57
Species Included:	Texas wild-rice (*Zizania texana*) fountain darter (*Etheostoma fonticola*) Texas blind salamander (*Typhlomolge rathbuni*)

Sonora[n] Tiger Salamander (*Ambystoma tigrinum stebbinsi*) Recovery Plan	
Original Recovery Plan Approved:	September 24, 2002
Page(s) Superseded:	13
Spikedace (*Meda fulgida*) Recovery Plan	
Original Recovery Plan Approved:	September 30, 1991
Page(s) Superseded:	19-22
Texas Poppy Mallow (*Callirhoe scabriuscula*) Recovery Plan	
Original Recovery Plan Approved:	March 29, 1985
Page(s) Superseded:	11

For

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: DEC 0 6 2019

Recovery Plan for *Zizania texana* (Texas wild-rice), Fountain Darter (*Etheostoma fonticola*) and Texas Blind Salamander (*Typhlomolge rathbuni*)
https://ecos.fws.gov/docs/recovery_plan/960214.pdf

Original Approved: February 14, 1996
Original Prepared by: San Marcos/Comal Recovery Team and the Austin Ecological Services Field Office

AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for *Zizania texana* (Texas wild-rice), fountain darter (*Etheostoma fonticola*), and Texas blind salamander (*Typhlomolge rathbuni*) since the San Marcos & Comal Springs & Associated Aquatic Ecosystems Recovery Plan (Recovery Plan) was last revised in February 1996. In this modification, we provide delisting criteria where none were provided in the 1996 Recovery Plan and the rationale supporting the recovery plan modification. We recommend ongoing implementation of existing recovery actions to foster and achieve recovery of *Zizania texana*, fountain darter, and Texas blind salamander. The proposed modification is shown as an appendix that supplements the Recovery Plan criteria for these species in Section A found in pages 54 through 57 of the 1996 Recovery Plan.

For
U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

December 2019

BACKGROUND INFORMATION

Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if

significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time.

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats, or species' response to management. An amendment could serve a critical function while awaiting a revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can, therefore, efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

Since the revision of the Recovery Plan in 1996, additional studies have been conducted including: (a) annual census surveys of *Zizania texana* (Poole 2012, Bio-West 2017, Hathcock 2018), (b) annual fountain darter sampling by Bio-West (2017), and (c) a capture-mark-recapture local population estimates for Texas blind salamanders at Ezell's Cave and Rattlesnake Cave (Krejca and Gluesenkamp 2007). These data, combined with recommendations we received from State and local species experts at Texas Parks and Wildlife Department (TPWD) and the Service's San Marcos Aquatic Resources Center (SMARC) contributed to this Recovery Plan amendment.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list." Legal challenges to recovery plans (see Fund for Animals v. Babbitt, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) have also affirmed the need to frame recovery criteria in terms of threats assessed under the five threat factors (ESA 4(a)(1)).

Recovery Criteria

The current recovery criteria for downlisting these three species can be found on pages 53-57 of the revised Recovery Plan (1996). Delisting was considered unattainable at the time the revised Recovery Plan was completed.

Synthesis

We used multiple reputable sources of information on the ecology of *Zizania texana*, fountain darter, and Texas blind salamander in our consideration of establishing criteria for delisting. We incorporated information from published scientific papers on *Zizania texana* habitat; fountain darter feeding ecology, growth rate, reproduction, habitat reliance on mosses and aquatic macrophytes, water temperature and water quality tolerances, and susceptibility to disease and parasites; and Texas blind salamander distribution and abundance. In the past two decades, there have been a handful of comprehensive system-wide surveys of aquatic macrophytes in the Comal River system and the upper San Marcos River system: Bartsch et al. 1999, Hardy et al. 2000, Saunders et al. 2001, Doyle 2001; Hardy and Shoemaker 2004, Owens 2009, Hardy 2009. In addition we have data and annual reports from the EAHCP (TE63663A) and scientists with

section 10(a)(1)(A) permits. There have been three reports by the National Academies of Sciences reviewing the EAHCP (2015, 2017, 2018). Finally, we used the results of research conducted by the San Marcos Aquatic Resources Center, TPWD, and Texas State University on the upper San Marcos River including hydraulic habitat models, results of macrophyte restoration efforts, and the removal of non-native macrophytes.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the species is no longer at risk of extinction and may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from an endangered species to a threatened species. The term "endangered species" means any species (species, sub-species, or Distinct Population Segment) which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely on the basis of the best scientific and commercial data available." Thus, while recovery plans provide important guidance to the U.S. Fish and Wildlife Service (Service), States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when we would anticipate that an analysis of the species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan, which triggers rulemaking. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

We provide delisting criteria for *Zizania texana*, fountain darter, and Texas blind salamander, which will supplement the downlisting criteria included in the current Recovery Plan, as follows:

Downlisting Recovery Criteria

Downlisting criteria will remain the same for *Zizania texana*, fountain darter, and Texas blind salamander as in the revised Recovery Plan (Service 1996, pp. 53-57).

Delisting Recovery Criteria

Zizania texana

Zizania texana may be considered for delisting when all of the following criteria are met:

1. In the San Marcos River, the long-term daily average discharge exceeds 140 cfs for 50 years including the drought of record, and the minimum daily average flow is not less than 45 cfs. The duration of the minimum daily average flow must not exceed six months and must be followed by three months of 80 cfs or greater.

   Justification: Adequate stream discharge is required to support *Zizania texana* habitat throughout the entire historic range. Due to its limited range (only one river system), the distribution of *Zizania texana* in all parts of its range provides population redundancy and is important for the species to withstand catastrophic events like floods which may scour the river bed and *Zizania texana* stands along with it. The instream flow requirements of *Zizania texana* are related in part to depth of water in the upper San Marcos River.

   The intensity of a drought and its effect on TWR is a combination of factors that include precipitation, temperature, water use, and persistence of drought conditions. Extreme droughts such as those similar to the drought of record are infrequent. For example, the interval from the drought of record to the drought of 2009 is 53 years. Less intense droughts where conditions are drier than "normal" occur more frequently. A long-term daily average of 140 cfs or greater for 50 years provides assurance that the managed aquifer ecosystem can sustain this species through infrequent extreme droughts.

2. A minimum instantaneous flow of 45 cfs is maintained in the San Marcos River as measured by the San Marcos streamflow gage (USGS 08170500) even in a drought of record.

   Justification: River discharge needs to remain above 45 cfs at all times to maintain habitat and prevent damage and destruction of *Zizania* plants on a finer timescale. The hydrologic drought of record considers the entire period of record for measured flows and that extends back to 1929. Criterion 1 together with Criterion 2 address the flow regime that must be exceeded to avoid widespread losses of *Zizania texana*.

3. Water quality is suitable and supportive by meeting these two requirements:

   a. Turbidity, total dissolved solids (TDS) , and pH of the San Marcos River are consistently within established 25 to 75 percentile range of the earliest published San Marcos River water quality data (USGS data for upper San Marcos River, various stations) over a period of 5 continuous years. In general, suitable lake and river turbidity values (historic reference conditions) are in the low range for nephelometric turbidity units (NTU less than 1.0). Suitable total dissolved solids and pH values are comparable to those reported by Slattery and Fahlquist (1997) and earlier. The assessment of water quality to determine if these criteria are met will be based on the standard protocols and

procedures of the USGS's National Field Manual (NFM) for the Collection of Water-Quality Data (USGS 2018). The selection of at least four sampling sites should be representative of the San Marcos River upstream from Cumming's Dam and water quality measurements from all sites must fall within the respective ranges for levels of turbidity, TDS and pH. The frequency of collection of water quality samples shall be a minimum of once per month and water-quality data shall be collected monthly for at least 5 years.

b. The environmental concentrations of known phytotoxic compounds as surveyed annually in the San Marcos River in *Zizania texana* Segments G through M (see Figure 1) (including dissolved copper, dissolved zinc, and listed U.S. Environmental Protection Agency [EPA] and Texas Department of Agriculture regulated herbicides) are consistently below known adverse effects levels each year for 30 consecutive years.

Justification: Water quality maintenance is important for the viability of the species because all *Zizania texana* populations are found in a relatively short (less than five river-miles) spring ambient river. Additional published water quality data are included in Ogden et al. (1986), and Guyton and Associates (1979).

4. Healthy, self-sustaining, and reproductive populations are established and maintained throughout the historic range. This criterion will be evaluated based on the presence of *Zizania texana* with more than minimum areal coverage and distribution provided in accompanying table of areal extent objectives (Table 1). Healthy for *Zizania texana* means free from disease, free from adverse biological interactions (e.g., free from detrimental levels of epiphytic algae), and free from limiting physical conditions (e.g., inadequate levels of photosynthetically active radiation as investigated by Crawford-Reynolds (2018)). To meet this criterion, the areal coverage by *Zizania texana* for each Upper San Marcos River segment must exceed delisting targets for that segment annually for 30 consecutive years. A population of *Zizania texana* in Segment X is not considered necessary for recovery as: (1) this habitat did not exist until Capes Dam and its mill race were constructed, (2) it has never had any significant stands of *Zizania texana* likely due unsuitable substrates, and (3) the mill race is subject to drying if or when Capes Dam is breached.

   Justification: This criterion prescribes the areal coverage objectives for ensuring that sexual reproduction occurs, leading to maintenance of genetic variation within and among *Zizania texana* segments. The ability to withstand more localized stochastic disturbances (resiliency) is enhanced by *Zizania texana* occupation of all of its historic range. For example, if a tree fall in the river results in damage to a stand, *Zizania texana* tillers floating downstream may be able to colonize the area affected and eventually fill available habitat to the extent it is not precluded or excluded by other plants or other factors (e.g., a change in river substrate, such as a sand-small gravel scoured to clay).

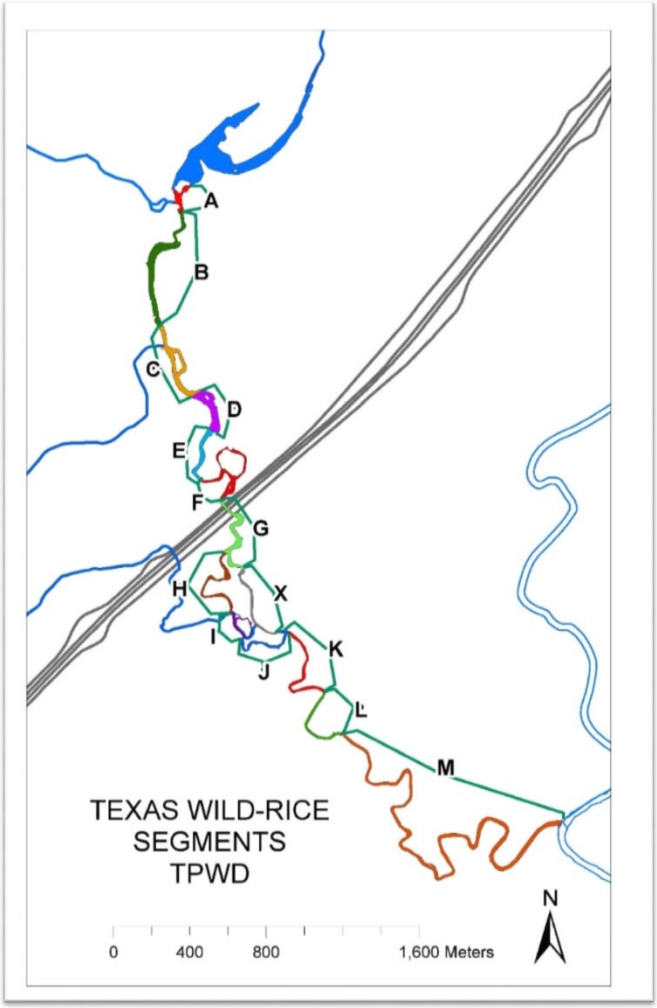
5. A minimum of two captive, reproducing *Zizania texana* stocks are maintained in separate geographic locations, until such time when the species is recovered.

Justification: Maintaining captive stocks of *Zizania texana* will ensure that genetic integrity of the species (representation) is preserved for reintroductions or supplementations, should a catastrophic event, such as an extreme drought, eliminate or drastically reduce numbers in the wild. The responsibility for maintaining these stocks need not be the Service's responsibility.

Table 1. Areal coverage objectives for delisting *Zizania texana* for Upper San Marcos River segments shown in Figure 1.

Segment Name	**Delisting Target in m^2**	**Delisting Percent of Segment (Occupied Habitat) Target**
Spring Lake	4,373	5
A	1,679	35
B	7,097	35
C	1,456	10
D	508	5
E	620	10
F	1,695	15
G	576	5
X	n/a	n/a
H	413	5
J	288	5
K	834	10
L	851	15
M	1,472	3
Total in m^2	**21,861**	

Figure 1. *Zizania texana* segments in the Upper San Marcos River. See Table 1 for the areal coverage of *Zizania texana* needed for meeting delisting criteria.



Fountain Darter

The fountain darter may be considered for delisting when the following criteria are met:

1. The long-term daily average discharge in the Comal River exceeds 225 cubic feet per second (cfs) for 50 years including the drought of record, and the minimum daily average flow is not less than 30 cfs. In the San Marcos River, the long-term daily average discharge exceeds 140 cfs for 50 years including the drought of record, and the minimum daily average flow is not less than 45 cfs. The duration of minimum daily average flows in both rivers must not exceed six months and must be followed by three months of 80 cfs or greater.

   Justification: The fountain darter occurs only in the Comal River of Comal County, Texas and the upper San Marcos River of Hays County, Texas. Thus, both river systems are considered crucial to the viability of the species. Criterion 1 supports the fullest extent of habitat in both the Comal and upper San Marcos rivers by ensuring the primary

determinant of structure and function of this aquatic ecosystem (its flow regime) is continuously supporting the only two populations of fountain darter. Poff et al. (2010) provided a consensus view of the importance of limiting hydrologic alterations.

2. The populations are equal to or greater than 500,000 individuals in the both the Comal and San Marcos river systems consecutively for 30 years (based on a Service approved sampling design).

   Justification: Larger population sizes are better able to adapt to changing environmental conditions over time, and thus more resilient. Large populations help avoid the myriad of negative effects common to small populations such as loss of genetic variation and increased likelihood that random events may result in loss of one or both populations. A population of greater than or equal to 500,000 individuals at the headwater of each spring ecosystem is considered to be: (1) realistic, assuming aquatic habitats are restored to the carrying capacity of Landa Lake and Spring Lake, (2) sustainable, given a stable spring flow regime with adequate submergent aquatic macrophytes, (3) practical, given the areal extent of suitable habitat in each ecosystem, and (4) a population size large enough to maintain genetic variation and avoid adverse effects related to small population size.

3. The mean weekly water temperature is less than or equal to 76 degrees Fahrenheit for 50 years. Water temperature will be measured at eight to ten representative sites including sites in Landa Lake, the Comal River Old Channel, the Comal River New Channel, Spring Lake, and downstream of Spring Lake, in 15 minute intervals using USGS NFM protocols and procedures. The specific locations will be developed by the Service with input by local scientists and river managers.

   Justification: Maintenance of water temperature will help each spring ecosystem realize its maximum potential habitat. When fountain darters are present throughout their lake-river system's historic range, they are less likely to suffer an extirpation or extinction event. Water quality (particularly a higher than average spring-ambient water temperature regime due to low springflow) in 1956 is considered to be an important factor in the extirpation of the fountain darter from the Comal River.

   The relation of water quality especially water temperature to fountain darter egg production and mortality of larvae has been researched at the San Marcos Aquatic Resources Center and Texas State University (Bonner et al. 1998).

4. Dissolved oxygen measured as the daily minimum at a height of 15 cm above the river bed in six designated sites (three in Landa Lake and three in Spring Lake) exceeds 4.0 mg/L for 95 percent of the time over 50 years. Additionally, dissolved oxygen as measured above must exceed 2.0 mg/L 100 percent of the time.

   Justification: Adequate dissolved oxygen is at the critical to the health of fishes and other aquatic organisms. Impairment of dissolved oxygen could lead to morbidity or mortality of fountain darters or their prey items.

Texas Blind Salamander

Texas blind salamander may be considered for delisting when the following criteria are met for all three management units (see criterion 4).

1. In the San Marcos River, the long-term daily average discharge exceeds 140 cfs for 50 years including the drought of record, and the minimum daily average flow is not less than 45 cfs. The duration of the minimum daily average flow must not exceed six months and must be followed by three months of 80 cfs or greater.

   Justification: This criterion addresses the maintenance of groundwater flow by using San Marcos springflow regime as a surrogate. Aquifer habitat for the Texas blind salamander is limited in geographic scope and the cessation of flow at San Marcos Springs may result in the encroachment of saline groundwater throughout some or all of its current range.

2. Water quality in the range of the Texas blind salamander consistently meets or exceeds established EPA numeric criteria for protection of aquatic life as measured within three Recovery Units located at: Rattlesnake Cave, Diversion Springs, and Johnson's Well. The water quality standards must be met at all three sites annually for 30 consecutive years. See two links that follow:

https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

https://www.epa.gov/wqc/aquatic-life-criteria-and-methods-toxics

   Justification: This criterion provides for the abatement of stressors that may reduce the health and population size of this species. The establishment of three recovery units for the Texas blind salamander will help in conservation planning by maintaining any local variation may have resulted from differences among Purgatory Creeks sites compared to Spring Lake sites and Rattlesnake Cave sites. Recovery for the Texas blind salamander would be discernable if local populations in each recovery unit were large enough and all three recovery units are found to be relatively safe from water quality degradation.

3. All measures identified in the Recovery Plan to remove or minimize local threats are completed or are ongoing to adequately address the identified threat. These measure include addressing the entrainment of Texas blind salamanders into wells by groundwater withdrawal, the destruction or pollution of local recharge features and caves, and holistic control of potential local pollution sources.

   Justification: Wells represent a source of mortality that may reduce the population to critically low levels. Wells are present throughout the known range and with the exception of the Texas State University artesian well near the Aquatic Biology building, no monitoring data are available to understand to attrition from this stressor.

4. Healthy populations must exceed 500 individuals annually, for 30 years in all three parts of the species range:

a. Rattlesnake Cave and Rattlesnake Well
b. Spring Lake, Sessom Creek Spring, and Texas State University wells
c. Caves and wells of the Purgatory Creek area

A population is considered healthy if all available information indicates it is free of disease, parasites and other factors that would adversely affect the reproductive and feeding ecology of Texas blind salamanders.

Justification: A population size of 500 or more individuals is adequate to minimize the vulnerabilities common to small populations (Lande and Barrowclough 1987, Lynch and Lande 1998). A population size exceeding 500 is needed to reduce the risks posed by genetic drift, demographic stochasticity and environmental stochasticity.

5. Three captive stocks from Rattlesnake Cave and Well, Spring Lake sites, and Ezells and Purgatory Creek sites are established and maintained for a minimum of 30 years for threatened Texas blind salamanders. Maintenance of captive stocks shall continue after the species is recovered.

   Justification: This criterion considers the scarcity of Texas blind salamander populations and helps ensure that a range-wide negative stressor such as a groundwater pollution event does not impact the Texas blind salamanders throughout its limited habitat.

Rationale for Amended Recovery Criteria

All three of these species (*Zizania texana*, fountain darter, and Texas blind salamander) long term viability depends on continued management. Regarding redundancy, each of these three species is challenged by the fact that only one or a few populations exist. When evaluating species threats and species response to those threats, we must also consider the effect of any existing regulatory mechanisms or conservation effort in ameliorating the impacts of those threats. If long-term management is needed after delisting to ensure that threats are adequately managed into the future, we may not be able to conclude that the threat is adequately addressed until establishment of regulations, continuing management agreements, or some other long-term mechanism to ensure ongoing management and mitigation of the particular threat.

For each of these species, continued management is needed to foster recovery and ensure the likelihood of extinction is reduced such that these species are not likely to become endangered within the foreseeable future. Management efforts on regional and local scales are currently provided by participants in the EAHCP. While the EAHCP participants by themselves are not required to recover these species, they may be able to provide the continued management that leads to recovery goals for one or more of these species.

The recovery criteria need to be objective and measurable. To be objective, criteria must be based on the best available science and free from bias. To be measurable, criteria need to be quantitative or easy to gauge progress and success of conservation efforts. Smith et al. (2018) defined three terms considered important to recovery planning: redundancy, representation, and resiliency (Table 2). Their definitions follow:

Table 2. Select terms related to enhancing recovery chances and decreasing the likelihood of extirpation or extinction. The Three Rs.

Term	Definition	Notes
Redundancy	The ability of a species to withstand catastrophic events by spreading risk among multiple populations or across a large area.	Supported by measures maintaining or increasing large habitat patch size in cases of only one population.
Representation	The ability of a species to adapt to changing environmental conditions over time as characterized by the breadth of genetic and environmental diversity within and among populations.	Positively affected when genetic variation is maintained in the wild. Larger population sizes help protect against loss of genetic diversity.
Resiliency	The ability of a species to withstand stochastic disturbance; resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations.	Supported by a positive intrinsic rate of growth (λ, lambda). In some cases, fragmentation of habitat (e.g., weirs and dams on a river) can adversely affect connectivity particularly in an upstream direction.

Incorporating these criteria in the current Recovery Plan will help municipal, regional, State and Federal entities by emphasizing the measurable habitat and biological attributes that will inform species status assessments and consideration of changes to the federal status for *Zizania texana*, fountain darter, and Texas blind salamander. The recovery actions in the current Recovery Plan are to inform conservation efforts that manage habitat, increase population sizes, and reduce threats.

The recovery strategy for the species associated with the San Antonio segment of the Edwards Aquifer is to work with stakeholders on a comprehensive management plan that addresses regional issues like groundwater withdrawal, and local issues like stormwater pollution and water recreation impacts.

Regional and local efforts are underway to address the potential loss of habitat due to drought and other factors. Meeting the delisting criteria in this amendment would demonstrate that these species: (a) are able to withstand catastrophic events like severe droughts and flooding, (b) will maintain their potential to adapt to changes in environmental conditions such as introduced nonnative species and altered river channels, and (c) survive stochastic environmental disturbances (e.g., sewage line or water main break).

ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS
Not applicable

COSTS, TIMING, PRIORITY OF ADDITIONAL RECOVERY ACTIONS
Not applicable.

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APPENDIX A – SUMMARY OF PUBLIC, PARTNER, AND PEER REVIEW COMMENTS RECEIVED

Summary of Public Comments

We published a notice of availability in the *Federal Register* on August 6, 2019 (84 FR 38288-38291) to announce that the draft amendment for the San Marcos & Comal Springs & Associated Aquatic Ecosystems Recovery Plan (Recovery Plan); specific to Texas wild-rice (*Zizania texana*), fountain darter (*Etheostoma fonticola*), and Texas blind salamander (*Typhlomolge rathbuni*), was available for public review, and to solicit comments by the scientific community, State and Federal agencies, Tribal governments, and other interested parties on the general information base, assumptions, and conclusions presented in the draft amendment. An electronic version of the draft recovery plan amendment was also posted on the Service's Species Profile website (https://ecos.fws.gov/docs/recovery_plan/Draft%20APG%20RP%20Amendment_San%20Marcos%20and%20Comal%20Springs_1.pdf).

The Service received eight responses to the request for public comments. These included comments from the City of San Marcos, the City of New Braunfels, the Guadalupe River Basin Authority, the San Marcos River Foundation, Texas Parks and Wildlife Department, the Edwards Aquifer Authority, and interested citizens.

Public comments ranged from providing minor editorial suggestions to specific recommendations on the amendment content. We have considered all substantive comments; we thank the reviewers for these comments. Below, we provide a summary of public comments received; however, some of the comments that we incorporated as changes into the revised recovery plan did not warrant an explicit response and, thus, are not presented here.

Comment (1): We received several comments pertaining to flows rates provided in the draft recovery plan amendment. These flow rates differ from those provided in the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan (EARIP). Some commenters suggested that the proposed delisting criteria are less protective then the minimum flows that the EARIP established, that the EARIP is based on more recent information and that the EARIP has been reviewed by the National Academies of Sciences (NAS).

Response: We have revised the minimum flow thresholds in the final recovery plan amendment to align with the EARIP. We recognize the significant effort made by the EARIP permittees and stakeholders that led to the development of the EARIP and we agree with the commenters that consistency with the EARIP is appropriate. Furthermore, we agree that the EARIP has been thoroughly reviewed by experts both locally and nationally and have made the requested changes.

Comment (2): Two commenters requested temperature monitoring sites downstream of Landa Lake and Spring Lake be included in the water temperature criterion for fountain darter. One commenter requested that the duration of the water temperature criterion be lengthened from 30 years to 50 years to better consider long-term effects of drought.

Response: We have added downstream monitoring locations to the list of temperature monitoring sites for the fountain darter's and extended the duration of monitoring the water temperature at all sites to 50 years.

Comment (3): One commenter asked that the Service convene a recovery team to review any amendment that is proposed to San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan with additional new species experts.

Response: There is no planned effort to revise the recovery plan at this time. The Service will coordinate with species experts if recovery plan revisions are considered necessary in the future.

Comment (4): One commenter noted that flooding and localized heavy rains from tropical storms can reduce the amount of Texas wild-rice and recommended that the Service establish a minimum size for Texas wild-rice stocks to ensure genetic diversity in captive stocks.

Response: The Service's San Marcos Aquatic Resources Center will develop a Texas wild-rice propagation and reintroduction plan in coordination with experts and local partners to ensure genetic diversity of captive propagated plants including minimum size of stocks and recommendations for replanting of propagated plants to maintain diversity in the wild.

Summary of Peer and Partner Review Comments

In accordance with the requirements of the Act, we solicited independent peer review of the draft amendment from qualified experts. Peer review was conducted concurrent with the *Federal Register* publication. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to Texas wild-rice, fountain darter, Texas blind salamander, and the Edwards Aquifer ecosystem. The qualifications of the peer reviewers are in the decision file and the administrative record for this Recovery Plan amendment.

In total, we solicited review and comment from six peer reviewers. We received comments from two peer reviewers. We considered all substantive comments, and to the extent appropriate, we incorporated the applicable information or suggested changes into the final Recovery Plan amendment. Below, we provide a summary of specific comments received from peer and partner reviewers with our responses; however, we addressed many of the reviewers' specific critiques and incorporated their suggestions as changes to the final amendment. Such comments did not warrant an explicit response, and as such, are not addressed here. We appreciate the input from all commenters, which helped us to consider and incorporate the best available scientific and commercial information during development and approval of the final Recovery Plan amendment.

Peer Review Comment (1): The wording of the criteria for minimum flow discharge for Texas wild-rice and fountain darter is not clear and is contradictory with statements made elsewhere in the draft amendment regarding flows that are necessary to prevent jeopardy to the species.

Response: We have updated the minimum flow thresholds and clarified the text in the flow criteria for all three species.

Peer Review Comment (2): For the fountain darter criteria, one commenter asked if three monitoring sites will be established in both lakes to log temperature at 15-minute intervals, where the sites will be established, who will maintain the sites and why only sites in lakes were included. We received a second comment on the locations of the temperature logging sites with a recommendation to exclude the Slough Arm because it is not considered prime fountain darter habitat and experiences higher temperatures in the summer, that sampling locations in Spring Lake can be monitored at one location upstream of Spring Lake Dam and downstream of the confluence with the Slough Arm, and that the sites should be approved by the Service.

Response: We have updated Delisting Criterion 3 to include downstream sites. We acknowledge that future discussion with stakeholders is needed to determine specific sampling locations, monitoring plans, and the responsible parties for implementing these actions. However, this recovery plan amendment is limited to developing quantitative recovery criteria for what constitutes a recovered species. The intent of a recovery plan amendment is to replace only a specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. Changes to other recovery plan content, such as recovery actions and the implementation schedule for those actions are beyond the scope of this amendment.

Peer Review Comment (3): A reviewer asked where and when will dissolved oxygen be measured.

Response: See response to Peer Review Comment 2 above. The Service will work together with interested parties to develop biologically appropriate locations for monitoring dissolved oxygen.

Peer Review Comment (4): One reviewer noted that water quality parameters are not currently being monitored and asked if the Service is now requiring monitoring of water quality parameters.

Response: Through our water quality delisting criterion we are encouraging the monitoring of water quality parameters relevant to the biology of these species. However, recovery plans are not regulatory documents and serve to provide guidance on actions that will promote the recovery of threatened and endangered species. The Service will work together with interested parties to develop a plan for water quality monitoring, as needed.

Peer Review Comment (5): One reviewer suggested that the location of water quality sampling sites for Texas wild-rice should be approved by the Service to ensure they are representative of the longitudinal profile of turbidity.

Response: See response to Peer Review Comment 2 above. The Service will work with interested parties to establish appropriate monitoring sites.