Appendix A
Springflow Habitat Protection Work Group
Meeting Agendas

Springflow Habitat Protection Work Group

Meeting 1 Agenda
April 22, 2020
9:00am-10:30am

1. **Confirm attendance**

2. **Meeting logistics**
   a. Virtual meeting logistics
   b. Meeting POCs
   c. Work Group logistics

3. **Public comment**

4. **Review and discussion of Work Group Charge**
   a. Overview of issues to be addressed
   b. Part 1 process—refinement of questions and issues to be addressed
   c. Part 2 process—development of scopes of work and review of resulting work product
      i. Set (a) scopes of work
      ii. Set (b) scopes of work

5. **Presentation on completed EAHCP research related to the issues to be addressed**
   a. Water quality impacts
   b. Texas wild-rice and fountain darter habitat
   c. Comal Springs riffle beetle
   d. San Marcos salamander

6. **Discussion to identify presenters for Part 1 to help inform refinement of the following issues to be addressed in Part 2**
   a. Water quality impacts of predicted extended periods of low flow
   b. Impacts of extended periods of low flow on Comal Springs riffle beetle populations
   c. Impacts of extended periods of low flow on San Marcos salamander populations and on Texas wild-rice and other vegetation serving as fountain darter habitat in San Marcos system
   d. Status of other adaptive management study commitments related to extended periods of low flow
   e. Process for additional input on potential presenters

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 2 Agenda—Revised

May 20, 2020

2:00pm-4:00pm

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs
   - Work Group logistics

3. **Public comment**

4. **80 cfs pulse flow component overview**
   - Led by Myron Hess (Work Group Chair) with input from Thom Hardy (Texas State University) and Ed Oborny (BIO-WEST)

5. **EARIP water quality modeling effort presentation and discussion**
   - Presentation by Thom Hardy, Texas State University

6. **2019 VISPO Adaptive Management Process low flow scenarios presentation and discussion**
   - Presentation by Chad Furl, Edwards Aquifer Habitat Conservation Plan

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 3 Agenda—Revisedv2

May 28, 2020

9:00am-11:00am

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs
   - Work Group logistics

3. **Public comment**

4. **Approve meeting minutes**
   - April 22, 2020

5. **San Marcos salamander biomonitoring *presentation and discussion***
   - Presentation by Ed Oborny, BIO-WEST

6. **Salamander population dynamics in the context of flow variation and drought *presentation and discussion***
   - Presentation by Nathan Bendik, City of Austin

7. **Meeting 2 follow up discussion**
   - Led by Myron Hess, Work Group Chair

8. **Public comment**

9. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 4 Agenda

June 3, 2020

2:00pm-4:00pm

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs
   - Work Group logistics

3. **Public comment**

4. **Texas Parks and Wildlife 2011 and 2014 Comal Springs mapping and how that relates to occupied Comal Springs riffle beetle (CSRB) habitat *presentation and discussion***
   - Presentation by Chad Norris, Texas Parks and Wildlife

5. **Preliminary Results of CSRB Occupancy Study *presentation and discussion***
   - Presentation by Weston Nowlin, Texas State University

6. **How recent drought (2011-2014) has impacted CSRB populations *presentation and discussion***
   - Presentation by Will Coleman, Texas State University

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 5 Agenda
June 18, 2020
9:00am-11:00am

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs
   - Work Group logistics

3. **Public comment**

4. **Approve meeting minutes**
   - May 20, 2020 (Meeting 2)
   - May 28, 2020 (Meeting 3)

5. **Regulatory framework for the San Marcos River State Scientific Area *presentation and discussion***
   - Presentation by Cindy Loeffler, Texas Parks and Wildlife

6. **Implementation of the San Marcos River State Scientific Area *presentation and discussion***
   - Presentation by Melani Howard, City of San Marcos

7. **Authorized pumping versus withdrawals *presentation and discussion***
   - Presentation by Charles Ahrens, Edwards Aquifer Authority

8. **Other Edwards Aquifer Habitat Conservation Plan adaptive management commitments *discussion***
   - Led by Myron Hess, Texas Living Waters, Work Group Chair

9. **Public comment**

10. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 6 Agenda
July 8, 2020
9:00am-11:00am

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs
   - Interactive polling

3. **Public comment**

4. **Work Group decision process *presentation and overview of discussion documents***
   - Led by Myron Hess, Texas Living Waters, Work Group Chair

5. **Overarching issue 1 *discussion***
   - Led by Myron Hess, Texas Living Waters, Work Group Chair

6. **Overarching issue 2 *discussion***
   - Led by Myron Hess, Texas Living Waters, Work Group Chair

7. **If time allows, overarching issue 3 *discussion***
   - Led by Myron Hess, Texas Living Waters, Work Group Chair

8. **Public comment**

9. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 7 Agenda
August 6, 2020
2:00-4:00pm

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs

3. **Public comment**

4. **Approve meeting minutes:**
   - Meeting 4 (June 3, 2020)
   - Meeting 5 (June 18, 2020)

5. **Menti meter Issue 1 prioritization poll results *presentation***
   - Led by Jamie Childers

6. **Overarching Issue 1 *discussion* regarding prioritization**
   - Led by Myron Hess, Work Group Chair

7. **Brief *presentation* on the Comal Springs riffle beetle Work Group (CSRB) and CSRB in the San Marcos system**
   - Led by Chad Furl

8. **Continuation of overarching Issue 2 (CSRB) *discussion* from Meeting 6**
   - Led by Myron Hess, Work Group Chair

9. **Public comment**

10. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 8 Agenda
August 21, 2020
9:00-11:00am

Click here to Join Microsoft Teams Meeting
Or call: 1 210-729-0064 Conference ID: 507 814 844#

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs

3. **Public comment**

4. **Approve meeting minutes:**
   - Meeting 6 (July 8, 2020)

5. **Mentimeter Issue 2 prioritization poll results *presentation***
   - Led by Jamie Childers

6. **Overarching Issue 2 *discussion* regarding prioritization**
   - Led by Myron Hess, Work Group Chair

7. **Overarching Issue 3 *discussion* regarding potential areas of focus**
   - Led by Myron Hess, Work Group Chair

8. **Approach for categorizing AMP study topics under Issue 4***
   - Led by Myron Hess, Work Group Chair

9. **Public comment**

10. **Future meetings**

* If time allows

Springflow Habitat Protection Work Group

Meeting 9 Agenda
September 9, 2020
2:00-4:00pm

Click here to Join Microsoft Teams Meeting

Or call: +1 210-729-0064 Conference ID: 862 727 847#

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs

3. **Public comment**

4. **Approve meeting minutes:**
   - Meeting 7 (August 6, 2020)

5. **Issue 2 Motion *discussion***

6. **Mentimeter Issue 3 prioritization poll results *presentation***
   - Led by Jamie Childers

7. **Overarching Issue 3 *discussion* regarding prioritization**
   - Led by Myron Hess, Work Group Chair

8. **Overarching Issue 4 *discussion* regarding categorizing and focusing AMP study topics**
   - Led by Myron Hess, Work Group Chair

9. **Public comment**

10. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 10 Agenda
September 23, 2020
2:00-4:00pm

Join Microsoft Teams Meeting
Or call 210-729-0064 Conference ID: 797 954 480#

1. **Confirm attendance**

2. **Meeting logistics**
   - Virtual meeting logistics
   - Meeting POCs

3. **Public comment**

4. **Approve meeting minutes:**
   - Meeting 8 (August 21, 2020)

5. **Issue 3 Motion *discussion***

6. ***Discussion* of summary of Issues 1 through 3 for the Part 2 Charge**
   - Led by Myron Hess, Work Group Chair

7. ***Discussion* of the process for submitting a Part 2 Charge to the Implementing Committee**
   - Led by Myron Hess, Work Group Chair

8. **Overarching Issue 4 *discussion* regarding categorizing and focusing AMP study topics**
   - Led by Myron Hess, Work Group Chair

9. **Public comment**

10. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 11 Agenda
November 19, 2020
9:00-11:00am

Click here to Join Microsoft Teams Meeting
Or call +1 210-729-0064 Conference ID: 843 714 401#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve meeting minutes:**
   - Meeting 9 (September 9, 2020)
   - Meeting 10 (September 23, 2020)

5. ***Discussion and decision on*** **Draft Part 2 Work Group Charge**
   - Led by Myron Hess, Work Group Chair
     - Issue 4 Work Group Priority Subset and related Issue 4 topics
     - Overall document

6. ***Discussion and decision on*** **next steps for finalizing Part 2 Work Group Charge document for presentation to Implementing Committee**
   - Led by Myron Hess, Work Group Chair

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 12 Agenda
January 14, 2021
9:00-11:00am

Click here to join the meeting
Or call in (audio only)
+1 210-729-0064 **ID** 984905742#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. ***Discussion and decision on comments and revisions to*** **Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   - Led by Myron Hess, Work Group Chair

5. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on*** **next steps for approving final version for presentation to Implementing Committee**
   - Led by Myron Hess, Work Group Chair

6. **Public comment**

7. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 13 Agenda
Friday, February 5, 2021
9:00am-11:00am

Click here to join the meeting
Or call in +1 210-729-0064,,724648700#
Phone Conference ID: 724 648 700#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve Meeting Minutes**
   - January 14, 2021

5. ***Continue the discussion of and potential decision on comments and revisions to* Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   - Led by Myron Hess, Work Group Chair

6. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on* next steps for approving final version for presentation to Implementing Committee**
   - Led by Myron Hess, Work Group Chair

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 14 Agenda
Friday, February 26, 2021
9:00am-11:00am

Click here to join the meeting
Or call in (audio only)
+1 210-729-0064,,443768174#
Phone Conference ID: 443 768 174#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve Meeting Minutes**
   - February 5, 2021

5. ***Continue the discussion of and potential decision on comments and revisions to* Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   - Led by Myron Hess, Work Group Chair

6. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on* next steps for approving final version for presentation to Implementing Committee**
   - Led by Myron Hess, Work Group Chair

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 15 Agenda
Monday, March 8, 2021
1:30pm-2:00pm

Click here to join the meeting
Or call in (audio only)
+1 210-729-0064,,861443177#
Phone Conference ID: 861 443 177#

1. **Confirm attendance**

2. **Public comment**

3. **Approve Meeting Minutes**
   - February 26, 2021

4. **Finalize *Work Group Part 1 Report and Proposed Part 2 Charge***
   - Led by Myron Hess, Work Group Chair

5. **Approve delivery of the *Work Group Part 1 Report and Proposed Part 2 Charge* to the Implementing Committee**

6. **Public comment**

7. **Discussion of Next Steps and Future Meetings**

Appendix B
Springflow Habitat Protection Work Group
Meeting Minutes

Springflow Habitat Protection Work Group

Meeting 1 Minutes
April 22, 2020
9:00am-10:30am

1. **Confirm attendance**
   Kristy Kollaus confirmed that all work group members had joined the meeting.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and work group logistics.

3. **Public comment**
   There were no public comments.

4. **Review and discussion of Work Group Charge**
   Myron Hess provided an overview of the Work Group charge and how the Work Group is going to work through the four overarching issues in a multi-part process. The first part of the charge will be focusing in on these issues to define more specific inquiries.

   Chuck Ahrens questioned if the group is to determine if water quality is an issue or if water quality was already identified as an issue. Myron Hess indicated that there was an assumption when the Habitat Conservation Plan (HCP) was developed that there were water quality impacts at extended periods of low flow and that, if new information exists to support a different determination, the Work Group may find that water quality is not an issue of concern. Cindy Loeffler agreed that more recent data may inform the discussion.

   Myron Hess replied to Kimberly Meitzen's request for a qualifying descriptor of "extended." He indicated that the HCP recommends that a 6-month period of low flows be followed by an 80 cfs pulse. He referenced 2019 modeling that illustrates low spring flow levels as summarized in the Voluntary Irrigation Suspension Program Option Adaptive Management Scientific Evaluation Report.

   Finally, Chad Furl responded to Patrick Shriver's question by confirming that the previous models only consider temperature and dissolved oxygen.

5. **Presentation on completed EAHCP research related to the issues to be addressed**

Chad Furl gave a brief overview of program research completed under the EAHCP relevant to the Work Group's efforts. There were no questions.

6. Discussion to identify presenters for Part 1 to help inform refinement of the following issues to be addressed in Part 2

Water quality suggested presenters included Thom Hardy, Ed Oborny, Al Groeger, Benjamin Schwartz, and Patrick Shriver suggested that someone with a broader perspective on water quality modeling present. Several participants, including Jacquelyn Duke, asked for the current water quality model to be validated with 2014 data. Chad Furl explained that a module of the EcoModel could be forced with the 2014 hydrograph to extract maximum dissolved oxygen and temperature. There was discussion of the potential for a simplified comparison of 2014 data to model outputs.

Comal Springs riffle beetle presentations proposed included Weston Nowlin, Chad Norris, Chris Nice and Eric Benbow who participated in the National Academy of Sciences review panel. Charlie Kreitler expressed interest in seeing a summary on what is known about the riffle beetle, particularly about their hydrologic setting.

Presenters on the San Marcos salamander were suggested from the San Marcos Aquatic Resources Center and a request was made to understand how their habitat changed following recent work on the dam; Ed Oborny was suggested following the meeting.

Finally, Myron Hess indicated that the status of other adaptive management study commitments may be premature to discuss and establish presenters. He indicated that the Work Group may want to ask Chad Furl to come back to the group to provide more detail on the studies he presented at Meeting 1.

Myron Hess asked that suggestions for future presenters/presentations be provided by May 1.

7. Public comment

Dianne Wassenich clarified that the depiction shared by Chad Furl of San Marcos Salamander habitat showed habitat in the Spring Lake dam eastern spillway (in the San Marcos River downstream of Spring Lake).

8. Future meetings

Equal response indicated that 1.5-hour or 2-hour meetings are preferred but 2 additional verbal comments were made that 2-hour meetings would be appropriate for future meetings to allow for presentations and discussion.

Springflow Habitat Protection Work Group

Meeting 2 Minutes
May 20, 2020
2:00pm-4:00pm

1. Confirm attendance

Jamie Childers called on each Work Group member. All members were present although Melani Howard joined the call late.

2. Meeting logistics

Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and work group logistics.

3. Public comment

There were no public comments.

4. 80 cfs pulse flow component overview

Myron Hess opened the discussion by asking Ed Oborny (BIO-WEST) and Thom Hardy (Texas State University) to provide a summary of the envisioned role of the 80 cfs pulse flow overall and then with a focus individually on Comal and San Marcos systems.

<u>Overall discussion</u>

For overall discussion of development of 80 cfs pulse component, Mr. Oborny noted four key issues identified in considerations of flow regime and 80 cfs recommendation: water quality concerns for temperature and dissolved oxygen (DO) for extended periods, DO more unknowns than temperature; aquatic vegetation die-off; sedimentation; and loss of wetted area.. He indicated that a lot of information has been gained through monitoring and studies undertaken since then. Dr. Hardy added that a lot was learned in the Ecomodeling effort. Dr. Hardy also indicated that there are unanswered questions about DO, especially as it relates to vegetation dynamics; he emphasized this for the San Marcos system.

Comal system discussion

Dr. Hardy indicated that additional QUAL2E modeling would not address DO unknowns in the absence of additional data related to sediment oxygen demand and vegetation decay to parameterize any model. He has concerns about sediment oxygen demand and the effect on DO.

Mr. Oborny noted that temperature was not a problem in 2014 when flows got down to around 60 cfs; this was consistent with model predictions. If had vegetation die-off, that would drive DO down, but 2014 experience and lab work suggest vegetation may do better than previously thought below 80 cfs. With increased temperature, have seen more biomass of vegetation. He also indicated that sedimentation from runoff along the western shoreline of Landa Lake could be a problem if springflows were inadequate to clear sediment away and that a lack of surface flow in the spring runs was the biggest issue for Comal Springs riffle beetle (CSRB), but we know that the CSRB survived the drought-of-record.

San Marcos system discussion

Dr. Hardy indicated that at minimum flows the main body of Spring Lake and downstream to nearly Rio Vista temperatures are well maintained. However, downstream, such as around Rio Vista, with low flows temperatures are above levels where see reduced survival of fountain darter larvae. Dr. Hardy also indicated that a loss of aquatic vegetation because of recreation is a concern in the San Marcos River. Because water depth is a function of flow, at 45 cfs Texas wild-rice and other vegetation is more vulnerable to recreation and even at 80 cfs, we will not get vegetation recovery unless can control recreation.

Mr. Oborny also noted that, at low flows, wetted area, depth, and loss of vegetation are issues. He indicated that the key is the duration and 80 cfs will increase depth somewhat, but we will still have impacts from recreation. He also indicated that sedimentation in Spring Lake and conditions in the eastern spillway downstream of Spring Lake dam are his biggest concern. Mr. Oborny indicated that with adequate flow over the eastern spillway, habitat will be maintained there.

5. EARIP water quality modeling effort presentation and discussion

Dr. Hardy gave a history of hydrologic and hydrodynamic modeling in the Comal and San Marcos systems and reiterated points from the earlier discussion. The QUAL2E model includes assumptions about flow from individual spring orifices based on the aquifer level. The QUAL2E model for the Ecomodel effort only had data through 2013. Modeled temperature is okay in key areas even at low flows. However, the model does not simulate a vertical profile. In the Comal system, the temperature vertical profile during low flows could be considered as it related to discharge through the culverts to the Old Channel. For San Marcos system, Dr. Hardy indicated that temperature is not really a concern down to Rio Vista dam area. Key concern is protection of vegetation downstream of Spring Lake, particularly in shallow areas.

6. 2019 VISPO Adaptive Management Process low flow scenarios presentation and discussion

Dr. Furl re-presented drought-specific flow projection information from the 2019 Scientific Evaluation Report prepared as part of the Voluntary Irrigation Suspension Program Option (VISPO) Adaptive Management Process. He discussed figures illustrating the predicted EAHCP Phase II flow regime from MODFLOW. Mr. Hess confirmed that the model assumes withdrawals of full permitted amounts during periods when critical period management limits are not in effect.

7. Public comment

There were no public comments during the second comment period.

8. Future meetings

Myron Hess provided a schedule of future meetings. Kimberly Meitzen proposed a future agenda item, based on the discussions from the meeting, related to the impacts of recreation.

Several members of the Work Group indicated that habitat loss downstream of Spring Lake dam was important and a more detailed discussion about impacts from recreation followed. Ms. Howard indicated that Texas wild-rice is currently thriving in areas it has never occurred because recreation access has been limited recently. State scientific area (SSA) exclosures can be implemented when flows are less than 120 cfs. SSA exclosures and the protection they provide under flow changes was proposed for a future meeting topic. Kimberly Meitzen raised questions about changed bathymetry in San Marcos River since maps used in modeling were developed and about changes in distribution of Texas wild-rice. Dr. Hardy raised questions of SSA exclosures versus depth

Cindy Loeffler also suggested that the group consider implications of changes in oxygen demand with changes in vegetation through implementation of EAHCP conservation measures. Ed Oborny indicated that overall vegetation levels may not have increased, instead there is a change in species make-up.

Following the meeting, Chuck Ahrens and Adam Yablonski suggested that a future meeting of the Work Group include a presentation as a follow up to Chad Furl's presentation regarding the Phase II flow regime. Dr. Furl's presentation indicated that the MODFLOW runs assume full permitted withdrawals, as adjusted for critical period management. Each year Chuck Ahrens presents pumping data versus permitted withdrawals to the EAHCP Committees and Edwards Aquifer Authority Board and that information could be provided to the Work Group.

Springflow Habitat Protection Work Group
Meeting 3 Minutes
May 28, 2020
9:00am-11:00am

1. Confirm attendance

Kristina Tolman indicated that all Work Group members were present.

2. Meeting logistics

Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and work group logistics.

3. Public comment

There were no public comments.

Prior to starting the meeting, Charlie Kreitler provided comments on Meeting 2. He suggested performing geophysical studies and adding monitoring wells to the western bank of Spring Run 1 to understand the substrate at different spring runs and to inform our understanding of interflow conditions.

4. Approve meeting minutes

A motion was made by Charlie Kreitler, seconded by Ryan Kelso, to approve the meeting minutes from April 22, 2020. In the absence of objection, the minutes were approved by consensus.

5. San Marcos salamander biomonitoring *presentation and discussion*

Ed Oborny of BIO-WEST presented the results of 20 years of San Marcos salamander sampling from 2002 through Spring 2020. Mr. Oborny summarized his comments by indicating that gardening in Spring Lake is key to San Marcos salamander (and fountain darter) habitat regardless of springflow in particular because of its benefit in reducing sediment buildup. Sediment levels are a key factor adversely affecting salamander habitat. He also indicated that habitat in the Spring Lake dam eastern spillway should be protected from excessive siltation. Although increased stands of Texas wild-rice in areas below the dam currently decrease areas favorable for salamander habitat, that effect will be variable over time, particularly with lower flows, and he does not consider it a significant concern. Finally, he referenced a 2017 study of San Marcos salamander statistics which indicated that more individuals are found at the top of the system than at the bottom of the system. He also provided a general observation that salamanders are resilient.

6. Salamander population dynamics in the context of flow variation and drought *presentation and discussion*

Nathan Bendik from the City of Austin Watershed Protection presented the results of studies on the Jollyville Plateau salamander and Barton Springs salamander. He described seasonal patterns in abundance and reproduction of Jollyville Plateau salamanders based on statistical models and gave examples of how they respond when springs go dry in terms of size, abundance, and reproduction. The results presented on Barton Springs salamander sampling indicate a relationship between discharge, sedimentation and survival; the results illustrate that survival increases with flow and goes negative as the predicted rate of flow decreases. Mr. Bendik also presented information showing a lagged relationship between numbers of juveniles/reproduction and flow, with numbers of juveniles increasing about 9 months after periods of higher flow. There is less of a pattern with numbers of adults. The reason for this is unknown, two hypotheses that have been offered relate to the possibility of perched underground reservoirs and to nutrient introduction into the aquifer during storm events.

Mr. Bendik summarized the relationship between habitat, sediment, drought and population size. He also noted that dissolved oxygen (DO) is strongly correlated with spring discharge and that the two parameters cannot be separated when studying salamander abundance.

Mr. Oborny indicated that the results Nathan presented regarding Jollyville Plateau salamanders were consistent with data collected on the Comal salamander in 2014 following low flows when some individual spring runs lost surface flow. After surface flow returned, salamanders were again found in the spring runs. In response to a question about whether San Marcos salamanders occur in the aquifer, Chad Furl indicated that the San Marcos Aquatic Resources Center regularly finds San Marcos salamanders in the same collection nets where they collect Texas blind salamanders that are ejected from the aquifer.

7. Meeting 2 follow up discussion

Myron Hess asked if there were specific items from Meeting 2 on which the Work Group wanted additional information. Adam Yablonski suggested the group hear a presentation on the most recent information on water withdrawals in the system. Chuck Ahrens indicated that he can provide the Work Group a presentation comparing historic withdrawals with permitted pumping. Melani Howard and Nathan Pence recommended a further discussion on the impacts of recreation.

8. Public comment

There were no public comments during the second comment period.

9. Future meetings

June 4th is the next scheduled meeting; additional meetings will be scheduled soon.

Springflow Habitat Protection Work Group

Meeting 4 Minutes
June 3, 2020
2:00pm-4:00pm

1. **Confirm attendance**
   Kristina Tolman indicated that all Work Group members were present except Doris Cooksey; Ryan Kelso called into the meeting late.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and work group logistics.

3. **Public comment**
   Damon Childs indicated that there were no public comments.

4. **Texas Parks and Wildlife 2011 and 2014 Comal Springs mapping and how that relates to occupied Comal Springs riffle beetle (CSRB) habitat** ***presentation and discussion***
   Chad Norris, Texas Parks and Wildlife presented work performed in 2011 and 2014 to map 425 spring features in the Comal Springs system, with a flow of about 240 cfs in 2011, and a history of studies performed to understand occupancy of the Comal Springs riffle beetles and their habitat. Efforts included collecting elevation data for spring emergence. Most of these features are dry at low flows. Have not sampled for CSRB at most of these features, primarily have focused sampling on spring runs 1-3, western shoreline, and Spring Island areas. He described 2014 conditions of sampling with flows between 90 cfs and 80 cfs when most spring features were dry or reduced to seeps along western shoreline. He did indicate that CSRBs were collected during biomonitoring in that year, although not at traditional locations.

5. **Preliminary Results of CSRB Occupancy Study** ***presentation and discussion***
   Weston Nowlin, Texas State University, presented on recent research on CSRB occupancy and N-mixture modeling to establish CSRB populations at spring orifices in Landa Lake. He presented preliminary results generated from Pearson correlations and ANOVAs for differences between site covariates and predictors. In the discussion that followed Dr. Nowlin indicated that the results from the models will not establish CSRB abundance but instead will describe the probability of occupancy for each of the sampled orifices. About 500 spring openings mapped in 2018. Selected 85 sites at random, distributed with 23 sites in spring runs 1-3, 33 along western shoreline, 12 in Spring Island area, 12 in Landa Lake, and 5 in spring run 4.

   He also indicated that CSRB were collected in Spring Run 4 where they had not previously been found; Spring Run 4 was an area of the system that did not have measurable flow

for a three-month period in 2014. Dr. Nowlin indicated that the collection of CSRB in Spring Run 4 does not tell us if they are moving through the subsurface versus the surface. Data analysis is ongoing, expect completion later this year.

6. How recent drought (2011-2014) has impacted CSRB populations *presentation and discussion*

Will Coleman, Texas State University, presented an overview of previous and current CSRB population and genetic studies. He detailed his ongoing research using a frequency model to simulate effective population size (i.e. breeding population) and make comparisons with observed summary statistics to estimate CSRB populations. Mr. Coleman indicated that the final analysis should be complete in 2021. Understanding how water moves may help us understand how CSRB could move within the subsurface.

A discussion of the work group followed:

Charlie Kreitler described previous work to understand flow paths in the Comal Springs system. He suggested the Work Group members consider performing geophysical studies to understand how water moves in the system during periods of flow less than 80 cfs and to better understand the distribution of CSRB habitat. Chad Norris deferred to Dr. Kreilter in the value of performing studies to understand how flow moves through the system and when areas go dry.

Dr. Meitzen proposed a comparison of well elevations with CSRB data collection to try to address habitat connectivity between springs with more robust population data from species sampling. Weston Nowlin indicated he could provide that data to Chad Norris to perform such an analysis.

Myron Hess reminded members of the Work Group process and invited members to begin thinking about how the questions of the charge can be refined and clarified.

7. Public comment

Damon Childs indicated that there were no public comments.

8. Future meetings

Myron Hess indicated that we will be scheduling the next meeting and proposed topics for that meeting.

Springflow Habitat Protection Work Group
Meeting 5 Minutes
June 18, 2020
9:00am-11:00am

1. Confirm attendance

Kristina Tolman indicated that all Work Group members were present.

2. Meeting logistics

Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and work group logistics.

3. Public comment

There were no public comments.

4. Approve meeting minutes

A motion was made by Cindy Loeffler, seconded by Charles Kreitler, to approve the meeting minutes from May 20, 2020 (Meeting 2). In the absence of objection, the minutes were approved by consensus.

A motion was made by Tom Arsuffi seconded by Charles Kreitler, to approve the meeting minutes from May 28, 2020 (Meeting 3). In the absence of objection, the minutes were approved by consensus.

5. Regulatory framework for the San Marcos River State Scientific Area *presentation and discussion*

Cindy Loeffler from Texas Parks and Wildlife Department (TPWD) presented an overview of the regulatory process for creating and designating the San Marcos River as a State Scientific Area. March 2012, the Texas Parks and Wildlife Commission adopted §57.910 of the TPWD rules which designated the San Marcos River, from Spring Lake dam to the San Marcos wastewater treatment plant, as a State Scientific Area (SSA). This effort was to help balance the impacts from aquatic recreation by protecting vulnerable habitat during low flow conditions. The rule prohibits the uprooting and disturbance of Texas wild-rice within the SSA, authorizes the installation of exclusion barriers at flows at or below 120 cfs, and prohibits unauthorized entry within exclusion areas. Violations are punishable as a Class C Misdemeanor.

Patrick Shriver asked how many times the exclusion zones have been implemented and if any citations have been issued? They were implemented in 2014 and 2015 and no citations have been issued.

Charles Kreitler commented that the SSA exclusion zones seem to only target the TWR, how does it protect the other endangered species? Cindy replied that by protecting the TWR, the exclusion zones also protect other species including the fountain darter and San Marcos salamander due to the overlap in habitat.

6. **Implementation of the San Marcos River State Scientific Area *presentation and discussion***

Melani Howard with the City of San Marcos, presented an overview of the challenges and successes of implementing the SMR SSA exclusion zones during low flow conditions. There were three criteria used to identify SSA exclusion zones including: TWR stands less than one-meter depth from Hardy's 2011 modeled 120 cfs bathymetry data, persistent stands of TWR from the TPWD annual TWR survey (since 1989), and proximity to aquatic recreation zones.

Melani then showed examples for how and where TWR stands were selected for SSA exclusion zones in 2014 and 2015. Exclusion zones were anchored with T-posts and floating buoys and noodles, educational signs were provided by TPWD. The Conservation Crew installed, maintained the zones through routine removal of accumulated floating vegetation, and educated recreationists. Cindy Loeffler complimented Melani and the Conservation Crew's successful implementation of the SSA exclusion zones.

Jacquelyn Duke asked what percent of the current TWR coverage would be protected by the current and proposed exclusion zones and if the proposed zones would significantly impact aquatic recreation? Melani and Kristina Tolman will provide the calculations. Melani noted that the impacts to recreation would include preventing dogs and people from accessing vulnerable areas, but overall insignificant.

Myron Hess inquired about the conditions for TWR at 120 cfs and 80 cfs and how the net disturbance is calculated. Melani replied that a range of conditions at and below 120 cfs were considered and that the annual net disturbance calculations for the Incidental Take Permit are based on the footprint of the perimeter of the exclusion zones.

7. **Authorized pumping and withdrawals *presentation and discussion***

Charles Ahrens from Edwards Aquifer Authority presented the 2019 and historic Edwards Aquifer authorized pumping versus withdrawals. In 2019, there were approximately 1,246 permit holders authorized to withdraw a combined 571,599 acre-feet of Edwards Aquifer water. Permitted water use fits into three categories: industrial (7%), agricultural irrigation (31%), and municipal (62%). The 2019 actual pumped amounts were 339,020 acre-feet with municipal withdrawing the most at 71 percent. Chuck then presented an overview of the historical pumping and how critical period management (CPM) influences pumping based on the San Antonio (J-17) and Uvalde (J-27) wells.

Cindy asked if, aside from the CPM and Voluntary Irrigation Suspension Program Option (VISPO) restrictions, there are any other reasons that the unpumped water was not pumped? Chuck replied that from a regulatory perspective, no. When SAWS's Vista Ridge comes online, we may see positive impacts for the unpumped category as they reduce their pumping of Edwards Aquifer water.

Tom Taggart asked about the exempt and federal pumping and if they were accounted for within the numbers? Chuck replied that they are not included, the numbers only account for the permitted and metered pumping and excludes any limited production wells or exempt pumping. Chad Furl commented that the MODFLOW groundwater modeled amounts were around 593,000 acre-feet which included an additional 21,000 acre-feet to account for limited production wells, federal and exempt pumping.

8. Other Edwards Aquifer Habitat Conservation Plan adaptive management study commitments *discussion*

Myron Hess presented a list of adaptive management study commitments included in the Edwards Aquifer Habitat Conservation Plan and specific studies, either completed or ongoing, identified by EAHCP staff as being responsive to the adaptive management process (AMP) commitments. He indicated that the next step on this task is for the Work Group to prioritize AMP study commitments that have not been addressed.

Cindy Loeffler requested an additional column to summarize studies and indicate how they did, or did not, address the AMP commitment listed in the first column.

Patrick Shriver inquired about the connection between what the Work Group has heard and the AMP commitments table. Myron responded that most of the Work Group meetings have been information based, but the next steps will be how the Work Group compiles the information into questions for technical evaluations. He indicated that table is not an indication of what is a priority, instead it is an effort to summarize what the EAHCP listed as study commitments and current status of studies.

Jamie Childers indicated the need for the Work Group to help define and prioritize the questions that have not been answered and asked that the Work Group identify items that are important for the progress of our EAHCP programs. Myron added that input from the Work Group is needed to prioritize studies that have an important role in AMP.

9. Public comment

There were no public comments during the second comment period.

10. Future meetings

Wednesday, July 8th at 9:00 am is the next scheduled meeting.

Springflow Habitat Protection Work Group
Meeting 6 Minutes
July 8, 2020
9:00am-11:00am

1. **Confirm attendance**
   All Work Group members were present.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and Work Group logistics.

3. **Public comment**
   There were no public comments.

4. **Work Group decision process *presentation and overview of discussion documents***
   Jamie introduced the Menti polling application which all attendees used to submit their comments and suggestions during the Issue 1 and 2 discussion.

   Myron Hess, Work Group Chair, presented an overview of the process of refining the final questions that the Work Group will recommend to the Implementing Committee to fulfill Part 1 of the Charge. He referenced documents provided to Work Group members including an outline the four main issues of the work group charge and lists potential questions and a matrix of "other" adaptive management process (AMP) study commitments listed in the HCP. The latter included his recommendations as a starting point for possible next steps.

   Cindy Loeffler expressed appreciation to Myron for addressing her comment from the previous meeting by providing recommendations for next steps.

5. **Overarching Issue 1 discussion**
   Myron talked about two potential overarching topics that could be related to Issue 1: elevated temperature in the Old Channel and potential for die-off of aquatic vegetation impacting the dissolved oxygen. According to Thom Hardy's presentation in Meeting 2, the springflow that emerges during low flow periods may not mix well and bypass the Old Channel which would result in warmer temperatures than originally modeled.

   Tom Arsuffi suggested that the temperature differential between the Old Channel and the New Channel should be assessed but asked if it is significant enough to influence the species and their habitat. He then inquired if temperature data were available for Landa Lake versus the Old Channel? Chad Furl responded that temperature data were collected for those sites during low

flow conditions in 2014 and there was not a significant differential, however, the differential may be greater if the systems experienced low flow for an extended period of time, such as years.

Charlie Kreitler noted that the data that have been collected during low flow do not show much of change because the groundwater temperature remains relatively constant. However, if the groundwater flow paths change between the artesian block and the upthrown block the water chemistry may change. Charlie also agreed that Cindy Loeffler's question about which springs are still flowing during low flow conditions was a more relevant question than the chemistry of the water.

Mark Enders inquired if there enough mixing of the spring water and do we know if the cooler water from Spring Runs 1, 2, and 3 are going to the New Channel instead of Old Channel? Chad Furl emphasized that after 20 years of temperature sampling, over a range of conditions, including a three-week period of flow down to 63 cfs in Comal system, water temperature has remained relatively constant. Chad also acknowledged it might change with a longer period of low flows. Myron acknowledged Chad's point about not having data at lower flows to inform modeling but added that the Work Group may also identify new ways of monitoring during low flow that better collect needed information.

Chad Norris inquired about Thom Hardy's temperature modeling and if it has been validated with recent data and newer models. Chad Furl replied that the temperature model from 2010 was calibrated with the 2009 data which represents low flow conditions in both systems; lower flows in the Comal system (2014) were not used in modeling.

Myron asked about the San Marcos water quality model results and if anyone had comments. Tom Taggart asked about carbon dioxide content and how that affects vegetation during low flows. Cindy noted that during Meeting 2 she asked Ed Oborny how the increased aquatic vegetation in the San Marcos could influence the net dissolved oxygen; at that meeting Ed noted there was not a net increase in vegetation. Jacquelyn Duke recalled an indication that flows below 45 cfs would be a loss of vegetation which may be more of an issue than the dissolved oxygen and the temperature. She asked if the 80 cfs is the appropriate flow to focus on and if vegetation loss needs to be addressed. Melani Howard responded that modeling Thom Hardy performed did show detrimental impacts to Texas wild-rice (TWR) at flows around 100 cfs, not sure about other macrophytes. Myron clarified that the Issue 1 is related to water quality and that the 100 cfs impacts to TWR may not be dissolved oxygen or temperature, but other factors; Melani agreed.

Meeting attendees submitted their comments and questions for Issue 1 via the Menti application. Original submissions can be viewed within the July 8, 2020

Presentations PDF. After providing an opportunity for input between meetings, members will discuss the themes and prioritization of the submissions at meeting 7.

6. Overarching Issue 2 discussion

Myron introduced four potential overarching topics related to Issue 2, the Comal Springs riffle beetle (CSRB), that might be considered. First, does the subsurface substrate in the spring runs allow for CSRB to migrate during extended periods of low flow? If they can migrate, will the CSRB adults and larvae survive? Thirdly, does sedimentation negatively impact the survival of CSRB during low flow? Variations of the topics listed above, as well as results from ongoing studies at Texas State University and the EAHCP Refugia, may be appropriate for assessment by the Comal Springs riffle beetle Work Group. Members were invited to begin entering proposed issues through the Menti application as well as raising them orally.

Myron referenced Chad Norris' presentation during Meeting 4 and how some findings from the 2014 Texas Parks and Wildlife Department (TPWD) Comal Springs survey may be inconsistent with the assumptions that have been made about springflow along the western shoreline. He also noted the subsurface flow path issue that Charlie Kreitler had discussed during Meeting 4 and its influence on spring flow during low flow conditions.

Chad Furl added that there are three separate entities (EAHCP Refugia, BIO-WEST, and Texas State University) actively investigating the CSRB with a total of six ongoing or planned studies in the coming years. These include two population surveys, one husbandry/life history, and one cotton lure study ongoing through the EAHCP Refugia and BIO-WEST; in addition to the population and genetic studies at Texas State University.

Tom Arsuffi inquired about the stability of the flow paths and if they change over time. Charlie replied that he is not aware of specific changes over time but when dye was injected near Panther Canyon, it emerged in springs along the western wall. However, dye injected into the Lower Colorado River Authority well then emerged in the lake and New Braunfels Utilities well near the golf course. He then added that the hydrogeology for Comal, and probably San Marcos, springs has been assessed at a more regional level and not specific level, but that detailed, site-specific information might be beneficial. That may entail geophysical surveys and shallow wells and assessing the elevation of various springs along the western shoreline and springs in Spring Lake. Charlie also noted that chemistry is different for springflows in southern part of Landa Lake than for those in northern part. Melani Howard added that Spring Lake staff have observed the southern springs there flowing more during low flow conditions and northern springs less.

Meeting attendees submitted their comments and questions for Issue 2 via the Menti application. Original submissions can be viewed within the July 8, 2020 Presentations PDF. Members will have further opportunity to submit CSRB input at the next meeting. We will also discuss the themes and prioritization of the Issue 1 input at Meeting 7.

7. If time allows, overarching Issue 3 discussion

The group agreed that they will need more time to assess Issues 1 and 2. Issue 3 will be discussed on a later date.

8. Public comment

There were no public comments.

9. Future meetings

A poll will be sent to Work Group members to select the next meeting date and time.

Springflow Habitat Protection Work Group
Meeting 7 Minutes
August 6, 2020
2:00-4:00pm

1. Confirm attendance

All Work Group members were present except Ryan Kelso.

2. Meeting logistics

Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and Work Group logistics. RSVPs will no longer be required for future meetings as the meeting link will be shared within the agenda and meeting announcements.

3. Public comment

There were no public comments.

4. Approve meeting minutes

A motion was made by Cindy Loeffler, seconded by Myron Hess to approve the meeting minutes from Meeting 4 (June 3, 2020). In the absence of objection, the minutes were approved by consensus.

A motion was made by Cindy Loeffler, seconded by Patrick Shriver to approve the meeting minutes from Meeting 5 (June 18, 2020). In the absence of objection, the minutes were approved by consensus.

5. Menti meter Issue 1 prioritization poll results

Jamie presented an overview of the Issue 1 prioritization results. Previously, members and meeting attendees submitted suggestions on how to focus consideration of broad Issue 1 of the SHP Work Group Charge. The suggestions were themed into 9 topic areas and the topic areas were prioritized by work group members using the Menti meter polling application. Jamie explained the ranking and point system used by Menti meter to generate the results. Overall, 11 of the 12 members responded to the poll and some prioritized all 9 themes while others prioritized just a few of the topics. Detailed results from the prioritization process are available within the presentation materials for this meeting posted on the SHP Work Group portion of the EAA website.

6. Overarching Issue 1 discussion regarding prioritization

Myron Hess asked the group how they would like to proceed in using the results in making prioritization decisions. Charlie Kreitler noted that, regarding theme 5, “evaluate the flow path and flow split at the Old Channel”, options for addressing the potential for springflow bypassing the Old Channel were

previously considered during the construction of the culvert at the Old Channel. The elevation of the intake was lowered to account for lower surface water elevation during low flow. Moreover, there was talk about installing a temporary, inflatable dam so that most of the flow would be routed to the Old Channel. It's a relevant issue to him to understand the potential for flows bypassing the Old Channel but addressing what to do about it may not be as applicable to the charge of this Work Group.

Members agreed to go through the topics from the lowest prioritized and discuss which addressed the charge of the Work Group and were a priority.

"Stormwater sampling" (9th and lowest priority): Cindy Loeffler offered that it may not be as important since they are considering low flow conditions. Patrick Shriver added that stormwater could be a big issue during low flow conditions because they are likely to have higher concentrations of pollutants during or after dry periods. Melani concurred but offered that it could be refined to assessing water quality conditions associated with a stormwater pulse after an extended period of low flows. Myron then reiterated that the charge is focused on the 80cfs pulse and the functions it is intended to serve.

Chad Norris commented that if the 80cfs pulse is not attainable, then the real concern is with extended periods of flow in the 30-80cfs range. Myron agreed with Chad's comment. Melani suggested an option that some of the themes be combined under a broader theme and look at eliminating some specific topics. Myron acknowledged the potential for that approach but offered that there would be a lot to topics to consider.

The group agreed to work in reverse order of priority ranking to hear rationales for and against carrying themes forward. Tom Arsuffi and Jacquelyn Duke agreed that the stormwater sampling is not as important as the higher ranked themes.

"Evaluate the COI for the impacts on water quality" (8th ranked theme): Patrick commented that COI (certificates of inclusion) are part of the EAHCP and something that has not been implemented. He noted that previous presentations did emphasize the impacts from recreation and that COIs potentially could be applied more broadly. but that may not be as relevant to the Work Group charge as the other issues. Members agreed to remove it from the prioritized list of themes

"Evaluation of Springflow in Spring Lake" (7th ranked theme): Melani commented that, while important, this theme could be combined with some of the other themes. She then elaborated that during low flows, the same springs stop flowing and that it would be beneficial to better understand those trends. Kimberley Meitzen agreed about combining but offered that without that data it would be hard to assess, a potential recommendation from the Work Group

could be monitoring of the flow from specific springs during low flow conditions and assessing how it impacts the Covered Species within Spring Lake.

"Evaluate temperatures and decreasing springflow" (6th ranked theme): Kimberly commented that it could potentially be combined with the highest ranked theme of validating the Hardy model with the 2014 data. Charlie noted that it could also be combined with the second ranked theme. Further discussion occurred about detailing this topic, and concerns about eliminating it entirely including the need to better understand spring flow sources during low flows particularly for CSRB and association with the upthrown block formations, until a motion was made by Dr. Tom Arsuffi, which, with the acceptance of a friendly amendment, was seconded by Patrick Shriver. The Work Group discussed the motion and agreed that it seemed to present an acceptable path forward. The Work Group further agreed that Myron Hess would work with EAHCP staff to capture the motion, as reflected in the discussion, in writing, which, after review by Dr. Arsuffi and Mr. Shriver, would be brought back to the Work Group for further consideration and action. That written Motion is reproduced immediately below.

Motion to Define Prioritization for Further Work Group Consideration Under Issue 1

Issue 1: The Implementing Committee should ensure a technical evaluation is undertaken of water quality impacts of predicted extended periods of flow below 80 cfs in both spring systems, either using the Hardy water quality model but calibrated and validated using data from recent low-flow periods or using an alternate approach

Motion by Tom Arsuffi, second by Patrick Shriver (made orally during August 6, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 1 for consideration in Part 2 of the Work Group's charge related to water quality below 80 cfs: 1) Calibrate, evaluate, and validate the Hardy Model using 2014 data; 2) Address dynamics of habitat, dissolved oxygen, and vegetation loss during low springflow; and 3) Review the outcomes of the 2016 Expanded Water Quality Work Group. These and other topics were summarized in the discussion documents for the Work Group meeting on August 6, 2020. The topic, "Evaluate temperatures and decreasing springflow (<80cfs)" are understood as being included under the three topics listed above.

Although this Motion prioritizes specific topics under Issue 1, it is not intended to suggest that other topics discussed pursuant to Issue 1 do not merit consideration in other processes or at other times, including through

recommendations, potentially by this Work Group, for future monitoring during periods of extended low flow.

7. Brief Presentation on the Comal Springs riffle beetle (CSRB) Work Group and CSRB in the San Marcos system

Chad Furl presented an overview of the CSRB Work Group charge, a list of EAHCP funded and non-EAHCP funded research related to the CSRB, as well as historical results of CSRB surveys conducted in the San Marcos Springs system. System-wide population surveys of CSRB in Comal system will be undertaken. He also reported that CSRB sampling in Spring Lake found CSRB associated with the springs emanating from the wall of the lake next to the old hotel (Meadows Center for Water and the Environment) and not with the deeper springs. CSRB initially discovered in Spring Lake in early 1990s, are found when they look for them but never in high numbers relative to Comal system.

8. Continuation of overarching Issue 2 (CSRB) discussion from Meeting 6

Jamie presented the themed submissions previously received for Issue 2 and gave meeting attendees time to submit additional comments and suggestions for Issue 2. These submissions will be combined and themed with the previous submissions. Work Group members will prioritize and rank the themes prior to the next meeting.

9. Public comment

There were no public comments.

10. Future meetings

The SHP Work Group Meeting 8 will be held on Friday, August 21 at 9:00am.

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
Comments	Modeling should incorporate predictions for future drought conditions using Dr. Hardy's models built for central Texas conditions.	WG virtual sessions one and two presentations reassured me that the current model and activities are protective. However, I am not opposed to the following suggestion of plugging the WQ data with 2011 lowest flow DO in as a means of sensitivity check.	The WQ Workgroup set the current parameters of what is available and has not been at all discussed in this process; it could provide context for questions regarding WQ.	Storm water sampling has mostly been incorporated during high flow events – should there be more concern of point sources during low flow contributions from localized runoff?	The springflow in Spring Lake also needs to be evaluated. Spring Lake staff have noticed historically that springs shift as flow decrease. the upper springs diminish.	Spring Island has highly sedimented over the decade and springs are covered in silt. Is anything going to be done to restore the habitat?	I believe the concern is two fold in regards to the old channel. 1) will the assumed flow reach the Culvert to Old Channel and 2) what habitat downstream in the ERPA will sustain temperatures. Have we compared data from 2014 drought to modeled temps?	I am not opposed to the potential of permit holders reinvigoratin g activities related to the COI (Certificate of Inclusions) as contemplate d and potential control regarding recreational activities that have the potential to adversely impact WQ	I think Chad answered the question for the short term that temps are not an issue for water quality down to 60cfs. the question is can WQ be sustained over the long run

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Is the Hardy model adequate to evaluate the effects of <80cfs?	What is the effect on dissolved oxygen in spring runs and Landa Lake from vegetation die-off during extended periods (more than 6-months) with flow below 80 cfs in the Comal Springs system?	Planning for WQ activities of the permit, which was/is a pragmatic approach of constituent testing. The WQ Workgroup set the current parameters of what is available and has not been at all discussed in this process; context for questions regarding WQ	Should a more detailed analysis of Nutrient stormwater load contributions be investigated to evaluate algae blooms and DO swings?	Should changes in CO2 levels in SM be considered for low flow conditions related to water quality?	With extended periods of drought, rainfall events will occur periodically and wash sediments into habitat. Consider studying potential impacts.	If the flow rates identified in the flow split table are met, wouldn't temperatures be somewhat homogenous at the split between Old and New?		Providing flows of up to 80 cfs are not achievable both politically and monetarily.

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	One of the presenters (Hardy) seemed to confer that additional WQ data would be a complex for any current model or actually any modeling platform. This seems to align with the direction that our WQ Workgroup took during Phase I .	Impacts to habitat quality under low flow (e.g., increased sediment, algae, temperature, decreased dissolved oxygen). How suitable habitat for endangered species changes	Do we believe any conclusions of the Expanded Water Quality Workgroup in 2016 are applicable?	Storm water s	If there is an increase in vegetation in the San Marcos, would that impact DO at low flows?	Before you clean the silt out of Spring Island area make sure this is of benefit to the riffle beetle.	With regard to the concern of water temperatures in the OC during extended low-flow periods: bathymetric surveys and flow-path modeling may be needed to determine if springflow discharge from western shoreline will be able to enter Old Channel..		Is 80cfs the best value to use, or should it be lowered to reflect more recent findings?

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Any model rebuild will contain some amount of uncertainty. What would the impacts of management be with new results?	What are the effects of extended low-flow (below 80cfs for six months) and vegetation die-off on DO levels in Landa Lake?					Does low temperature springflow bypass culverts to old channel during low flow?		I suspect the major issue at the springs is significant decrease flow in individual springs, and not a change in “chemistry” of the spring discharge. Spring chemistry should remain constant. During low flow, discharge would definitely decrease and points of discharge would change. Which springs go dry whether larger springs are at different elevations would be important. A proposed study would be to review of all previously

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Using more than one model may be useful. Averaging over several models can help identify components that are not accounted for by any single model.	Evaluation of potential for vegetation die-off in Landa Lake during extended periods of low flow affecting DO					A simple modeling of flow through Landa Lake from the wall springs to the Old Channel culvert should provide enough information as to whether DO or temperature will decrease/increase to the point that it is critical for the species in the Old Channel. I do not anticipate that there will be a significant change in either DO or temperature as discharge from the		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Can the Hardy model tell us which spring/seep outlets will be flowing at 80 cfs and below?	Potential for low DO in Landa Lake					Whether surface water flow during an extended low flow (<80 cfs) period through Landa Lake to the culvert for the Old Channel will warm enough to cause temperature and DO issues for the fountain darters in Old Channel.		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Use data collected in 2014 to validate WQ model results	what is the status of the vegetation modeling? Sounds as though it may be useful for evaluation of flows below 80cfs.					Surface flow (i.e residence time) through Landa Lake and potential increase in temperature and declines in DO is probably more critical. This should be a relatively easy back-of -the envelope calculation to determine whether there is a potential problem. If this is an issue, then more field measurements and additional surface water modelling may be needed. During LBG-		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	How well does the Hardy model represent water quality when the 2014 drought is modeled?	to Thom's point: as flows decrease, pollution concentration increases, and CO2 increases in association (and DO decreases). Turbidity is likely to increase especially if recreation continues. There are many negative factors that will impact WQ							

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Hardy's Qual2E report needs evaluation with regard to broader water quality modeling understanding. There are at least 3 recent reviews of water quality models strengths and weaknesses - context and comparison would be helpful for confidence and assumptions	We all understand this is a Take Permit? We know there are some species loss during instances. Since we got a glimpse of an empirical time 2014 for this in SM and another in Comal. Why not look at take trends.							

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
	Can we calibrate the Hardy model to 2014 drought data to better understand if the accuracy of the model?	habitat loss, prey decrease, predator accessibility... The bottom line is that a dramatic change in springflow regime for 7 years is a hard hit on the ecosystem							
		Low flow/vegetation interactions at low flow may limit mixing in the lakes, isolating areas of dense vegetation from cool spring flows.							

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
		Monitor changes to DO and Carbon Dioxide related to vegetation & nutrients etc. during lower flow over the next permit period in both lakes.							
		During earlier periods there were discussions of field level lab simulations to test concepts should resources be shifted to do this level of science for DO and vegetation? (And When)							

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Consider stormwater sampling.	Evaluate springflow in Spring Lake.	Evaluate sediments near Spring Island and Spring Runs.	Evaluate the flow path and flow split at the Old Channel.	Evaluate COIs for the impacts on water quality.	Evaluate temperatures and decreasing springflow (<80cfs).
		Including more protective measures for SSA's as they specifcally relate to low flow and total area protected. Evaluating current SSA boundaries, possibly expanding them during low flows,moving/shifting them, or maybe including more SSAs.							

Springflow Habitat Protection Work Group

Meeting 8 Minutes
August 21, 2020
9:00-11:00am

1. **Confirm attendance**
   All Work Group members were present except Ryan Kelso.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and Work Group logistics.

3. **Public comment**
   There were no public comments.

4. **Approve meeting minutes:**
   A motion was made by Cindy Loeffler, seconded by Tom Arsuffi to approve the meeting minutes from Meeting 6 (July 8, 2020). In the absence of objection, the minutes were approved by consensus.

5. **Issue 1 final draft Motion**
   Myron Hess presented the draft Issue 1 motion and described the process for developing the motion language. He indicated that at the end of the process a single product of all the motions would become the Part 2 charge.

6. **Mentimeter Issue 2 prioritization poll results *presentation***
   Jamie Childers presented the results of the Mentimeter prioritization poll.

7. **Overarching Issue 2 *discussion* regarding prioritization**
   Myron Hess opened the discussion of the prioritization of topics. He agreed that, as Kimberly Meitzen suggested, it might be appropriate to combine "Study CSRB in the San Marcos" with "spring opening investigation of CSRB habitat" in the number one ranked topic. Myron noted his understanding that the primary issue for CSRB in San Marcos under that topic likely would be monitoring individual spring openings during low flow periods. Tom Arsuffi indicated that there is a need to understand what spring openings disappear at different flow rates under "Substrate, subsurface well, and spring opening investigation of CSRB habitat" but that several substrate studies have been done and additional substrate studies are not needed. Charlie Kreitler explained that he thinks technical studies are needed to better understand the hydrogeology at Comal

Springs, including further analysis of existing studies and data. Specifically, need to evaluate the aquifer elevation of the springs that go dry, the formation with which they are associated, and which springs have the highest population of CSRBs that need to be protected. Cindy Loeffler agreed that Charlie's summary is what the Work Group should be trying to understand. In statements made later, Patrick Shriver and Tom expressed agreement with Charlie's summary and on the point of not focusing on the substrate issue. Tom suggested the Work Group move on to the second topic of: Low springflow and impacts on CSRB populations, survival, and life stage development.

Tom indicated that the second topic included very broad questions that he had ranked low because he could not figure out how to address effectively. Chad Norris indicated that he believed work discussed under the first topic looking at flow at individual spring openings would help address key issues under this topic. Chad Norris indicated that defining what springs are flowing through investigations of spring openings would benefit the species and that the questions from the second topic are difficult to address.

The discussion continued onto "Use results of genetic testing to inform study efforts." Myron noted his understanding that this topic focused mostly on using the results of ongoing work rather than proposing anything different be done. Tom Arsuffi and Cindy Loeffler agreed. Chad Norris, responding to a question from Charlie Kreitler, noted that there might be further understanding that could be gained from genetic work in addition to what has been done or is ongoing. Chad Furl indicated that the CSRB Work Group is not considering the issue of genetics—it is not within its charge. Chad Furl indicated that for the refugia work, the decision is to wait for Will Coleman to complete his work before initiating genetics work at the refugia.

He also indicated that genetics work has been done, in addition to the ongoing study by Will Coleman, and which he understands to indicate pervasive gene flow amongst CSRB populations (Lucas 2016). Chad Furl clarified that refugia work that will include consideration of genetics will be seeking to address different questions than this Work Group. With respect to the question of interaction with the CSRB Work Group, Myron indicated his understanding that the charge of the CSRB Work Group is to address a limited, and different, set of questions regarding CSRB than what the SHP Work Group is discussing. Chad Furl confirmed the specific topics covered by the CSRB Work Group. Chad Norris indicated the valuable contribution that genetics work can provide.

The discussion then led into a proposed motion by Myron Hess, which was seconded from Charlie Kreitler. After subsequent discussion, the initial motion was revised. The motion was later reduced to writing as follows.

Motion to Define Prioritization for Further Work Group Consideration Under Issue 2

Issue 2: The Implementing Committee should ensure a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on Comal Springs riffle beetle (CSRB) populations.

Motion by Myron Hess, second by Charles Kreitler, and later amended upon the suggestion of Jacquelyn Duke and Tom Arsuffi (made orally during August 21, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 2 for consideration in Part 2 of the Work Group's charge related to impacts of extended periods of flow below 80 cfs on CSRB populations. Topics included under the topic area, or theme, of "substrate, subsurface well, and spring opening investigation of CSRB habitat" but with the removal of the topics specific to substrate investigation, with the addition of monitoring of spring openings in Spring Lake that are proximal to CSRB habitat to assess which openings continue to flow at different levels of low overall flow, and with the addition of the consideration of genetic studies and the results of those studies focused on understanding how low springflow may impact CSRB populations and, particularly, local adaptations exhibited by CSRB associated with different springflow areas.

8. **Overarching Issue 3 *discussion* regarding potential areas of focus**
Myron Hess presented the statement of Issue 3. Attendees used Mentimeter to provide questions and comments for consideration in addressing the issue.

9. **Approach for categorizing AMP study topics under Issue 4**
Myron Hess described a possible approach to addressing Issue 4 by categorizing the adaptive management study commitments he identified from a review of the Edwards Aquifer Habitat Conservation Plan.

10. **Public comment**
There were no public comments.

11. **Future meetings**
The next meeting is scheduled Wednesday, September 9, 2-4pm.

Theme	Issue 2 should be given to the CSRB Work Group.	Use CSRB Work Group analysis and expertise to inform our work.	Low springflow and impacts on CSRB populations, survival, and life stage development.	Use results of genetic testing to inform study efforts.	Substrate, subsurface well, and spring opening investigation of CSRB habitat.	Study CSRB in San Marcos.	Regular monitoring rather than "experimental habitats."	Adaptive Management Process.	Additional springflow studies.
	CSRB issues should go to CSRB work group	We may have heard from participants of the beetle (CSRB) during these sessions I am much more inclined to leave the science up to the specialized consideration of this groups work - Can someone update for the group?	Does the low flow condition affect the reproduction or life stage development of the beetles even if they can migrate to subsurface layers? Population studies should look at more than just if they can live under those conditions.	The Genetics work that lends itself to the population level understanding appears promising to follow-up on	Subsurface wells investigation for habitat extent and impacts subsurface understanding were suggested during WG sessions	What about CSRB at San Marcos Springs? Why have they never been considered or mentioned?	Data analysis of regular monitoring and special study data could provide insights on survival of CSRB adults and larvae. "Experimental habitats" have limited potential in comparison to analysis of existing / forthcoming data.	USFWS regs. require HCP and ITP's to include adaptive management processes. Is it fair to say or ask that studies on CSRB that are being done may require time before AMP.	Conduct forward modeling of low flow using future climate change predictive models for conditions within the CS and SM segments of the Edwards Aquifer.
	Don't we have a CSRB science committee that handles studies for this species?	Consider how best to partner with CSRB work group to help us work through interpretation of scientific studies	Refer to Dr. Nair's dissertation chapter on CSRB water temp and DO limits	Though I am supportive of shallow bio-wells investigations I would like to see some of the less invasive genetic or modeled habitat extent calculations of population before proceeding.	Which spring openings will still be flowing below 80cfs and what is CSRB habitat like at those locations/flows?	Are the limited beetles in San Marcos same as Comal?	Use of the monitoring database could add insights unavailable from the well designed but temporally limited studies currently being conducted by TSU.		Calibrate the Hardy model with most recent extended low flow data
	Prior to knowing the results of CSRB work group how do we address this? The HCP assumes some wet area and not all will be de-watered meaning likely recovery. I am not sure what more can be done other than study.	Wasn't there work to attract or look at broader beetle work and or experts - did this result in any that looked at their dependence to wetted regimes?	What are the 'normal' beetle population fluctuations, and how do low flow (<80cfs) alterations differ from this? Are the beetles dying off or are beetles simply migrating deeper into the springs?	Before we have the ability to determine CSRB retreat into orifices and re-emergence as safeguard against low-flow, we need to wait for some of the genetics/capturing studies to be advanced.	Unclear on the substrate survival concern for CSRB at low flows given survival for months during the drought of the 50's?	Monitoring spring flow output in spring lake proximal to CSRB habitat - how do these springs respond to low flow conditions?			

Theme	Issue 2 should be given to the CSRB Work Group.	Use CSRB Work Group analysis and expertise to inform our work.	Low springflow and impacts on CSRB populations, survival, and life stage development.	Use results of genetic testing to inform study efforts.	Substrate, subsurface well, and spring opening investigation of CSRB habitat.	Study CSRB in San Marcos.	Regular monitoring rather than "experimental habitats."	Adaptive Management Process.	Additional springflow studies.
	Appropriate salvage take during low flows.	Looking forward to CSRB WG results to be able to better program!	The current modeling being done with the occupancy survey data will be hard pressed to say much about low spring flows, or the relationships between flow and abundance/ CSRB count.		Investigate substrates in spring runs.				
	"Based on NAS shouldn't focus be on appropriate take assessment/accou nting?- again not withholding we are still studying a lot."				Evaluate flow paths for major spring features at Comal Springs				
					Installing shallow well for CSRB habitat evaluations has the potential to connect conduits that were not previously connected. What safeguards would be appropriate?				
					Hydrogeologic investigations of the shallow subsurface at Comal Spring/ Landa Lake.				
					(1) Developing a spatial-temporal map of which springs stop flowing as spring flow decreases, (2) evaluate how these changes influence CSRB suitable habitat availability, and (3) measuring/modeling CSRB habitat availability and connectivity between springs which cease to flow and more persistent spring flow orifices as spring flow decreases.				

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					Additional detailed geology could be obtained with shallow geophysical surveys run along both the down thrown and upthrown blocks. A similar survey was conducted at Barton Springs and showed some interesting anomalies. Most of the CSRBs appear to be associated with springs directly discharging from Edwards Limestone on the western wall of the lake (upthrown block). CSRBs do not appear to be prolific in the surface alluvial sediments on the downthrown side. Geophysical surveys on the upthrown block along the lake front would be difficult, but possible. Electrical anomalies might indicate presence of cave features. A grid-oriented survey on the down thrown block might also indicate anomalies in the shallow subsurface that might indicate the presence of caves.				
					Monitoring groundwater levels from the upthrown and downthrown blocks during low spring flow. I am not sure whether water level data are still being collected from the LCRA well or the Panther Canyon well. Both of these wells, however, monitor relatively deep conditions of both fault blocks, and do not monitor shallow groundwater conditions where CSRB may live. A shallow monitoring well on the upthrown block could be installed in Panther Canyon. A shallow monitoring well of the surface geology/ soils overlying the downthrown block could be installed in a flat area east of Spring Run #3. Drilling data of these two wells would be integrated into any proposed geophysical surveys to help ground truth electrical data.				
					Subsurface flow paths of the areas CSRB could "retreat" to; food resources when flows are low; monitoring of flow rates during low flow conditions.				
					How do subsurface flow paths change? Where do the beetles go?				

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					Why do we make the assumption that the CSRB are fragile and not able to handle low? They survived the drought of the 50's. We truly do not know near enough about the CSRB to make assumptions.				
					I'm unclear on the sedimentation concern below 80cfs, since at those low flows it hasn't rained for a while and if it does won't there be a flushing effect?				
					Spring Island has highly sedimented over the decade and springs are covered in silt. Is anything going to be done to restore the habitat?				
					With extended periods of drought, rainfall events will occur periodically and wash sediments into habitat. Consider studying potential impacts.				
					Need to understand how riffle beetles can survive extended periods in substrate.				
					Where do the beetles go during low flow?				
					Spatial habitat modeling to evaluate changes in spring flow orifices and flow conditions from declining flows below 80cfs, with CSRB habitat and connectivity between CSRB habitats.				
					Evaluate probable changes in sedimentation and key water quality parameters like salinity that could affect habitat of the CSRB at low flows.				
					What happens to individual spring openings as flows drop below 80?				
					Undertake flow assessments of flow at individual spring openings in Comal system during low flow periods.				

Theme	Issue 2 should be given to the CSRB Work Group.	Use CSRB Work Group analysis and expertise to inform our work.	Low springflow and impacts on CSRB populations, survival, and life stage development.	Use results of genetic testing to inform study efforts.	Substrate, subsurface well, and spring opening investigation of CSRB habitat.	Study CSRB in San Marcos.	Regular monitoring rather than "experimental habitats."	Adaptive Management Process.	Additional springflow studies.
					Additional hydrologic/ dye studies that may better define flow paths to springs associated with known riffle beetle habitat. It appears that most of the riffle beetle habitats are associated with limestones springs on the upthrow block at Comal Springs and San Marcos Springs (Hotel Springs). Under low flow conditions (>80cfs) it will be important to know which springs have the highest population of beetles and which springs are most prone to going dry. This can be tested by a.Estimate the number of individuals at each spring or spring complex to define which springs/spring complexes are the most critical to maintain. b.Determine the elevations of each spring/spring complex to determine which spring/spring complexes will go dry first with declining spring flows and water levels, primarily in the upthrown block (monitoring in Panther Canyon well). c.Water level data for Panther Canyon and LCRA data should be available. Data transducers should still be collecting data from theses two wells. If low flow evaluation for the drought period of "2012" has not been done, it should. d.Determine discharge rates for critical springs at low flows. Difficult task. e.Dye tracers studies. Review all previously conducted dye studies at Comal Springs to possibly determine flow paths from the upthrown block to individual springs. If possible conduct new dye studies during low flow conditions to substantiate important flow paths.				

Springflow Habitat Protection Work Group

Meeting 9 Minutes
September 9, 2020
2:00-4:00pm

1. **Confirm attendance**
   All Work Group members were present.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics, meeting points of contact, and Work Group logistics.

3. **Public comment**
   No public comments.

4. **Approve meeting minutes**
   An amendment was proposed to Meeting 7 minutes on page 2 in the second paragraph regarding Patrick Shriver's comments related to pollutant concentration during low flow conditions. A motion was made by Myron Hess, seconded by Ryan Kelso to approve the meeting minutes from Meeting 7, as amended (August 6, 2020). In the absence of objection, the minutes were approved by consensus.

5. **Issue 2 Motion discussion**
   Myron Hess opened the floor for comments regarding the Issue 2 final draft Motion from Meeting 7. There were no comments.

6. **Mentimeter Issue 3 prioritization poll results presentation**
   Jamie Childers presented Menti poll responses from the 9 participants on Issue 3 theme prioritization. In order of preference, the results were Recreation Impacts and Management with the highest ranking, followed by Habitat Management, Spring Discharge, Dam Impacts, Sedimentary Study, and then Genetics, in that order.

7. **Overarching Issue 3 discussion regarding prioritization**
   Genetics
   Charles Kreitler advocated for the removal of the Genetics theme due to a disconnect with the overall focus on low flow issues. Myron Hess also expressed uncertainty about how genetics information would inform flow issues.

   Sedimentation Study

Cindy Loeffler posed the question of sedimentation rates during low flow events in the absence of flushing from spring flows. Myron Hess noted potential impacts on the San Marcos Salamander, acknowledging the unaccounted-for sediment impacts below the dam and noted that a topic under the Spring Discharge theme does include consideration of sedimentation associated with low springflows and effects on San Marcos salamander, although not directly addressing areas below Spring Lake.

Dam Impacts

Charles Kreitler noted the east side of the dam is higher than the west side. He noted previous recommendations that the dam be configured to direct water to the east side towards endangered species' habitat and not over the west side during low flows. He suggested follow-up to assess if that change was made. Kimberly Meitzen raised a question about how recent repairs may have affected that aspect.

Chad Furl indicated that crest height did not change on the spillway's east or west side. He added that construction was on the lakeside and downstream side, not the crest, but did reduce leaks on the eastern side.

Tom Arsuffi raised a question about the effect of water depth in Spring Lake, in terms of pressure, on flow from the springheads.

Melani Howard brought up 90s study, by Kenneth Saunders and Kevin Mayes, that may have addressed spring head pressure. Cindy recommended the topic be included under springflow discharge relating to how the manipulation of boards in the dam may affect outflows.

Kimberly Meitzen voiced concern about temperatures-- if Spring Lake levels are lower, the side slough feeding eastern side of dam warms up and is warmer than the western side of the dam. She noted concern for suitable temperatures for San Marcos salamanders below the eastern spillway of the dam.

Charles Kreitler recalled a bit of history regarding a potential lawsuit over the dam board height arguing for lowering dam board heights with an aim of higher flow downstream for increased recreation. Previous studies concluded that lowered boards would impact hydrodynamics of the Edwards Aquifer via faster drainage.

Jamie Childers cited the Spring Lake Management Plan and management of lake discharge. She questioned how the surface water permit was acquired.

Dianne Wassenich explained that the water rights were issued before lake management issues were addressed and cited Andy Sansom as an expert on those rights. She recalled quibbles over adding board to the dam, during low springflow, for glass bottom boats and counter arguments from kayakers wanting more flow downstream. She recalls that a TPWD (Texas Parks and

Wildlife Department) study indicated changing of height was negligible to springflow. Dam board changing now requires public notice, all of this existing outside of HCP. Melani Howard pointed out that the Spring Lake management plan is referenced in HCP.

Jamie Childers noted diversions is a covered activity under incidental take permit for Texas State University and is dependent on USGS flow meter downstream. Melani Howard mentioned the list of agencies that must be notified of dam board changes.

Patrick Shiver asked for clarification, outside of levels of take, on the topic of the salamander location in relation to flow over dam. How are they doing and how have they done regarding surrounding changes as acknowledged in Meeting 2?

In response to an inquiry, Ed Oborny remarked that the salamanders below the eastern spillway are doing well given habitat changes. Their largest issue is increased sedimentation from changes to upstream vegetation. He reminded the group not to discount that salamanders also occur on the western side below the dam, where they are harder to sample. He also noted that the big impacts could come from recreational activity, habitat management particularly related to aquatic vegetation, and discharge. Have not seen big differences in temperature between east and west sides at flow levels experienced recently.

Spring Discharge
Charlie Kreitler noted springflow at San Marcos has always been reasonable. Monitoring of spring discharge from the bottom of the lake is a complex problem and would require higher spending for increased data which may not yield many insights. He also noted that Benjamin Schwartz may have done more work on springflow in Spring Lake.

Myron Hess mentioned changes in ratio of outputs at lower flows in the bottom of the lake from the northern end in comparison with the southern end as an issue of interest. Cindy Loeffler echoed the importance of monitoring Spring Lake spring characteristics during low flow conditions.

Patrick Shiver asked Charlie Kreitler about the relation of his comment on springflows to the procedures of measurement. Charlie referenced the potential for lower accuracy and difficulty in measuring flow at an individual orifice in the lake.

Habitat Management
Myron Hess polled the group regarding an understanding of covered issues under this broad topic.

Patrick Shriver brought up vegetation management and managing differing response and interaction with the environment as springflow changes.

Melani Howard indicated a desire for more information on specific aspects of management e.g. the question of the effect of managing vegetation below the spillway on salamander status.

Kimberly Meitzen suggested the issue might be bundled with the first issue of recreation management because habitat management is affected by recreation management. Charlie Kreitler seconded the importance of recreation management and the relationship to habitat management.

Finalizing three topic areas (or themes)
Myron asked the work group about focusing on recreation impacts and management, habitat management, and spring discharge as the themes under Issue 3. Melani Howard advocated for inclusion of Dam Impacts over Spring Discharge. In response to Melani's comment, Myron suggested including the three themes with the addition of studying how water flows over the dam between 80 and 45 cfs. There were multiple expressions of support.

Charles Kreitler stressed the importance of Recreation Impacts and Management of how a short period of low flow combined with a weekend of heavy recreation by students could undo years of effort and dollars.

Kimberly Meitzen agreed and noted people are entering the river through unofficial access points (the culvert under Sessom). People are setting up chairs and hanging out below eastern spillway even during the period of reduced recreation with minimal enforcement or signage. She noted protection signs face upstream, not informing those traveling upstream, which is happening more often. She noted river is above carrying capacity for recreation and also advocated for increased education and enforcement.

Melani Howard highlighted that Conservation Crew have been pulled off the river due to Covid-19 so behaviors going unchecked.

A motion was made by Myron Hess, seconded by Melani Howard, to approve the topic areas (themes) of Recreation Impacts and Management, Habitat Management, and Spring Discharge with the inclusion of consideration of distribution of flow over the dam during periods of 45-80 cfs. During discussion members did not indicate concerns or objection to the motion. The motion was later finalized in writing as follows.

Issue 3: The Implementing Committee should ensure that a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on San Marcos salamander populations, particularly for populations in the area below Spring Lake dam, and on Texas wild-rice and other vegetation serving as habitat for fountain darters downstream of Spring Lake dam, including consideration of impacts from recreation.

Motion by Myron Hess, second by Melani Howard with no further discussion (made orally during September 9, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 3 for consideration in Part 2 of the Work Group's charge related to potential impacts of predicted extended periods of flow below 80 cfs on San Marcos salamander populations, particularly for populations in the area below Spring Lake dam, and on Texas wild-rice and other vegetation serving as habitat for fountain darters downstream of Spring Lake dam, including consideration of impacts from recreation:

Topics included under the topic area, or theme, of Recreation Impacts and Management, Habitat Management, and Spring Discharge and with the understanding that further consideration of the distribution of flow over the Spring Lake Dam between 80-45 cfs total flow also is included.

8. **Overarching Issue 4 discussion regarding categorizing and focusing study topics**

   Myron Hess described potential starting points for assessment of status of studies included in the document "Adaptive Management Studies Referenced in Chapter 4 and 6 of EAHCP": no obvious inconsistency with EAHCP study commitments (green highlights), permit extension issue (turquoise), and Work Group priority subset (red). Myron made clear that the entry in the work group recommendation column is a possible starting point and is in no way a final decision. The group discussed the statements pulled from the EAHCP summarizing study commitments and discussed a process for characterizing and carrying forward studies from this list. Patrick Shriver noted the importance of differentiating science from policy and not prejudging management decisions. Members agreed to spend time with the document before the next meeting and provide comments for discussion.

9. **Public Comment**
   There were no public comments.

10. **Future Meetings**
    The next Work Group meeting will be held on Wednesday, September 23 at 2:00-4:00pm.

Theme	Comment
Dam Impacts	Can we have further connection of how the dam impacts flow in the below Spring Lake specificity???
Dam Impacts	When it comes to San Marcos salamander why are we specifically separating out the populations below the dam?
Dam Impacts	What are the temperature thresholds for the SM salamander and how will low flows promote higher temps in the area that drains above Spring Lake Dam? And, will these potentially higher temps be a problem for the salamander?
Dam Impacts	Several years ago we had the spillway elevation of the dam surveyed and found that the eastern end of the dam was higher than the western end. So that at low flow periods most of the discharge would be on the western side rather than on the eastern side where the San Marcos salamander lived below the dam. I believe this was changed when restoration work was done on the dam so that more flow from the lake went to the eastern side..
Dam Impacts*	What are the impacts of dams on sediiment movement?
Genetics	The genetic relationship between SM salamander populations and those collected from western Edwards plateau springs, within the contributing and recharge zones.
Habitat Management	We received early presentations on this item that I recall did not indicate concerns with current in place gardening and controls.
Habitat Management	Impacts to: population size, reproduction and survival, prey base, water quality, sediment impacting habitat, changes in vegetation. Also if there's ways for management to mitigate impacts of low flows on habitat.
Habitat Management	Establish a mapped baseline of habitat necessary to maintain minimal fountain darter populations - this provides a tool for decision making on behalf of local, state and federal agencies.
Habitat Management	Habitat availability is a reflection of flow conditions - how are those conditions being influenced by management of human activity as they near 30 cfs? And earlier? Should there be additional controls based on evidence?
Recreation Impacts and Management	What specific recreational impacts exist and what are their data-supported impacts to wild-rice and fountain darters?
Recreation Impacts and Management	Recreation and TWR: re-evaluating exclosures in the SSA to ensure they are in the most effective placement for TWR, and recommendation to include more closed areas triggered by low flow conditions as wadeable areas shift/change with decreasing flow levels.
Recreation Impacts and Management	Evaluate approaches for delineation of recreational exclosures that provide readily available information to adjust boundaries in response to changes in flow and vegetation coverage.
Recreation Impacts and Management	Impacts recreation will have on species when flow is low. Work with biologists from state and federal. How prepared refugia is for salvage events and for how long it is reliable.
Recreation Impacts and Management	Not a study need, but a recommendation for an official SSA 'exclusion' and signage to protect the salamander habitat below Spring Lake Dam from recreation impacts (people wading and sitting on the rocks below the dam).
Recreation Impacts and Management	Evaluate approaches for adjusting recreational exclosures in area just downstream of Spring Lake Dam to protect SM salamander as occupied habitat changes.
Recreation Impacts and Management	Develop updated bathymetry data/map for the San Marcos River to evaluate SAV and wadeable areas to inform areas threatened by recreation impacts during low flow.
Recreation Impacts and Management	Recent photographs in the Austin American of the recreational use of the San Marcos River were eye opening. The river was absolutely packed with people mostly without masks, which was the point of the article. In an extended low period, we should expect to see even more people “bathing”. It may not be stoppable. So much for the wild rice!
Sedimentation Study	Specifically look at sedimentation as a result of decreased flows. How important is clearing vegetation from around all potential salamander habitat as flows decrease? Will that enhance salamander success during low flows?
Sedimentation Study	What is the effect of low flow on sediment accumulation?
Sedimentation Study*	Monitor changes in spring flow emergence within Spring Lake during periods of flow below 80 cfs to better understand sedimentation and potential impacts on SM salamander.
Sedimentation Study*	What are the impacts of dams on sediiment movement?
Spring Discharge	Consider the change in Spring Lake Springs also. What happens to available salamander spring habitat in the lake as flows drop?
Spring Discharge	Most of the spring discharge probably comes from the upthrown block and not the deeper confined section. There may not be any discharge from the deeper confined section as is observed at Comal Springs. Deep confined discharge may stop at Comal Springs.
Spring Discharge	The discharge curves for San Marcos Springs are very different than for Comal Springs. The spring flow for Comal can be very spiky, correlates very closely to J-17 water levels (in San Antonio), San Marcos Spring flow does not. Often San Marcos flows do not track Comal Springs. Spring flow at San Marcos often shows flood events on the Guadeloupe River.
Spring Discharge	Spring discharge is predominantly from the bottom of Spring Lake. The only location for discharge from the cliff face on the western side is from Hotel Springs. It is interesting to note that the southern springs are slightly warmer than the northern springs and have a small difference in chemistry. The northern springs may be more locally sourced whereas the southern springs may come from a more regional flow in the Edwards.
Spring Discharge*	Monitor changes in spring flow emergence within Spring Lake during periods of flow below 80 cfs to better understand sedimentation and potential impacts on SM salamander.

*Comment was put into multiple themes

Adaptive Management Studies Referenced in Chapters 4 and 6 of EAHCP

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation?
Comal Springs				
A. "This objective assumes that a 10 percent deviation in average conditions would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of the fountain darter will be addressed as part of the AMP."	Page 4-5 repeated at page 4-27 Issue CS 1	- Low-flow food source threshold study (BIO-WEST 2013) - Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) - Effects of predation on fountain darters (Texas State University and BIO-WEST 2014) - Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b) - Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		No obvious inconsistency with EAHCP study commitments.

B. "This objective assumes that a 10 percent deviation would be acceptable. More extensive work to evaluate and assess water quality tolerances of the Comal Springs riffle beetle will be addressed as part of the AMP."	Page 4-12 Issue CS 2	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b)		No obvious inconsistency with EAHCP study commitments.
C. Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "This goal assumes that a 10 percent deviation would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of these species will be addressed as part of the AMP."	Page 4-15	None.		Permit extension issue
D. Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "As such, semiannual drift net sampling for both species will be continued in the context of the AMP during Phase I, and this additional data will be evaluated with the intent of establishing population metrics for these species for Phase II of the HCP."	Page 4-15	Semiannual drift net sampling has continued during Phase I for these species. No 'population metrics' have been established.		Permit extension issue

E."At this time, it is uncertain whether 196 cfs as a long-term average would be supportive of the conditions necessary to rejuvenate the system to the degree that would be necessary to prepare the system for repeated low-flow periods or extended low-flow periods. This rejuvenation of habitat is important not only to the fountain darter, but to all Covered Species at Comal Springs. This question will be examined in the AMP."	Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue

F. "In addition, the projected extended periods of consecutive days below 150 cfs, 120 cfs, and 80 cfs for the HCP will require additional evaluation during the Phase I AMP. Each of those three flow levels is a take threshold. At 150 cfs, take for the fountain darter starts to occur in the Upper Spring Run reach. At 120 cfs, Spring Runs 1 and 2 start to constrict and go subsurface, and below 80 cfs Spring Run 3 also constricts and goes subsurface." "Relative to the fountain darter, during the drought of record the system was below 150 cfs for 1,063 straight days (nearly 3 years). With the Phase I and Phase II flow-related measures in the HCP, the consecutive period below 150 cfs is projected to be approximately 2,760 days (or over 7.5 years). That is longer than the Phase I period itself, and approximately 3 times the life span of a fountain darter in the wild. With respect to the Comal Springs riffle beetle, during the drought of record, springflow in the Spring Runs 1 and 2 were below 120 cfs for 750 consecutive days (just over 2 years straight) and the riffle beetle as well as the other Covered invertebrate species survived. However, even with the flow-related measures (Phase I and II), flows below 120 cfs are projected for approximately 2,400 consecutive days (over 6.5 years). During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed."	Page 4-56	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue? WG priority subset: Recompute duration statistics with Phase II flow regime and additional flow increments?

G. During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed.	Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		No obvious inconsistency with EAHCP study commitments for Fountain Darter; Permit extension issue for other species
H. "A concern noted in Hardy (2011) is that at 30 cfs total Comal springflow, there is the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel. This could affect water quality in the Old Channel and the success of the proposed ERPA, and, thus, this flow pattern is proposed for study during Phase I."	Page 4-74	Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits		WG priority subset/ Overlap with WQ

I. "Three main concerns noted in Hardy (2011) regarding this flow regime were 1) the potential for aquatic vegetation die-off and subsequent dissolved oxygen (DO) problems in Landa Lake, 2) the reduction in larval production of fountain darters that would likely be experienced, and 3) the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel, which could result in water quality impacts, including higher temperatures, greater than currently predicted in the Old Channel. Regarding the first concern, the aquatic vegetation question remains unanswered and assessing aquatic vegetation dynamics relative to springflow is a critical applied research component in the AMP. … The third concern is directly related to uncertainty associated with the temperature modeling and will require additional hydrodynamic modeling with follow-up water temperature modeling in addition to intensified spatial monitoring during low-flow events, which are proposed HCP research components."	Page 4-88	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits		1. and 2. No obvious inconsistency with EAHCP study commitments. 3. WG priority subset/ Overlap with WQ

		-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		
J. "Applied research and modeling conducted during Phase I are anticipated to provide valuable information on the low-flow requirements and subsurface habitat use of the Comal Springs riffle beetle, which will inform any Phase I and Phase II adjustments that may be necessary. (See, e.g., Section 6.3.4.2). From the statistical flow analysis presented in Table 4-30 it is evident that periods of low-flow will be extended for the HCP alternative compared to what was historically observed. As discussed in Section 4.2.1.3.1, this along with the long-term average flow management objective will need to be evaluated during Phase I activities.	Page 4-106	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b)		No obvious inconsistency with EAHCP study commitments.

		-Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017) -Comal Springs Riffle Beetle (Heterelmis comalensis): Life History and Captive Propagation Techniques (BIO-WEST 2018)		

K. Comal Springs Dryopid Beetle and Peck's Cave Amphipod "A concern identified, during these low-flow periods which will require further research includes the impacts to the energy flow regime in the Aquifer and near the springs."	Page 4-108	None.		Permit extension issue

L. "A key unknown is the tolerance of native aquatic vegetation to reduced flow conditions in these systems. The timing and duration of these low-flow events will be studied relative to the native vegetation, starting with the plant species identified in the long-term biological goals for the fountain darter. Decay of the above ground and below ground biomass will be measured over time. Above ground biomass is important for Covered Species habitat while below ground biomass is critical for root establishment and holding the plant in place during any subsequent pulse event. Water quality will be continuously measured to evaluate the before, during, and after effects of vegetation decay on water temperature, dissolved oxygen, carbon dioxide, and pH. Additional water quality parameters such as nutrients may also be studied. In addition to studying the effect of vegetation decline, decay and ultimately death, studies will be designed to evaluate recovery of native vegetation following various stages of aquatic vegetation decline and decay.	Pages 6-8 and 6-9	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Suspended sediment impacts on Texas wild-rice & other aquatic plant growth characteristics & aquatic macroinvertebrates (Crawford-Reynolds et al. 2017) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000		No obvious inconsistency with EAHCP study commitments.

		to 2015 (Hutchinson and Foote 2017) -Landa Lake DO mgt plan -EAA RTWQ network -EAHCP WQ/Biomon monitoring		
M. Another critical component of fountain darter habitat that is presently unknown is the relationship of macroinvertebrates (fountain darter's main food source) to low-flow conditions. Studies will be designed to evaluate the simulated effects of changing water quality conditions and aquatic vegetation composition on the macroinvertebrate (mainly amphipods) community. … Similar to the aquatic vegetation study, not only will simulated impacts be assessed during extended periods of simulated low flow, but recovery following these periods will be studied to learn response time (amphipod recovery) following a severe event.	Page 6-9	-Low-flow food source threshold study (BIO-WEST 2013)		No obvious inconsistency with EAHCP study commitments.

N. The first step will be to assess the survival success of adults. Once an adult population is established, flow manipulations will be performed to study the affinity of riffle beetles to flow and to track movement from surface to subsurface habitats and vice versa. The immediate goal is not to establish a reproducing riffle beetle population but to evaluate movement patterns of riffle beetles during periods of varying springflow.	Page 6-9	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017)		Permit extension issue

O. Once a population is established in the experimental habitat, extended periods of low-flow will be tested to evaluate the effect of these periods on riffle beetle survival and habitat use. Surface habitat will be completely removed for extended periods of time, water quality will be altered to simulate extreme conditions, and other factors adjusted (e.g., reductions in leaf material or detritus, etc.) to simulate conditions that might be experienced in the wild during these conditions. As with other proposed Tier A efforts, recovery following impacts will also be investigated.	Pages 6-9 and 6-10	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017)		Permit extension issue

P … the concept of spring run connectivity will be tested. This will involve simulating subsurface habitat cutoff from surface habitat and riparian detritus, and subsurface habitats that are connected to surface habitats via the trickling of water across the surface habitat. This is a key study to assess the value of this concept as an additional protection measure in Spring Run 3 of the Comal system as discussed in BIO-WEST (2011).	Page 6-10	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)		Permit extension issue
Q A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to fountain darters. A whole host of questions can be addressed under this topic with just a few examples including: • when and where do darters move as vegetation decays and water quality deteriorates; • when does reproduction stop or does it; • does compensatory reproduction get triggered, and if so, when and what causes it; and • what is the effect of predation on fountain darter population size?	Page 6-10	-Low-flow food source threshold study (BIO-WEST 2013) -Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) -Effects of predation on fountain darters (Texas State University and BIO-WEST 2014) -Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b)		No obvious inconsistency with EAHCP study commitments.

R A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to Comal Springs riffle beetles. A core question is: when are reproduction and survival compromised as physical habitat (surface and subsurface) declines and water quality deteriorates? The reproduction component assumes that a reproducing population can be established in the study habitat during Phase I. If a reproducing population is successfully established, this flow manipulation research could be expanded to include evaluation of desirable and threshold environmental conditions for larval and pupae stages.	Page 6-10	Reproducing populations haven't been established		Permit extension issue for reproduction WG priority subset for survival aspects
S Towards the end of Phase I, specific studies will be designed and conducted to test the validity of ecological model results. This may involve simple or complex parameters and single or multiple low-flow events depending on Phase II questions that may be relevant at that time.	Page 6-11	None.		WG priority subset
T The initial activity will be the evaluation of alternative methods for snail removal so that removal can be accomplished in the most effective, yet least destructive manner. The second activity deals with understanding the magnitude of snail removal necessary to affect downstream cercaria concentrations in the water column. Once the magnitude of snail removal for effective control of water column cercaria is identified, a study is necessary to evaluate the long-term benefits of that removal.	Page 6-13	None.		Permit extension issue
U Should it be determined during applied research conducted at the NFHTC during Phase I that spring run connectivity is effective and that additional protection may be required for the Comal Springs riffle beetle, then	Page 6-18	-Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)		Permit extension issue

some version of that component may be implemented during Phase II.				
V Comal Springs Dryopid Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer; • Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate.	Page 6-19	Life history of CSDB is currently underway with Refugia program.		Permit extension issue
W Edwards Aquifer Diving Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer; and • Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate.	Pages 6-19 and 6-20	None.		Permit extension issue

San Marcos Springs				
X "To be conservative, the long-term goal assumes that a 10 percent deviation would be acceptable; however, more extensive work to evaluate and assess the validity of that assumption and the water quality tolerances of the Texas blind salamander will be considered in the AMP."	page 4-35	None		Permit extension issue
Y "Although the projected long-term average flows are not concerns, the extended periods of consecutive daily average flows under 100 cfs and 80 cfs were examined. At 100 cfs, take for the fountain darter and impacts to Texas wild-rice have been documented. At 80 cfs, take is anticipated for the San Marcos salamander. Unfortunately, there is not a duration factor (i.e, memory) incorporated into any of the basic habitat modeling conducted for the incidental take analysis presented below. As such, a future evaluation of these potential impacts will be addressed with Phase I applied research and mechanistic ecological modeling."	page 4-62	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue
Z "As discussed for Comal Springs, during Phase I, applied research on the effects of low flows on the Covered Species and their habitat at San Marcos Springs will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I Package will be improved. Until the Phase I AMP decision-making is complete, it is not known whether additional flow protection measures might be necessary or what duration might be acceptable, or amount of additional flows that might be needed."	page 4-63	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue for species other than fountain darter For fountain darter, no obvious inconsistency with EAHCP study commitments.

AA An assumption was made that a minimum number of salamanders would survive in Spring Lake as long as some springflow was provided. Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows. It has been observed in Landa Lake (Comal system) that as upwelling springs in the Upper Spring Run area cease flowing, siltation ensues and salamanders retreat from those areas. Although observed at Comal Springs, flows have not reached a level over the past decade at San Marcos Springs to cause a similar condition in Spring Lake, and as such this assumption is currently unfounded. Similarly, establishing a cutoff point on habitat suitability within Spring Lake would be equally unfounded at this time. This again highlights the importance of the applied research and mechanistic ecological modeling to be developed for this species as part of the AMP.	Page 4-140.	None		WG priority subset

Springflow Habitat Protection Work Group

Meeting 10 Minutes
September 23, 2020
2:00-4:00pm

1. **Confirm attendance**

   All Work Group members were present.

2. **Meeting logistics**

   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   No public comments.

4. **Approve meeting 8 minutes**
   A motion was made by Cindy Loeffler, seconded by Patrick Shriver, to approve the meeting minutes from Meeting 8 (August 21, 2020). In the absence of objection, the minutes were approved by consensus.

5. **Issue 3 Motion discussion**
   No issues were raised regarding the written version of the Issue motion. It will be incorporated for consideration of Part 2 of the Work Group charge.

6. **Discussion of summary of Issues 1 through 3 for the Part 2 Charge**
   Jamie Childers and Myron Hess have begun development on summary document that will serve as Part 2 of the Work Group Charge and will consolidate meeting material, drafted motions, and comments and summarize activities from Part 1 of the Work Group. This document will eventually be presented to the implementing committee and, upon approval by that committee, will become the Part 2 charge. The current version of the draft is available in the Chat section of the Teams site for the Work Group and is named "10_part 2 discussion document.pdf." Jamie has developed question that can be used, going forward, in development of proposals for technical evaluations.

   One of the goals for Part 1 was to clarify and refine the broad issues set out in the May 2019 discussion document. Along those lines, Jamie has pulled questions from comments on each of the overarching issues covered by the group. Some of these questions could be answered now, while others require further study. At the end of the document is an updated version of the table from Part 1 of the Work Group Charge, containing a "study set a" and "study set b" to further clarify the Work Group process moving forward.

Myron Hess announced his aim for this meeting regarding the draft as focusing more on consideration of the overall approach than on specific language. If the approach is agreed upon, a revised version would be sent out to the group.

Charles Kreitler raised the question of garnering expert input in refining the questions. Jamie Childers noted that some questions probably are sufficiently developed to support development of a scope of work, such as validating the Hardy model to 2014 data, but for others will need further input. Myron Hess added that for some questions, "set a" studies may be contracted out to experts to recommend a specific study approach that might be undertaken.

Kimberly Meitzen inquired about whether this effort may be a combination of HCP staff denoting what they can accomplish internally and what needs to be put into statements of work to put up requests for proposals and seek contractors. Jamie responded that scopes of work will need to be defined to inform any decision about relying on staff resources versus contractors. Additionally, there is a need for consideration of which questions are feasible to pursue at this juncture.

Cindy Loeffler and Doris Cooksey voiced support for the proposed report format.

7. **Discussion of the process for submitting a Part 2 Charge**
   Myron Hess stated his aim to have the Part 2 Charge completed for the December 17th Implementing Committee meeting with Work Group meetings in October and November to get that done. Patrick Shriver noted the need for adequate time to review drafts, noting, for example, the amount of time required for review of each of the topics in the Issue 4 matrix.

   Charles Kreitler mentioned that various Issue 4 AMP (Adaptive Management Process) recommendations will fold into the original three issues discussed and noted the need for integration of the inquiries into the other major issue areas.

8. **Overarching Issue 4 discussion regarding categorizing and focusing AMP study topics**
   Previously, the two focuses of the group were 1) what are the appropriate categories for topics under the AMP list and 2) focus on priority topics for the Work Group. The aim of this discussion was to reach agreement on appropriate categories and what would fall into the Work Group priority list.

   In Part 1 of the Work Group Charge, Issue 4 is as follows: The Implementing Committee should ensure that a rigorous review process, involving input from qualified experts in addition to the Science Committee, is undertaken, as soon as reasonably possible, to inform study design for each of the above-listed technical evaluations and to assess the extent to which adaptive management study commitments included in the EAHCP that are related to flow impacts have been met, will be met, or should be adjusted.

With respect to the adaptive management study commitments, Myron Hess generated the list of HCP commitments based on a review of the HCP, primarily Chapters 4 and 6. Chad Furl responded to that list by identifying previous and ongoing work related to each topic. Myron then proposed a categorization approach and categorization for each item in the matrix document. Regarding this proposed categorization, Patrick Shriver suggested rephrasing "No obvious inconsistency with EAHCP study commitments" (in green highlighting) as "Appears consistent with EAHCP study commitments" and rephrasing "Permit extension issue" (in teal highlighting) to "Deferred for permit extension consideration".

Jacquelyn Duke noted that the green highlight and phrasing implies a finished task, rather than a work in progress under the scope of HCP, not this Work Group. She also posed a question regarding what happens if the Work Group does not flag a study commitment that has not been completed, will it get looked at? Jamie noted that any commitment in the HCP is required to be done consistent with the USFWS permit, unless it is removed from the HCP as part of the adaptive management process. Chad Furl responded that some of these green and teal highlighted topics are purposely in stasis as they are currently unanswerable without additional intensive research. He added that it is difficult to speak in general on these issues but that he likely could shed light on why specific issues were and weren't done. One of the things he is seeking from this Work Group is helping to prioritize topics for study.

The group broke for 10 minutes and resumed to address comments made on the draft alphabetized Issue 4 matrix. Elaborations on comments made is noted below:

Matrix Topic C (Comal Springs Dryopid Beetle and Peck's Cave Amphipod water quality issues). Comment submitted about phrasing, as noted above, of categorization, but no disagreement on proposed category.

Matrix Topic F (Predicted extended periods of low flows). Myron Hess noted that he had proposed a subpart of this topic for inclusion in the Work Group priority subset to assess predicted flow statistics for flow levels between 80 cfs and the minimum flow for each spring system. Charles Kreitler explained the need for integrated inquiries of flow levels in that range and what happens at each level. Adam Yablonski added that there is new information on pumping data and new developments, just as with data on species response to flows, to consider when assessing flow increments and impacts. Cindy Loeffler echoed Charles' concern for understanding impacts of the range of 30- 80 cfs low flow as representing an extremely important issue.

Jamie Childers opened the Menti poll to rank the issues proposed for inclusion in the Work Group priority subset regarding which of the three proposed matrix categories was considered appropriate for each.

Matrix Topics H and I (Potential for cool water from springs to bypass Old Channel during low flow periods). For these topics, both of which address understanding the flow path during periods of low flows from locations where

water emerges from spring openings through Spring Lake, Charles Kreitler indicated it would be possible to track whether flow is heading down the new channel or old channel.

Matrix Topic P (Testing spring run connectivity). An initial comment was made by Charles Kreitler that sediments in spring orifices of Spring Lake were either sediments from dead biota or quartz sand brought in for beautification reasons and raised the issue of whether it should be removed. [This comment is more applicable to Topic AA and will be considered there.]

Additionally, Charles suggested a dye trace study under low flow conditions could yield results as to the connectivity of springs on the west wall. A dye trace study may prove to be simpler and more definitive than a study of genetics.

Matrix Topic R (Low-flow experiments with Comal Springs Riffle Beetle regarding survival and reproduction). Myron clarified that the proposed classification as a Work Group priority applies only for the survival component of this topic, not the reproduction component. Tom Arsuffi and Chad Furl expressed hesitation about whether we are far enough along, at this point, for additional Comal Springs riffle beetle study under this topic at the San Marcos Aquatic Research Center (SMARC). Cindy Loeffler noted a study of survival seems feasible. Tom Arsuffi suggested that ongoing riffle beetle monitoring may provide answers. Kimberly Meitzen clarified that a SMARC study would include a study of flow manipulation that is not possible in the field.

Matrix Topic S (Validation of Ecomodel results). Myron Hess and Charles Kreitler agreed upon the need for additional specificity for how to proceed with this issue. Myron noted that, if it is carried forward, Work Group would explore options for proceeding, including potentially by contracting for evaluation of approaches for doing so, and the Work Group could decide later if a feasible approach is available.

Matrix Topic AA (Sedimentation around spring openings in Spring Lake during low flows). Melani Howard indicated that she had forwarded Charles Kreitler' s comments on the dumped sand, noted above under Matrix Topic P, to Robert Mace. Dr. Kreitler noted that the quartz sand may be bigger issue than small-grained sediment.

The Menti poll summary results regarding prioritization of the proposed Work Group priority subset topics were presented for consideration. However, because of the need for a closer look to better understand the individual underlying responses represented by the prioritization result, discussion was deferred to the next meeting.

9. Public Comments

There were no public comments.

10. Future Meetings

The SHP Work Group Meeting 11 is TBD.

Adaptive Management Studies Referenced in Chapters 4 and 6 of EAHCP

Comments were received on the overall categories from Patrick Shriver and Jacquelyn Duke:

"appearing consistent with EAHCP study commitments" would satisfy this workgroups review as being on target or paced well with the progress of the HCP and Policy decisions to date.

"deferred for permit extension considerations" are potentially not satisfying but there is seems to be mutual consensus that these items have been logically prioritized and are sufficient for permits future consideration.

"permit extension issues": what happens if the recommendation regarding the apparent shortcoming result in no action/a rejection of action? As an example: Issue N (beetle movement from surface to subsurface etc.): we discussed the value of this data extensively. If these are not carried forward by the work group, what happens? Will it even matter during the time of the permit extension as this work group would have likely completed its charge by then?

work group (SHP – WG) in red are going to illicit varied positions or responses based on understanding.

Tom Arsuffi and I (Patrick Shriver) suggested focusing discussion or revisiting these topics. I have had to go back and try to read and recall contextual material related to this final category – which I am defining as:

- Species other than the Fountain Darter
  - Science and research potential – does this WG add something new? Reminder of the sentinel approach…
- Water Quality robustness
  - Some of the discussion conflicts with priorities set by previous WQ Work Group – are we saying expansion to do something different than this past work?
- Recreational Management
  - There has been significant discussion about how more should be understood or done going from 80 – 30 cfs. periods of stress? Assuming tangible maximized flow mitigation opportunities have been implemented are we studying or implementing additional habitat management during extended stressful low flow droughts approaching DOR?
- Satisfactions with modeling
  - Particularly the Ecological Model, which is admittedly complex and was designed and informed based on what it could perform. It is actually four models that do have validations towards ERPA calibrations. The question is around whether it has predictive potential or not? And how to pursue that; my past recollection is it was a balance of capability and cost…

Suggest we receive refresher from someone related to the context of how it [the Eco Model] was conceived in the HCP as contrasted to what the product was/is… ***I lean towards*** even the items the SHP – WG differs on are not failures of the HCP they are appropriate building blocks – I am a skeptic of decisions solely based on modeling, but am ok with informed use and to cost effectively incorporate them in potential future work, if appropriate.

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
Comal Springs								
A. "This objective assumes that a 10 percent deviation in average conditions would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of the fountain darter will be addressed as part of the AMP."	Page 4-5 repeated at page 4-27 Issue CS 1	- Low-flow food source threshold study (BIO-WEST 2013) - Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) - Effects of predation on fountain darters (Texas State University and BIO-WEST 2014)		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
		- Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b) - Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.						
B. "This objective assumes that a 10 percent deviation would be acceptable. More extensive work to evaluate and assess water quality tolerances of the Comal Springs riffle beetle will be addressed as part of the AMP."	Page 4-12 Issue CS 2	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b)		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			
C. Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "This goal assumes that a 10 percent deviation would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of these species will be addressed as part of the AMP."	Page 4-15	None.		Permit extension issue	Deferred for Permit extension considerations: As a point of context the HCP processes have prioritized science that needs to be completed before additional work can begin. I also think that reviewing the NAS report helps to shed			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
					light on 10% deviations of WQ – referred to as conservative by them based on understandings of the Fountain Darter, which as I have reminded everyone was one of the three sentinel species of the ecological model with the most known about it. I interpret their issues to be more on the clear documentation and applicability to the Wild Rice and or Comal Springs Riffle beetle. Or better yet the other species not the three.			
D. Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "As such, semiannual drift net sampling for both species will be continued in the context of the AMP during Phase I, and this additional data will be evaluated with the intent of establishing population metrics for these species for Phase II of the HCP."	Page 4-15	Semiannual drift net sampling has continued during Phase I for these species. No 'population metrics' have been established.		Permit extension issue	Deferred for Permit extension considerations			
E."At this time, it is uncertain whether 196 cfs as a long-term average would be supportive of the conditions necessary to rejuvenate the system to the degree that would be necessary to prepare the system for repeated low-flow periods or extended low-flow periods. This rejuvenation of habitat is important not only to the fountain darter, but to all Covered Species at Comal Springs. This question will be examined in the AMP."	Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue	Deferred for Permit extension considerations			

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F. "In addition, the projected extended periods of consecutive days below 150 cfs, 120 cfs, and 80 cfs for the HCP will require additional evaluation during the Phase I AMP. Each of those three flow levels is a take threshold. At 150 cfs, take for the fountain darter starts to occur in the Upper Spring Run reach. At 120 cfs, Spring Runs 1 and 2 start to constrict and go subsurface, and below 80 cfs Spring Run 3 also constricts and goes subsurface." "Relative to the fountain darter, during the drought of record the system was below 150 cfs for 1,063 straight days (nearly 3 years). With the Phase I and Phase II flow-related measures in the HCP, the consecutive period below 150 cfs is projected to be approximately 2,760 days (or over 7.5 years). That is longer than the Phase I period itself, and approximately 3 times the life span of a fountain darter in the wild. With respect to the Comal Springs riffle beetle, during the drought of record, springflow in the Spring Runs 1 and 2 were below 120 cfs for 750 consecutive days (just over 2 years straight) and the riffle beetle as well as the other Covered invertebrate species survived. However, even with the flow-related measures (Phase I and II), flows below 120 cfs are projected for approximately	Page 4-56	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue? WG priority subset: Recompute duration statistics with Phase II flow regime and additional flow increments?	Deferred for Permit extension considerations ???Don't know about this. I would have phrased recompute duration statistics with Phase II workplan input; additional flow mitigations practicality have been ruled out by the HCP analysis and are not part of the current permit – refugia is the fall back for worse than specific defined mitigation(s) in the wild…	Permit extension issue? WG priority subset: Recompute duration statistics with Phase II flow regime and additional flow increments? Legitimate issue. Potentially large study that needs to be fleshed out. Carry forward.	F this work group is going to recompute the duration statistics and add additional flow increments (as the note on the right suggests), I think the work group should consider using more realistic estimates of pumping in their assumptions. Chuck's presentation at an SHPWG meeting 5 showed that over the last 12 years, at least 50,000 (and as much as 265,000) acre-feet remain unpumped every year, even after accounting for forbearance programs, Critical Period reductions, exempt pumping, and federal pumping. There has been no year, since permitting began, in which every acre-foot permitted was pumped from the aquifer. In addition, SAWS now has the Vista Ridge project online, which makes it even less likely that they will pump their entire Edwards permitted amount. We are currently assuming that every possible acre-foot is pumped every single year, which is inconceivable for the duration of our ITP. I think we should discuss	

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
2,400 consecutive days (over 6.5 years). During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed."							coming up with a pumping model that is at least a little more realistic, while still remaining conservative for planning purposes.	
G. During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed.	Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		No obvious inconsistency with EAHCP study commitments for Fountain Darter; Permit extension issue for other species	Appears Consistent with EAHCP study commitments for Fountain Darter; Deferred for Permit extension considerations; context was that models would be kept simple with the use of sentinel species due to the complex nature of using ecological modeling…			
H. "A concern noted in Hardy (2011) is that at 30 cfs total Comal springflow, there is the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel. This could affect water quality in the Old	Page 4-74	Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits		WG priority subset/ Overlap with WQ	WG priority subset/ Overlap with WQ it has been recommended that looking at turnover rate and temperatures during low flow should be revisited.	WG priority subset/ Overlap with WQ Legitimate issue that needs to be evaluated. Can be incorporated into WQ		This is a priority but it is specific to 30 cfs. Does this fit into the charge of the WG?

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
Channel and the success of the proposed ERPA, and, thus, this flow pattern is proposed for study during Phase I."								
I. "Three main concerns noted in Hardy (2011) regarding this flow regime were 1) the potential for aquatic vegetation die-off and subsequent dissolved oxygen (DO) problems in Landa Lake, 2) the reduction in larval production of fountain darters that would likely be experienced, and 3) the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel, which could result in water quality impacts, including higher temperatures, greater than currently predicted in the Old Channel. Regarding the first concern, the aquatic vegetation question remains unanswered and assessing aquatic vegetation dynamics relative to springflow is a critical applied research component in the AMP. … The third concern is directly related to uncertainty associated with the temperature modeling and will require additional hydrodynamic modeling with follow-up water temperature modeling in addition to intensified spatial monitoring during low-flow events, which are proposed HCP research components."	Page 4-88	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits		1. and 2. No obvious inconsistency with EAHCP study commitments. 3. WG priority subset/ Overlap with WQ	1. and 2. Appears Consistent with EAHCP study commitments. 3. WG priority subset/ Overlap with WQ Responses to date through presentations have been that aquatic gardening and access management have been protective to the lowest flows experienced in the experimental record. As a point of context field based stressing to learn about low flow conditions and species **were considered and passed on by all parties involved in the HCP development**…	1. and 2. No obvious inconsistency with EAHCP study commitments. 3. WG priority subset/ Overlap with WQ Legitimate issue that needs to be evaluated		

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
		-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.						
J. "Applied research and modeling conducted during Phase I are anticipated to provide valuable information on the low-flow requirements and subsurface habitat use of the Comal Springs riffle beetle, which will inform any Phase I and Phase II adjustments that may be necessary. (See, e.g., Section 6.3.4.2). From the statistical flow analysis presented in Table 4-30 it is evident that periods of low-flow will be extended for the HCP alternative compared to what was historically observed. As discussed in Section 4.2.1.3.1, this along with the long-term average flow management objective will need to be evaluated during Phase I activities.	Page 4-106	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
		beetle (Nowlin et al., 2017) -Comal Springs Riffle Beetle (Heterelmis comalensis): Life History and Captive Propagation Techniques (BIO-WEST 2018)						
K. Comal Springs Dryopid Beetle and Peck's Cave Amphipod "A concern identified, during these low-flow periods which will require further research includes the impacts to the energy flow regime in the Aquifer and near the springs."	Page 4-108	None.		Permit extension issue	Deferred for Permit extension considerations			
L. "A key unknown is the tolerance of native aquatic vegetation to reduced flow conditions in these systems. The timing and duration of these low-flow events will be studied relative to the native vegetation, starting with the plant species identified in the long-term biological goals for the fountain darter. Decay of the above ground and below ground biomass will be measured over time. Above ground biomass is important for Covered Species habitat while below ground biomass is critical for root establishment and holding the plant in place during any subsequent pulse event. Water quality will be continuously measured to evaluate the before, during, and after effects of vegetation decay on water temperature,	Pages 6-8 and 6-9	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015)		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
dissolved oxygen, carbon dioxide, and pH. Additional water quality parameters such as nutrients may also be studied. In addition to studying the effect of vegetation decline, decay and ultimately death, studies will be designed to evaluate recovery of native vegetation following various stages of aquatic vegetation decline and decay.		-Suspended sediment impacts on Texas wild-rice & other aquatic plant growth characteristics & aquatic macroinvertebrates (Crawford-Reynolds et al. 2017) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Landa Lake DO mgt plan -EAA RTWQ network -EAHCP WQ/Biomon monitoring						
M. Another critical component of fountain darter habitat that is presently unknown is the relationship of macroinvertebrates (fountain darter's main food source) to low-flow conditions. Studies will be designed to evaluate the simulated effects of changing water quality conditions and aquatic vegetation composition on the macroinvertebrate (mainly amphipods) community. … Similar to the aquatic vegetation study, not only will simulated impacts be assessed during extended periods of simulated low flow, but recovery following these	Page 6-9	-Low-flow food source threshold study (BIO-WEST 2013)		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
periods will be studied to learn response time (amphipod recovery) following a severe event.								
N. The first step will be to assess the survival success of adults. Once an adult population is established, flow manipulations will be performed to study the affinity of riffle beetles to flow and to track movement from surface to subsurface habitats and vice versa. The immediate goal is not to establish a reproducing riffle beetle population but to evaluate movement patterns of riffle beetles during periods of varying springflow.	Page 6-9	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017)		Permit extension issue	Deferred for Permit extension considerations			
O. Once a population is established in the experimental habitat, extended periods of low-flow will be tested to evaluate the effect of these periods on riffle	Pages 6-9 and 6-10	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014)		Permit extension issue	Deferred for Permit extension considerations			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
beetle survival and habitat use. Surface habitat will be completely removed for extended periods of time, water quality will be altered to simulate extreme conditions, and other factors adjusted (e.g., reductions in leaf material or detritus, etc.) to simulate conditions that might be experienced in the wild during these conditions. As with other proposed Tier A efforts, recovery following impacts will also be investigated.		-Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017)						
P … the concept of spring run connectivity will be tested. This will involve simulating subsurface habitat cutoff from surface habitat and riparian detritus, and subsurface habitats that are connected to surface habitats via the trickling of water across the surface habitat. This is a key study to assess the value of this concept as an additional protection measure in Spring Run 3 of the Comal system as discussed in BIO-WEST (2011).	Page 6-10	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)		Permit extension issue	Deferred for Permit extension considerations	Permit extension issue Need further explanation what the issues of “spring run connectivity” and how to test. Could tracer dyes be injected at a spring particularly under low flow conditions?		

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
Q A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to fountain darters. A whole host of questions can be addressed under this topic with just a few examples including: • when and where do darters move as vegetation decays and water quality deteriorates; • when does reproduction stop or does it; • does compensatory reproduction get triggered, and if so, when and what causes it; and • what is the effect of predation on fountain darter population size?	Page 6-10	-Low-flow food source threshold study (BIO-WEST 2013) -Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) -Effects of predation on fountain darters (Texas State University and BIO-WEST 2014) -Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b)		No obvious inconsistency with EAHCP study commitments.	Appears Consistent with EAHCP study commitments.			
R A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to Comal Springs riffle beetles. A core question is: when are reproduction and survival compromised as physical habitat (surface and subsurface) declines and water quality deteriorates? The reproduction component assumes that a reproducing population can be established in the study habitat during Phase I. If a reproducing population is successfully established, this flow manipulation research could be expanded to include	Page 6-10	Reproducing populations haven't been established		Permit extension issue for reproduction WG priority subset for survival aspects	Deferred for Permit extension considerations WG priority subset for survival in the wild aspects Contextually I recall many approaches discussed to try and simulate this both in the laboratory and in field experimentation. The results were prioritizing the current science, so this workgroup would be revisiting and potentially putting new or different priorities on the table. I as a workgroup member have not heard specifically which ones that would be with the current status of what is known about the Comal	Permit extension issue for reproduction WG priority subset for survival aspects Sounds like a difficult "lab" experiment at SMARC. Is enough known about the riffle beetle to be able to conduct these experiments		

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
evaluation of desirable and threshold environmental conditions for larval and pupae stages.					Springs Riffle Beetles – other than explore subsurface understanding. Based on NAS evaluation and earlier comments about WQ above I am more in the camp that we need to finish the current prioritized science first, so I would defer for permit extension.			
S Towards the end of Phase I, specific studies will be designed and conducted to test the validity of ecological model results. This may involve simple or complex parameters and single or multiple low-flow events depending on Phase II questions that may be relevant at that time.	Page 6-11	None.		WG priority subset	WG priority subset I have went back and reviewed much of the context of the development of the HCP ecological model. From Annear & Associates, NAS and final report May 2017. Models can be useful within context. Their development based on varied complexity is challenging. Again the IC and Stakeholders were informed all the way along what this model is and what it is not. It refers to itself as a "Beta" and should not be permanently coupled to flow models without considerable more development. Validity against Darter suitability in a number of ERPA's was calibrated with field data. The report does address as future possible expansion, but using the Fountain Darter it met and was briefed to all	WG priority subset Need to be more specific other than "specific studies will be designed and conducted"		

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
					involved related to this statement in my evaluation.			
T The initial activity will be the evaluation of alternative methods for snail removal so that removal can be accomplished in the most effective, yet least destructive manner. The second activity deals with understanding the magnitude of snail removal necessary to affect downstream cercaria concentrations in the water column. Once the magnitude of snail removal for effective control of water column cercaria is identified, a study is necessary to evaluate the long-term benefits of that removal.	Page 6-13	None.		Permit extension issue	Deferred for Permit extension considerations			
U Should it be determined during applied research conducted at the NFHTC during Phase I that spring run connectivity is effective and that additional protection may be required for the Comal Springs riffle beetle, then some version of that component may be implemented during Phase II.	Page 6-18	-Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)		Permit extension issue	Deferred for Permit extension considerations			
V Comal Springs Dryopid Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer;	Page 6-19	Life history of CSDB is currently underway with Refugia program.		Permit extension issue	Deferred for Permit extension considerations			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
• Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate.								
W Edwards Aquifer Diving Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer; and • Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate.	Pages 6-19 and 6-20	None.		Permit extension issue	Deferred for Permit extension considerations			
San Marcos Springs								
X "To be conservative, the long-term goal assumes that a	page 4-35	None		Permit extension issue	Permit extension issue			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
10 percent deviation would be acceptable; however, more extensive work to evaluate and assess the validity of that assumption and the water quality tolerances of the Texas blind salamander will be considered in the AMP."								
Y "Although the projected long-term average flows are not concerns, the extended periods of consecutive daily average flows under 100 cfs and 80 cfs were examined. At 100 cfs, take for the fountain darter and impacts to Texas wild-rice have been documented. At 80 cfs, take is anticipated for the San Marcos salamander. Unfortunately, there is not a duration factor (i.e, memory) incorporated into any of the basic habitat modeling conducted for the incidental take analysis presented below. As such, a future evaluation of these potential impacts will be addressed with Phase I applied research and mechanistic ecological modeling."	page 4-62	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue	Permit extension issue			
Z "As discussed for Comal Springs, during Phase I, applied research on the effects of low flows on the Covered Species and their habitat at San Marcos Springs will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I Package will be improved. Until the Phase I	page 4-63	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.		Permit extension issue for species other than fountain darter For fountain darter, no obvious inconsistency with EAHCP study commitments.	Permit extension issue for species other than fountain darter For fountain darter, no obvious inconsistency with EAHCP study commitments.			

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach	Scheduled next steps, if any	Work Group recommendation? **DISTRIBUTED**	**Patrick Shriver**	**Charlie Kreitler**	**Adam Yablonski**	**Jacquelyn Duke**
AMP decision-making is complete, it is not known whether additional flow protection measures might be necessary or what duration might be acceptable, or amount of additional flows that might be needed." **AA** An assumption was made that a minimum number of salamanders would survive in Spring Lake as long as some springflow was provided. Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows. It has been observed in Landa Lake (Comal system) that as upwelling springs in the Upper Spring Run area cease flowing, siltation ensues and salamanders retreat from those areas. Although observed at Comal Springs, flows have not reached a level over the past decade at San Marcos Springs to cause a similar condition in Spring Lake, and as such this assumption is currently unfounded. Similarly, establishing a cutoff point on habitat suitability within Spring Lake would be equally unfounded at this time. This again highlights the importance of the applied research and mechanistic ecological modeling to be developed for this species as part of the AMP.	Page 4-140.	None		WG priority subset	WG priority subset The overview of the NAS indicates primary recommendations dealt with monitoring for the silt free habitat requirements; likely important terrestrial sources eliminated from getting in the habitat. And considering adjustment for population density type calculation for the individual ERPA's.	WG priority subset As I remember, the "white sand" in the Spring Lake spring orifices is probably quartz, and is therefore artificial to any native San Marcos spring setting. It may be golf course trap sand placed there to make the springs look more attractive. Should it be removed?		

Springflow Habitat Protection Work Group

Meeting 11 Minutes
November 19, 2020
9:00-11:00 a.m.

1. **Confirm attendance**

   All Work Group members were present, except Adam Yablonski.

2. **Meeting logistics**

   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   No public comments.

4. **Approve meeting minutes:**
   - **Meeting 9 (September 9, 2020)**
     A motion was made by Melani Howard, seconded by Tom Arsuffi, to approve the meeting minutes from Meeting 9 (September 9, 2020) with the correction of a typographical error noted by Patrick Shriver. In the absence of objection, the minutes were approved by consensus.
   - **Meeting 10 (September 23, 2020)**
     A motion was made by Cindy Loeffler, seconded by Patrick Shriver, to approve the meeting minutes from Meeting 10 (September 23, 2020). In the absence of objection, the minutes were approved by consensus.

5. ***Discussion and decision on*** **Draft Part 2 Work Group Charge**
   SHP Work Group Chair, Myron Hess, led the discussion on the Draft Part 2 Work Group charge by working through the comments received by the work group members.

   Key changes agreed upon are as follows:

   To avoid implications of shortcomings in permit compliance, discussion of the status of EAHCP studies will note the ongoing nature of adaptive management, acknowledge that many factors affect the appropriate timing for completion of studies, and reflect that the Work Group recommendations simply prioritize certain studies.

Issue 1
What was Question 4-2 will be renumbered and moved to become a new Question 1-3, with appropriate renumbering of the remaining Issue 1 questions, including to reflect a reordering to move what was Question 1-4 to last. What is now Question 4-2 will be acknowledged as having relevance to Issue 1.

Issue 2
There was discussion about terminology, with reference to the potential for defining upthrown and downthrown block in Question 2-1. Concern was also noted about the potential to overburden the document through an attempt to add definitions of terms. In addition, the discussion recognized that much specificity will be added when requests for proposals are developed.

Question 2-2 will be rephrased to acknowledge that ongoing genetic studies may not provide relevant insights about low-flow impacts and that variations of those studies or new studies may be needed.

Question 2-3 will be deleted, with some alteration of Question 2-1 to cover the topic.

Issue 3
Reference to Comal system will be added to introductory language to acknowledge that Question 3-1 addresses aspects of both systems. Reference to San Marcos salamander will be added to Question 3-3 and reference to fountain darter added to Question 3-4.

Issue 4
Explanation will be added that the studies listed under Issue 4 did not fit under Issues 1-3. In addition, discussion will be added about timing of studies reflecting multiple considerations as part of an ongoing adaptive management process, with specific studies reflecting Work Group prioritization, in order to avoid a potential implication of a failure to meet permit requirements.

What is currently Question 4-2 will be moved under Issue 1 and renumbered. An acknowledgment of the relevance of what is currently Question 4-3, which will be renumbered as 4-2, will be added under Issue 1 to ensure it is considered as Requests for Proposals are developed pursuant to Issue 1.

Part 2 charge process
Members discussed the process for prioritization of studies and what happens with studies that are not addressed. The language of the charge will acknowledge the need for the Work Group to consider prioritizing studies, the need for schedule flexibility, and the potential for the Work Group to make recommendations regarding studies that are not completed as part of the Work Group process.

A role for the Science Committee in reviewing study proposals will be noted in Table 1.

6. ***Discussion and decision on*** **next steps for finalizing Part 2 Work Group Charge document for presentation to the Implementing Committee**
   The Work Group approved a process through which Jamie Childers and Myron Hess will circulate a revised draft document to the Work Group members for review on an expedited basis. If no Work Group member indicates the need for revisions, the draft will become the final version and will be presented to the Implementing Committee (IC), as an informational item, at the IC's December 17, 2020, meeting and considered for approval at a subsequent IC meeting. If the only concerns raised by the Work Group are typographical-level changes, a revised draft will be promptly circulated to the Work Group for a final review.

   If a Work Group member raises substantive concerns, the draft will not be presented to the IC until the Work Group has a chance to meet and address those concerns. If possible, a meeting will be held during the week of November 30th to allow the report to be finalized and presented at the December 17th IC meeting. If a meeting is required and it cannot be scheduled during the week of November 30th, presentation to the IC will be delayed until a subsequent IC meeting to allow the Work Group to finalize the document.

7. **Public comment**
   Cindy Loeffler announced her retirement from Texas Parks and Wildlife Department, effective December 31, 2020. The EAHCP program staff and stakeholders voiced gratitude for her participation and recognized her legacy of environmental stewardship over her long career.

8. **Future meetings**
   A doodle poll will be sent to members to schedule a tentative Meeting 12, prior to the Implementing Committee meeting on December 17, 2020.

Springflow Habitat Protection Work Group

Meeting 12 Meeting Minutes
January 14, 2021
9:00-11:00am

1. **Confirm attendance**
   Eight of eleven Work Group members were present; Tom Arsuffi called in after attendance was confirmed and Doris Cooksey, Adam Yablonski and Ryan Kelso did not attend. Former Work Group member Cindy Loeffler is no longer with the Texas Parks and Wildlife Department. Myron Hess, the Work Group Chair, let the other members know that he would be reaching out to the Texas Parks and Wildlife Department to request identification of a proposed Work Group representative for consideration by the Implementing Committee at its March meeting.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There was no public comment.

4. ***Discussion and decision on comments and revisions to*** **Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   Work Group members participated in an extensive discussion of the comments received on the *December draft Work Group Part 1 Report and Proposed Part 2 Charge* (December draft) and member's understanding of the intent of the topic areas carried forward by the Work Group.

   Myron Hess opened the discussion with a proposed approach for the meeting. Patrick Shriver then provided an overview of his perspective and the comments he provided on the December draft. He noted concerns that the document is still overly broad and that there are several items he disagrees with and for which, at minimum, dissent needs to be acknowledged in the document. He also noted, while acknowledging the efforts to run effective meetings, the challenges of having to meet solely in virtual meetings, which hinders communication and deliberation. He indicated that he would not be ready to state a final position on the proposed document in this meeting. He also noted that the discussion during the briefing to the Implementing Committee in December highlighted

that the December draft is difficult to follow because the questions are so broad, and they mean different things to different people. He summarized the issues in the December draft as falling in three buckets of science; (1) gradation of the 80 to 30 to 45 cubic feet per second (cfs) with scopes that use existing tools with up to date data because developing new tools may not be practical, (2) recreational research and data collection, and (3) species populations specific to certain areas with a recognition that the tools are complex but also simple and focused on specific habitat areas. Patrick noted that he had concerns with some questions in that third bucket.

Myron Hess noted his perspective that prioritization and further refinement of scopes of work would occur during Part 2 of the Work Group and acknowledged that the topic areas are not at the point of supporting RFPs (requests for proposals). Patrick Shriver further clarified his concerns that the December draft would appear to the Implementing Committee as representing consensus even though he does not support portions of it and other members also may not. Myron Hess noted that if the group is not able to reach consensus, which is the preferred outcome, the EAHCP procedure has been to provide the opportunity for inclusion of a minority report. Patrick indicated he would rather clarifications and minority opinions are made in what is presented to the Implementing Committee. Patrick also highlighted the need for missing Work Group members to have the opportunity to go back and hear what was presented today and to weigh in.

The Group agreed to begin working through the December draft and the specific comments on that draft. The draft with comments was shared online with the meeting participants to help guide the discussion. The Work Group members talked through comments and proposed edits for the portion of the document preceding the Issue 1 topic area. Jamie Childers made edits and notes on the shared version of the December draft to reflect the discussion. All members eventually agreed that the edits that were discussed and found acceptable during the meeting represented a good way to proceed.

Regarding a suggestion to have summaries of presentations to the Work Group included in the document, Myron Hess and Jamie Childers reminded members that the minutes from previous meetings, which include summaries of presentations, are proposed to be included as Appendix B to the December draft. Those appendices have been shared previously with Work Group members. Patrick Shriver asked that the December draft acknowledge the successful implementation of studies to date. Work Group members worked through editorial changes to acknowledge the benefits of the research done to date addressing the overarching issues being considered by this Work Group. Other tracked changed changes were approved and edited in these sections.

The Work Group took a break before proceeding to discussion of questions under Issue 1.

Charlie Kreitler opened the discussion of Issue 1 noting that he views the overall intent of Issue 1 as the overall physiochemical conditions, the quality of the springs and not limited to narrow water quality parameters. Patrick asked if that should be added to one of the *Questions* under this issue. Work Group members discussed where that could be placed to acknowledge the components Charlie described, but concluded it may not be necessary.

Members talked through their understanding of the intent of each question and discussed options for clarifying language.

Question 1-1: Chad Norris clarified that the need to validate the Hardy model arises from data collected during the 2014 drought. A key concern in the modeling was fountain darter reproduction during low flows, particularly in the Old Channel (of the Comal) because of potential elevated temperature during low flow periods. Comparison of model predictions to the 2014 data could provide insights.

Tom Arsuffi highlighted the use of 'adequate' and indicated his interest in knowing how the Hardy WQ model compares to other water quality models in terms of criteria (model equations and input assumptions) beyond the springs. He indicated he would like to see a comprehensive comparison of models. Myron Hess suggested that Question 1-5 may provide the opportunity to address the model comparisons suggested by Tom Arsuffi.

Members then discussed the overarching issue of the 80 cfs "pulse" flow component in the EAHCP, including whether the "pulse" was intended to be natural or engineered. They then discussed the 80 cfs was included because of concerns about prolonged low-flow and the need for an induced 80 cfs flow. Chad Norris indicated that there was never consideration that the pulse flows would be natural, instead it was to be an engineered solution. It came from concerns over (1) reproduction of the fountain darter, (2) mobility of the Comal Springs riffle beetle, and (3) recreation and downstream concerns in terms of flows being held at 30 cfs for extended periods. Patrick recalled the various alternatives considered in the development of the EAHCP and that they ultimately settled on the interventions of the springflow packages rather than highly engineered solutions.

Myron Hess, the Chair, then refocused the Work Group to the questions in Issue 1. He revisited that the Work Group is focused on the significance of periods of flow below 80 cfs and not on ways to produce 80 cfs.

Discussion of the need to briefly clarify the intent of each question followed. There was mixed interest in attempting to add these statements of intent. Myron, Charlie, and Tom Arsuffi noted concerns that the group does not get too far into the details of the questions at this time. Patrick again focused on the

value of understanding the intent of the questions and indicated there may be some policy implications within the Charge. Myron acknowledged that specificity would be ideal, but also would require significant effort for the Work Group to agree upon language for all the questions. He also reminded members that the topics will be prioritized in Part 2, which may mean that not all questions will be addressed through proposed studies so that not all of them would have to be fleshed out.

Work Group members went on to identify refinements to the language of Question 1-1 which were reflected in the edits Jamie made online. The Work Group discussed each of the remaining Issue 1 questions. No specific changes to the language were identified beyond the edits previously proposed in the online version.

5. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on*** **next steps for approving final version for presentation to Implementing Committee**
Although the Work Group did not specifically address this agenda item, the Work Group identified the need to schedule two additional meetings to continue working on the Proposed Part 2 Charge.

6. **Public comment**
There was no public comment.

7. **Future meetings**
A poll will be sent to Work Group members to set two future meeting dates.

Springflow Habitat Protection Work Group

Meeting 13 Minutes
Friday, February 5, 2021
9:00am-11:00am

1. **Confirm attendance**
   Nine of eleven Work Group members were present; Melani Howard and Ryan Kelso did not attend. A replacement has not been appointed for Cindy Loeffler following her resignation from the Texas Parks and Wildlife Department.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There was no public comment.

4. **Approve Meeting Minutes**
   Tom Arsuffi made a motion, seconded by Myron Hess, to approve the meeting minutes from Meeting 13 (January 14, 2021). In the absence of objection, the minutes were approved by consensus.

5. ***Continue the discussion of and potential decision on comments and revisions to* Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   Work Group members continued to discuss comments received on, and potential revisions to, questions under Issues 2, 3 and 4 of the *December draft Work Group Part 1 Report and Proposed Part 2 Charge* and to explore their understanding of the intent of the topic areas carried forward by the Work Group.

   The Issue 2 discussion opened with an examination of the comment asking if *we know enough about the Comal Springs riffle beetle (CSRB) to initiate additional studies that are specifically related to the low-flow conditions.* A number of members ultimately agreed that more specific knowledge of the CSRB was not needed to do the kinds of studies suggested by Question 2-1. Charlie Kreitler indicated that a review of previously collected data to compare the elevation of springs with water levels could be a starting point to understand which springs would be flowing during low-flow conditions. Several members noted that such an understanding would also provide useful information for other species. Doris Cooksey indicated that these studies would address questions related to all the Covered Species and that just because we list it here does not mean it will be

prioritized. This recognition, that having questions included in the Proposed Part 2 charge does not mean that related studies will be prioritized and implemented, was reiterated at several points in the meeting.

Patrick Shriver pointed members back to the charge which is specific to the CSRB. He referenced the presentations to the work group and the results of the National Academy of Sciences (NAS) review. He recalled that NAS questioned how we were accounting for and sampling CSRB, topics being covered by the CSRB Work Group. He later indicated that (1) there are provisions in the HCP (Habitat Conservation Plan) that address monitoring through the least invasive approach, recalling the effort to be cautious about interventions to reduce danger of being overly involved or having a detrimental outcome during the development of the HCP and that these were the reasons why the focus was on the overall ecosystem rather than a single orifice; and (2) that there is a lot we need to know from the CSRB Work Group.

Myron Hess, and other members, agreed with the importance of being cautious in avoiding invasive, or potentially damaging, approaches. Charlie's suggestion of starting with a compilation and analysis of existing data was acknowledged again as a potential first step.

Tom Arsuffi indicated that understanding where the springs are flowing at different flow rates is critical to being able to address secondary questions about whether CSRB are there or not and what makes them thrive when springs are flowing. Charlie and Kimberly Meitzen agreed. Kimberly also noted that the group is creating a list of studies and that needs to be inclusive for topics to be examined and evaluated, as decisions are made later about prioritization.

Patrick wanted to clarify that the group is working to manage the Incidental Take Permit not the individual spring orifices. Myron clarified that Question 2-1 is focused on understanding of where the flow is going to emerge and asked what the concern would be about gathering that information. Patrick indicated he's not concerned with gathering the information but wanted to be transparent that the HCP was developed knowing that the springs would go dry and that approaches to augment flow could be very invasive. Myron acknowledged that it is understood some springs would go dry but that this question is designed to collect information to understand what springs are going to continue to flow to help inform future management decisions. He also noted that looking at, for example, ways to augment flow in specific areas would be, in his opinion, beyond the scope of this work group. Although there was continuing discussion, there was no specific objection stated to retaining Question 2-1 in the charge and the group moved to discussion of Question 2-2.

In the discussion of Question 2-2, Myron Hess gave his understanding of the intended focus as involving waiting to evaluate results of ongoing genetic studies that may provide insight about what, if any, genetic bottlenecks

occurred in the past and how low flows might have contributed. And if those results cannot help provide useful insights, focus would be on whether some variation on the analyses or studies could provide those insights. Tom Arsuffi noted his support for use of genetics as a new tool for helping to understand population viability and reiterating the value it could bring to understand bottlenecks. Kimberly Meitzen and Jacquelyn Duke supported Tom's statements. There was general agreement to defer to the biologists in the group and leave the question in the document and decide later about prioritization.

Myron introduced the comments and questions of Issue 3. There was no discussion or objection stated regarding Questions 3-1 or 3-2. Charlie Kreitler indicated that the Question 3-3 was a high priority, particularly after hearing of the study Kimberly Meitzen is working on regarding the impacts of recreation in the San Marcos River. There were no concerns raised about Question 3-3 or Question 3-4. Kimberly Meitzen communicated her support of Question 3-4. The discussion of Question 3-5 led to a minor language revision, including reference to the State Scientific Area, and acknowledgment of the need to get further input from Melani Howard on the intent of the question for the group's consideration. Patrick asked work group members to begin thinking about what range of flows these questions should be focused on.

There was extensive discussion of Questions 4-1 and 4-2 regarding the mechanism to meet 80 cfs and its inclusion in the HCP flow objectives as a three-month average flow. Myron stated his thinking on Question 4-1 is that there may be some flow between 30-80 cfs that could be achieved for three-months, or some similar period, even if not 80 cfs, and what would that flow do to benefit the species. Patrick Shriver reminded the group of discussions during the development of the HCP that were not able to identify engineered solutions to meet the 80 cfs and instead other management strategies were identified. Chad Furl asked for further clarification because the current MODFLOW includes the bottom up package of the drought of record along with an ecological model that describes the response of the fountain darter to those perturbations. Chad indicated that if the group wanted to know the impacts to the species the group would have to specifically define the species, flow rate, and impacts they were looking to better understand.

Patrick asked Myron if he was seeking to understand if there would be less "take" if the flow regime was different. Myron went on to clarify his understanding that the take was calculated with the flow in the HCP and that that take was calculated assuming the 80 cfs would be met but the current modeling indicates that the 80 cfs would not be met. He is not suggesting that the take analysis be redone or that we focus on level of take. This question is intended to apply the work that has been done to better understand what flows are needed, based on improved understanding of species impacts, to benefit the Covered Species consistent with what was intended to be achieved by the 80 cfs component. Patrick reiterated that during development of the HCP many of the

ecosystem measures, like removing floating vegetation, were established because engineered solutions were not an option. Charlie Kreitler indicated that he had been unclear of the purpose of Question 4-1 and continues to be.

Myron also indicated that information obtained pursuant to questions identified under other issues could clarify aspects of the flow needs of the Covered Species. Charlie asked Myron to further clarify Question 4-1 to better communicate why we are doing this and what it is we want to be doing. Doris also asked that we be very specific about what a "pulse flow" is because moving forward this could be very confusing, especially as people who were involved early in the process may no longer be participating. Patrick also asked that we consider the management implications that may impact species and not just achieving a specific flow number.

The discussion of Question 4-2 sought to further define what model results would be validated in addressing this question. Patrick asked what we would want the models to be validated against: field observations or something else? Chad Furl indicated that the ecological modeling report included a chapter on validation and, therefore, no additional studies were performed to validate the ecological model. There was acknowledgment that the ecological model consists of four sub-models. Charlie Kreitler indicated that this question needs to be more fleshed out if it is carried forward. Chad Furl noted that an initial step may be to review the validation done as part of development of the ecological model. Charlie added it ties back to Issue 1 and may be appropriate to revisit all the models to bring them up to date with the most recent data. Chad indicated that the sub-models vary in the degree to which they are up to date.

Having reached the end of the planned meeting duration, the group decided to continue discussion of Question 4-2 at the next meeting. Myron indicated he would develop, and circulate, a draft parenthetical statement for each question for the work group members to review as a possible starting point for adding explanation of the intended inquiry.

6. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on*** **next steps for approving final version for presentation to Implementing Committee**
The Work Group did not address this agenda item but agreed to meet again.

7. **Public comment**
There was no public comment.

8. **Future meetings**
The next meeting of the work group will be Friday, February 26 at 9am.

Springflow Habitat Protection Work Group

Meeting 14 Minutes
Friday, February 26, 2021
9:00am-11:00am

1. **Confirm attendance**
   Eight of eleven Work Group members were present; Adam Yablonski, Doris Cooksey, and Ryan Kelso did not attend.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There was no public comment.

4. **Approve Meeting Minutes**
   Tom Arsuffi made a motion, seconded by Charlie Kreitler, to approve the meeting minutes from the February 5, 2021 meeting. In the absence of objection, the minutes were approved by consensus.

5. ***Continue the discussion of and potential decision on comments and revisions to* Draft Work Group Part 1 Report and Proposed Part 2 Charge**
   Work Group members continued to discuss comments received on, and potential revisions to the *December draft Work Group Part 1 Report and Proposed Part 2 Charge*. The group began with continued discussion of questions under Issue 4 and of the accompanying draft parenthetical statements Myron Hess provided for each question.

   The draft parenthetical for Question 4-1 was updated to clarify that *further review of existing Modflow model predictions will be undertaken to identify other such flow levels which will be assessed using the ecological model and other appropriate tools for potential benefits to the Covered Species, including through consideration of new insights gained through inquiries pursuant to other questions.* The change was made in response to concerns expressed by Patrick Shriver that the statement may be interpreted as being focused primarily on the Modflow modeling aspects instead of on species impacts based on the biological goals set in our current permit.

Question 4-2 was deleted upon agreement that sufficient analysis and validation is documented in the ecomodel report, *Final Report: Fountain Darter Modeling System for the Comal and San Marcos Rivers*.

Following brief discussion of Question 4-3, now renumbered as 4-2, the draft parenthetical was revised, in response to a request by Kimberly Meitzen, to add a reference to San Marcos salamander habitat downstream of Spring Lake Dam.

The Work Group also briefly discussed the Part 2 Process and report Table 1. No changes were made to the schedule in the current draft. Jamie Childers updated the group on revisions made, to limit workload and potential delays, providing that scopes of work would be provided for review by Work Group members, including the three Science Committee members on the Work Group, but not all Science Committee members. Patrick Shriver questioned if there was interest in involving Science Committee members to bridge gaps in knowledge. Chad Furl clarified that expertise on specific topics would be sought out in the development of scopes of work if that expertise exists outside the Work Group members. Patrick Shriver deferred to Chad's recommendation and there was no further discussion of Table 1.

The Work Group then quickly moved through review of the draft parentheticals for each question under Issues 1, 2, and 3. Because of the deletion of the original Question 4-2, the reference to that question under the Issue 1 topic was deleted. In response to a suggestion by Kimberly Meitzen, Question 3-5 was revised to add a reference to ongoing data collection. Charlie Kreitler asked for closure from the group that they were happy with the inclusion of the parentheticals and their intent. Myron Hess and Patrick Shriver agreed. In response to a comment by Patrick Shriver, a statement confirming the focus of the studies on informing management decisions, which is found in the Part 2 Charge section of the draft, was repeated in the Part 2 Process section.

6. ***If unresolved issues remain regarding Draft Work Group Part 1 Report and Proposed Part 2 Charge, discussion and decision on* next steps for approving final version for presentation to Implementing Committee**

Work Group members agreed to review a final clean version of the report and to provide everyone the opportunity to weigh-in. Myron Hess offered an approach to moving forward. Patrick Shriver asked that a document be circulated and that the group plan for a 30-minute meeting to check-in for all the members to say they are good with the report moving forward. Jamie Childers indicated she would send the group a clean version and a track-changes version on February 26 and members were asked to provide a written response, including any proposed edits, by 3:00 pm on March 3. Jamie indicated she would quickly turn around an updated document, reflecting the responses, for final review and, based on the results of a Doodle Poll, schedule a meeting time for assessing final consensus prior to delivery to the Implementing Committee.

7. Public comment

There was no public comment.

8. Future meetings

The next meeting of the Work Group will be scheduled for 30 minutes the afternoon of Friday, March 5 or Monday, March 8. This meeting will be held to consider confirming the final *Work Group Part 1 Report and Proposed Part 2 Charge* to be delivered to the Implementing Committee at their March 18, 2021 meeting.

Appendix C
Springflow Habitat Protection Work Group
Issue 1 Motion and Topics

Springflow Habitat Protection Work Group

Draft Issue 1 Motion

August 6, 2020

Motion to Define Prioritization for Further Work Group Consideration Under Issue 1

Issue 1: The Implementing Committee should ensure a technical evaluation is undertaken of water quality impacts of predicted extended periods of flow below 80 cfs in both spring systems, either using the Hardy water quality model but calibrated and validated using data from recent low-flow periods or using an alternate approach.

Motion by Tom Arsuffi, second by Patrick Shriver (made orally during August 6, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 1 for consideration in Part 2 of the Work Group's charge related to water quality below 80 cfs: 1) Calibrate, evaluate, and validate the Hardy Model using 2014 data; 2) Address dynamics of habitat, dissolved oxygen, and vegetation loss during low springflow and 3) Review the outcomes of the 2016 Expanded Water Quality Work Group. These and other topics were summarized in the discussion documents for the Work Group meeting on August 6, 2020. The topic, "Evaluate temperatures and decreasing springflow (<80cfs)" are understood as being included under the three topics listed above.

Although this Motion prioritizes specific topics under Issue 1, it is not intended to suggest that other topics discussed pursuant to Issue 1 do not merit consideration in other processes or at other times, including through recommendations, potentially by this Work Group, for future monitoring during periods of extended low flow.

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Evaluate temperatures and decreasing springflow (<80cfs).
Comments	Modeling should incorporate predictions for future drought conditions using Dr. Hardy's models built for central Texas conditions.	WG virtual sessions one and two presentations reassured me that the current model and activities are protective. However, I am not opposed to the following suggestion of plugging the WQ data with 2011 lowest flow DO in as a means of sensitivity check.	The WQ Workgroup set the current parameters of what is available and has not been at all discussed in this process; it could provide context for questions regarding WQ.	I think Chad answered the question for the short term that temps are not an issue for water quality down to 60cfs. the question is can WQ be sustained over the long run
	Is the Hardy model adequate to evaluate the effects of <80cfs?	What is the effect on dissolved oxygen in spring runs and Landa Lake from vegetation die-off during extended periods (more than 6-months) with flow below 80 cfs in the Comal Springs system?	Planning for WQ activities of the permit, which was/is a pragmatic approach of constituent testing. The WQ Workgroup set the current parameters of what is available and has not been at all discussed in this process; context for questions regarding WQ	Providing flows of up to 80 cfs are not achievable both politically and monetarily.
	One of the presenters (Hardy) seemed to confer that additional WQ data would be a complex for any current model or actually any modeling platform. This seems to align with the direction that our WQ Workgroup took during Phase I .	Impacts to habitat quality under low flow (e.g., increased sediment, algae, temperature, decreased dissolved oxygen). How suitable habitat for endangered species changes	Do we believe any conclusions of the Expanded Water Quality Workgroup in 2016 are applicable?	Is 80cfs the best value to use, or should it be lowered to reflect more recent findings?

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Evaluate temperatures and decreasing springflow (<80cfs).
	Any model rebuild will contain some amount of uncertainty. What would the impacts of management be with new results?	What are the effects of extended low-flow (below 80cfs for six months) and vegetation die-off on DO levels in Landa Lake?		I suspect the major issue at the springs is significant decrease flow in individual springs, and not a change in “chemistry” of the spring discharge. Spring chemistry should remain constant. During low flow, discharge would definitely decrease and points of discharge would change. Which springs go dry whether larger springs are at different elevations would be important. A proposed study would be to review of all previously collected spring data to see whether and how the chemistry, discharge, and spring location changes under low conditions.
	Using more than one model may be useful. Averaging over several models can help identify components that are not accounted for by any single model.	Evaluation of potential for vegetation die-off in Landa Lake during extended periods of low flow affecting DO		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Evaluate temperatures and decreasing springflow (<80cfs).
	Can the Hardy model tell us which spring/seep outlets will be flowing at 80 cfs and below?	Potential for low DO in Landa Lake		
	Use data collected in 2014 to validate WQ model results	what is the status of the vegetation modeling? Sounds as though it may be useful for evaluation of flows below 80cfs.		
	How well does the Hardy model represent water quality when the 2014 drought is modeled?	to Thom's point: as flows decrease, pollution concentration increases, and CO2 increases in association (and DO decreases). Turbidity is likely to increase especially if recreation continues. There are many negative factors that will impact WQ		
	Hardy's Qual2E report needs evaluation with regard to broader water quality modeling understanding. There are at least 3 recent reviews of water quality models strengths and weaknesses - context and comparison would be helpful for confidence and assumptions	We all understand this is a Take Permit? We know there are some species loss during instances. Since we got a glimpse of an empirical time 2014 for this in SM and another in Comal. Why not look at take trends.		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Evaluate temperatures and decreasing springflow (<80cfs).
	Can we calibrate the Hardy model to 2014 drought data to better understand if the accuracy of the model?	habitat loss, prey decrease, predator accessibility... The bottom line is that a dramatic change in springflow regime for 7 years is a hard hit on the ecosystem		
		Low flow/vegetation interactions at low flow may limit mixing in the lakes, isolating areas of dense vegetation from cool spring flows.		
		Monitor changes to DO and Carbon Dioxide related to vegetation & nutrients etc. during lower flow over the next permit period in both lakes.		
		During earlier periods there were discussions of field level lab simulations to test concepts should resources be shifted to do this level of science for DO and vegetation? (And When)		

Theme	Calibrate, evaluate, and validate the Hardy Model using 2014 data.	Address dynamics of habitat, dissolved oxygen and vegetation loss during low springflow.	Review the outcomes of the 2016 Expanded Water Quality Work Group.	Evaluate temperatures and decreasing springflow (<80cfs).
		Including more protective measures for SSA's as they specifcally relate to low flow and total area protected. Evaluating current SSA boundaries, possibly expanding them during low flows,moving/shifting them, or maybe including more SSAs.		

Appendix D
Springflow Habitat Protection Work Group
Issue 2 Motion and Topics

Springflow Habitat Protection Work Group

Draft Issue 2 Motion

August 21, 2020

Motion to Define Prioritization for Further Work Group Consideration Under Issue 2

Issue 2: The Implementing Committee should ensure a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on Comal Springs riffle beetle (CSRB) populations.

Motion by Myron Hess, second by Charles Kreitler, and later amended upon the suggestion of Jacquelyn Duke and Tom Arsuffi (made orally during August 21, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 2 for consideration in Part 2 of the Work Group's charge related to impacts of extended periods of flow below 80 cfs on CSRB populations:

Topics included under the topic area, or theme, of "substrate, subsurface well, and spring opening investigation of CSRB habitat" but with the removal of the topics specific to substrate investigation, with the addition of monitoring of spring openings in Spring Lake that are proximal to CSRB habitat to assess which openings continue to flow at different levels of low overall flow, and with the addition of the consideration of genetic studies and the results of those studies focused on understanding how low springflow may impact CSRB populations and, particularly, local adaptations exhibited by CSRB associated with different springflow areas.

Theme	Low springflow and impacts on CSRB populations, survival, and life stage development.	Use results of genetic testing to inform study efforts.	Substrate, subsurface well, and spring opening investigation of CSRB habitat.	Study CSRB in San Marcos.
	Does the low flow condition affect the reproduction or life stage development of the beetles even if they can migrate to subsurface layers? Population studies should look at more than just if they can live under those conditions.	The Genetics work that lends itself to the population level understanding appears promising to follow-up on	Which spring openings will still be flowing below 80cfs and what is CSRB habitat like at those locations/flows?	What about CSRB at San Marcos Springs? Why have they never been considered or mentioned?
	Refer to Dr. Nair's dissertation chapter on CSRB water temp and DO limits	Though I am supportive of shallow bio-wells investigations I would like to see some of the less invasive genetic or modeled habitat extent calculations of population before proceeding.	Evaluate flow paths for major spring features at Comal Springs	Are the limited beetles in San Marcos same as Comal?
	What are the 'normal' beetle population fluctuations, and how do low flow (<80cfs) alterations differ from this? Are the beetles dying off or are beetles simply migrating deeper into the springs?	Before we have the ability to determine CSRB retreat into orifices and re-emergence as safeguard against low-flow, we need to wait for some of the genetics/capturing studies to be advanced.	(1) Developing a spatial-temporal map of which springs stop flowing as spring flow decreases, (2) evaluate how these changes influence CSRB suitable habitat availability, and (3) measuring/modeling CSRB habitat availability and connectivity between springs which cease to flow and more persistent spring flow orifices as spring flow decreases.	Monitoring spring flow output in spring lake proximal to CSRB habitat - how do these springs respond to low flow conditions?
	The current modeling being done with the occupancy survey data will be hard pressed to say much about low spring flows, or the relationships between flow and abundance/ CSRB count.		Additional detailed geology could be obtained with shallow geophysical surveys run along both the down thrown and upthrown blocks. A similar survey was conducted at Barton Springs and showed some interesting anomalies. Most of the CSRBs appear to be associated with springs directly discharging from Edwards Limestone on the western wall of the lake (upthrown block). CSRBs do not appear to be prolific in the surface alluvial sediments on the downthrown side. Geophysical surveys on the upthrown block along the lake front would be difficult, but possible. Electrical anomalies might indicate presence of cave features. A grid-oriented survey on the down thrown block might also indicate anomalies in the shallow subsurface that might indicate the presence of caves.	
			Monitoring groundwater levels from the upthrown and downthrown blocks during low spring flow. I am not sure whether water level data are still being collected from the LCRA well or the Panther Canyon well. Both of these wells, however, monitor relatively deep conditions of both fault blocks, and do not monitor shallow groundwater conditions where CSRB may live. A shallow monitoring well on the upthrown block could be installed in Panther Canyon. A shallow monitoring well of the surface geology/ soils overlying the downthrown block could be installed in a flat area east of Spring Run #3. Drilling data of these two wells would be integrated into any proposed geophysical surveys to help ground truth electrical data.	
			Subsurface flow paths of the areas CSRB could "retreat" to; food resources when flows are low; monitoring of flow rates during low flow conditions.	
			How do subsurface flow paths change? Where do the beetles go?	
			Why do we make the assumption that the CSRB are fragile and not able to handle low? They survived the drought of the 50's. We truly do not know near enough about the CSRB to make assumptions.	
			Where do the beetles go during low flow?	
			Spatial habitat modeling to evaluate changes in spring flow orifices and flow conditions from declining flows below 80cfs, with CSRB habitat and connectivity between CSRB habitats.	
			What happens to individual spring openings as flows drop below 80?	

Theme	Low springflow and impacts on CSRB populations, survival, and life stage development.	Use results of genetic testing to inform study efforts.	Substrate, subsurface well, and spring opening investigation of CSRB habitat.	Study CSRB in San Marcos.
			Undertake flow assessments of flow at individual spring openings in Comal system during low flow periods.	
			Additional hydrologic/ dye studies that may better define flow paths to springs associated with known riffle beetle habitat. It appears that most of the riffle beetle habitats are associated with limestones springs on the upthrow block at Comal Springs and San Marcos Springs (Hotel Springs). Under low flow conditions (>80cfs) it will be important to know which springs have the highest population of beetles and which springs are most prone to going dry. This can be tested by a.Estimate the number of individuals at each spring or spring complex to define which springs/spring complexes are the most critical to maintain. b.Determine the elevations of each spring/spring complex to determine which spring/spring complexes will go dry first with declining spring flows and water levels, primarily in the upthrown block (monitoring in Panther Canyon well). c.Water level data for Panther Canyon and LCRA data should be available. Data transducers should still be collecting data from theses two wells. If low flow evaluation for the drought period of "2012" has not been done, it should. d.Determine discharge rates for critical springs at low flows. Difficult task. e.Dye tracers studies. Review all previously conducted dye studies at Comal Springs to possibly determine flow paths from the upthrown block to individual springs. If possible conduct new dye studies during low flow conditions to substantiate important flow paths.	

Appendix E
Springflow Habitat Protection Work Group
Issue 3 Motion and Topics

Springflow Habitat Protection Work Group

Draft Issue 3 Motion

September 9, 2020

Motion to Define Prioritization for Further Work Group Consideration Under Issue 3

Issue 3: The Implementing Committee should ensure that a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on San Marcos salamander populations, particularly for populations in the area below Spring Lake dam, and on Texas wild-rice and other vegetation serving as habitat for fountain darters downstream of Spring Lake dam, including consideration of impacts from recreation.

Motion by Myron Hess, second by Melani Howard with no further discussion (made orally during September 9, 2020 meeting and later formalized in writing for consideration for formal action):

Move that the Work Group carry forward the following topics under Issue 3 for consideration in Part 2 of the Work Group's charge related to potential impacts of predicted extended periods of flow below 80 cfs on San Marcos salamander populations, particularly for populations in the area below Spring Lake dam, and on Texas wild-rice and other vegetation serving as habitat for fountain darters downstream of Spring Lake dam, including consideration of impacts from recreation:

Topics included under the topic area, or theme, of Recreation Impacts and Management, Habitat Management, and Spring Discharge and with the understanding that further consideration of the distribution of flow over the Spring Lake Dam between 80-45 cfs total flow also is included.

Theme	Comment
Dam Impacts	Can we have further connection of how the dam impacts flow in the below Spring Lake specificity???
Dam Impacts	Several years ago we had the spillway elevation of the dam surveyed and found that the eastern end of the dam was higher than the western end. So that at low flow periods most of the discharge would be on the western side rather than on the eastern side where the San Marcos salamander lived below the dam. I believe this was changed when restoration work was done on the dam so that more flow from the lake went to the eastern side..
Habitat Management	We received early presentations on this item that I recall did not indicate concerns with current in place gardening and controls.
Habitat Management	Impacts to: population size, reproduction and survival, prey base, water quality, sediment impacting habitat, changes in vegetation. Also if there's ways for management to mitigate impacts of low flows on habitat.
Habitat Management	Establish a mapped baseline of habitat necessary to maintain minimal fountain darter populations - this provides a tool for decision making on behalf of local, state and federal agencies.
Habitat Management	Habitat availability is a reflection of flow conditions - how are those conditions being influenced by management of human activity as they near 30 cfs? And earlier? Should there be additional controls based on evidence?
Recreation Impacts and Management	What specific recreational impacts exist and what are their data-supported impacts to wild-rice and fountain darters?
Recreation Impacts and Management	Recreation and TWR: re-evaluating exclosures in the SSA to ensure they are in the most effective placement for TWR, and recommendation to include more closed areas triggered by low flow conditions as wadeable areas shift/change with decreasing flow levels.
Recreation Impacts and Management	Evaluate approaches for delineation of recreational exclosures that provide readily available information to adjust boundaries in response to changes in flow and vegetation coverage.
Recreation Impacts and Management	Impacts recreation will have on species when flow is low. Work with biologists from state and federal. How prepared refugia is for salvage events and for how long it is reliable.
Recreation Impacts and Management	Not a study need, but a recommendation for an official SSA 'exclusion' and signage to protect the salamander habitat below Spring Lake Dam from recreation impacts (people wading and sitting on the rocks below the dam).
Recreation Impacts and Management	Evaluate approaches for adjusting recreational exclosures in area just downstream of Spring Lake Dam to protect SM salamander as occupied habitat changes.
Recreation Impacts and Management	Develop updated bathymetry data/map for the San Marcos River to evaluate SAV and wadeable areas to inform areas threatened by recreation impacts during low flow.
Recreation Impacts and Management	Recent photographs in the Austin American of the recreational use of the San Marcos River were eye opening. The river was absolutely packed with people mostly without masks, which was the point of the article. In an extended low period, we should expect to see even more people “bathing”. It may not be stoppable. So much for the wild rice!
Spring Discharge	Consider the change in Spring Lake Springs also. What happens to available salamander spring habitat in the lake as flows drop?
Spring Discharge	Most of the spring discharge probably comes from the upthrown block and not the deeper confined section. There may not be any discharge from the deeper confined section as is observed at Comal Springs. Deep confined discharge may stop at Comal Springs.
Spring Discharge	The discharge curves for San Marcos Springs are very different than for Comal Springs. The spring flow for Comal can be very spiky, correlates very closely to J-17 water levels (in San Antonio), San Marcos Spring flow does not. Often San Marcos flows do not track Comal Springs. Spring flow at San Marcos often shows flood events on the Guadeloupe River.
Spring Discharge	Spring discharge is predominantly from the bottom of Spring Lake. The only location for discharge from the cliff face on the western side is from Hotel Springs. It is interesting to note that the southern springs are slightly warmer than the northern springs and have a small difference in chemistry. The northern springs may be more locally sourced whereas the southern springs may come from a more regional flow in the Edwards.
Spring Discharge*	Monitor changes in spring flow emergence within Spring Lake during periods of flow below 80 cfs to better understand sedimentation and potential impacts on SM salamander.

*Comment was put into multiple themes

Appendix F
Springflow Habitat Protection Work Group
Issue 4 Motion and Topics

Excerpt from EAHCP referencing issue to be studied.	Page in EAHCP	Status of studies or alternative approach
Comal Springs		
F. "In addition, the projected extended periods of consecutive days below 150 cfs, 120 cfs, and 80 cfs for the HCP will require additional evaluation during the Phase I AMP. Each of those three flow levels is a take threshold. At 150 cfs, take for the fountain darter starts to occur in the Upper Spring Run reach. At 120 cfs, Spring Runs 1 and 2 start to constrict and go subsurface, and below 80 cfs Spring Run 3 also constricts and goes subsurface." "Relative to the fountain darter, during the drought of record the system was below 150 cfs for 1,063 straight days (nearly 3 years). With the Phase I and Phase II flow-related measures in the HCP, the consecutive period below 150 cfs is projected to be approximately 2,760 days (or over 7.5 years). That is longer than the Phase I period itself, and approximately 3 times the life span of a fountain darter in the wild. With respect to the Comal Springs riffle beetle, during the drought of record, springflow in the Spring Runs 1 and 2 were below 120 cfs for 750 consecutive days (just over 2 years straight) and the riffle beetle as well as the other Covered invertebrate species survived. However, even with the flow-related measures (Phase I and II), flows below 120 cfs are projected for approximately 2,400 consecutive days (over 6.5 years). During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed."	Page 4-56	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.
H. "A concern noted in Hardy (2011) is that at 30 cfs total Comal springflow, there is the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel. This could affect water quality in the Old Channel and the success of the proposed ERPA, and, thus, this flow pattern is proposed for study during Phase I."	Page 4-74	Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits
I. "Three main concerns noted in Hardy (2011) regarding this flow regime were 1) the potential for aquatic vegetation die-off and subsequent dissolved oxygen (DO) problems in Landa Lake, 2) the reduction in larval production of fountain darters that would likely be experienced, and 3) the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel, which could result in water quality impacts, including higher temperatures, greater than currently predicted in the Old Channel. Regarding the first concern, the aquatic vegetation question remains unanswered and assessing aquatic vegetation dynamics relative to springflow is a critical applied research component in the AMP. … The third concern is directly related to uncertainty associated with the temperature modeling and will require additional hydrodynamic modeling with follow-up water temperature modeling in addition to intensified spatial monitoring during low-flow events, which are proposed HCP research components."	Page 4-88	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.
S Towards the end of Phase I, specific studies will be designed and conducted to test the validity of ecological model results. This may involve simple or complex parameters and single or multiple low-flow events depending on Phase II questions that may be relevant at that time.	Page 6-11	None.
San Marcos Springs		
AA An assumption was made that a minimum number of salamanders would survive in Spring Lake as long as some springflow was provided. Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows. It has been observed in Landa Lake (Comal system) that as upwelling springs in the Upper Spring Run area cease flowing, siltation ensues and salamanders retreat from those areas. Although observed at Comal Springs, flows have not reached a level over the past decade at San Marcos Springs to cause a similar condition in Spring Lake, and as such this assumption is currently unfounded. Similarly, establishing a cutoff point on habitat suitability within Spring Lake would be equally unfounded at this time. This again highlights the importance of the applied research and mechanistic ecological modeling to be developed for this species as part of the AMP.	Page 4-140.	None