APPENDIX F
AGENDAS, MINUTES, AND CHARGES AND REPORTS FOR WORK GROUPS ONLY,
OF EAHCP COMMITTEES FOR 2019

Appendix F1 – Implementing Committee

Appendix F2 – Comprehensive Phase II Work Plan Work Group

Appendix F3 – Comal Springs Riffle Beetle Work Group

Appendix F4 – EAHCP Budget Work Group

Appendix F5 – Adaptive Management Stakeholder Committee

Appendix F6 – Adaptive Management Science Committee

Appendix F7 – Research Work Group
APPENDIX F1
IMPLEMENTING COMMITTEE – 2019 ACTIVITIES

January 24, 2019  Meeting Agenda
                 Meeting Minutes
March 21, 2019   Meeting Agenda
                 Meeting Minutes
May 23, 2019    Meeting Agenda
                 Meeting Minutes
October 3, 2019  Meeting Agenda
                 Meeting Minutes
December 19, 2019 IC Meeting Agenda
                 IC Meeting Minutes
A meeting of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan will be held on the date, time, and location stated above.

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements and Reports

4. Approval of Minutes

4.1 Approval of previous committee meeting minutes  
- October 18, 2018

5. Reports

5.1 Receive report from Scott Storment, EAHCP Program Manager and Cindy Loeffler, Phase II Work Group Chair, on the draft Comprehensive Phase II Work Plan.

6. Individual Consideration

6.1 Consider staff recommendation to approve extending the Funding and Management Agreement (FMA) Strategic Adaptive Management proposal and Comprehensive Phase II Work Plan due dates to March 21, 2019.

7. Future Meetings

8. Questions from the Public

9. Adjourn
Olivia Ybarra
Habitat Conservation Plan Coordinator

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

Chairman Enders called the meeting to order at 10:30 AM.

Present: Mark Enders, Roland Ruiz, Darren Thompson, Kimberly Meitzen, Tom Taggart and Nathan Pence.

2. Public Comment

There were no citizens who requested to address the Implementing Committee.

3. EAHCP Program Manager Announcements and Reports

4. Approval of Minutes

4.1 Approval of previous committee meeting minutes
- October 18, 2018

A motion was made by Darren Thompson, seconded by Tom Taggart to approve meeting minutes from October 18, 2018.

The motion was approved.

5. Reports

5.1 Receive report from Scott Storment, EAHCP Program Manager and Cindy Loeffler, Phase II Work Group Chair, on the draft Comprehensive Phase II Work Plan.

6. Individual Consideration
6.1 Consider staff recommendation to approve extending the Funding and Management Agreement (FMA) Strategic Adaptive Management proposal and Comprehensive Phase II Work Plan due dates to March 21, 2019.

A motion was made by Tom Taggart, seconded by Mark Enders, to approve extending the Funding and Management Agreement (FMA) Strategic Adaptive Management proposal and Comprehensive Phase II Work Plan due dates to May 23, 2019.

The motion was approved.

7. Future Meetings

Cindy Loeffler made a motion to begin EAHCP Committee Meetings no earlier than 10:00 AM. The Committee approved the motion by consensus.

8. Questions from the Public

9. Adjourn

There being no further business to discuss, the meeting adjourned at 11:33 AM.

___________________________
Robert Mace
Secretary, Implementing Committee
NOTICE OF OPEN MEETING

EAHCP Implementing Committee

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

Thursday, March 21, 2019 10:00 AM EAA Board Room

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

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements

3.1

- Hydrologic Update
- SAWS ASR
- Budget Reports
- EAHCP Program Management
- Spring Communities Update

4. Approval of Minutes

4.1 Approval of previous committee meeting minutes.

- January 24, 2019

5. Individual Consideration

5.1 Consider staff recommendation for approval of the 2018 Edwards Aquifer Habitat Conservation Plan Annual Report submittal to the U.S. Fish and Wildlife Service.

5.2 Consider staff recommendation to approve an amendment to the 2019 City of San Marcos Work Plan.

5.3 Consider staff recommendation to approve an amendment to the 2019 Edwards Aquifer Authority Work Plan.
5.4 Consider staff recommendation to approve an amendment to the Edwards Aquifer Habitat Conservation Plan Program FY2019 Funding Application of the Edwards Aquifer Authority in the amount not to exceed $2,398,190.

6. Reports

6.1 Receive report from Scott Storment, EAHCP Program Manager, on EAHCP Resolution No. 05-19-001, related to an analysis and validation of the Phase I to Phase II transition.

6.2 Receive report from Scott Storment, EAHCP Program Manager, on the final draft of the Comprehensive Phase II Work Plan.

7. Future Meetings

8. Questions from the Public

9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

## EAHCP Implementing Committee

*Mark Enders (New Braunfels), Chairman*

*Robert Mace (Texas State University), Nathan Pence (GBRA), Roland Ruiz (EAA), Tom Taggart (San Marcos), and Darren Thompson (SAWS)*

*Scott Storment - EAHCP Program Manager*

<table>
<thead>
<tr>
<th>Thursday, March 21, 2019</th>
<th>10:00 AM</th>
<th>EAA Board Room</th>
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1. **Call to Order**

   Chairman Enders called the meeting to order at 10:03 AM.

   Present: Mark Enders, Roland Ruiz, Darren Thompson, Robert Mace, Tom Taggart and Nathan Pence.

2. **Public Comment**

   Annalisa Peace, Greater Edwards Aquifer Alliance, presented House Bill No. 4110 to the Implementing Committee.

3. **EAHCP Program Manager Announcements**

3.1

   - Hydrologic Update
   - SAWS ASR
   - Budget Reports
   - EAHCP Program Management
   - Spring Communities Update

4. **Approval of Minutes**

4.1 Approval of previous committee meeting minutes.

   - January 24, 2019

   A motion was made by Roland Ruiz, seconded by Darren Thompson to approve meeting minutes from January 24, 2019.
   The motion was approved.

5. **Individual Consideration**
5.1 Consider staff recommendation for approval of the 2018 Edwards Aquifer Habitat Conservation Plan Annual Report submittal to the U.S. Fish and Wildlife Service.

A motion was made by Tom Taggart, seconded by Darren Thompson, to approve submitting the 2018 Edwards Aquifer Habitat Conservation Plan Annual Report to the U.S. Fish and Wildlife Service. The motion was approved.

5.2 Consider staff recommendation to approve an amendment to the 2019 City of San Marcos Work Plan.

A motion was made by Robert Mace, seconded by Roland Ruiz, to approve amendments to the 2019 City of San Marcos Work Plan. The motion was approved.

5.3 Consider staff recommendation to approve an amendment to the 2019 Edwards Aquifer Authority Work Plan.

A motion was made by Tom Taggart, seconded by Roland Ruiz, to approve amendments to the 2019 Edwards Aquifer Work Plan. Due to a potential conflict of interest, Robert Mace abstained from the Committee's vote. The motion was approved.

5.4 Consider staff recommendation to approve an amendment to the Edwards Aquifer Habitat Conservation Plan Program FY2019 Funding Application of the Edwards Aquifer Authority in the amount not to exceed $2,398,190.

A motion was made by Roland Ruiz, seconded by Tom Taggart, to approve amendments to the Edwards Aquifer Authority FY2019 Funding Application. The motion was approved.

6. Reports

6.1 Receive report from Scott Storment, EAHCP Program Manager, on EAHCP Resolution No. 05-19-001, related to an analysis and validation of the Phase I to Phase II transition.

Scott Storment, EAHCP Program Manager, briefed the committee on EAHCP Resolution No. 05-2019-001 and Memorandum. Action to approve the Resolution will be determined by the Implementing Committee at the May 23, 2019 meeting.
6.2 Receive report from Scott Storment, EAHCP Program Manager, on the final draft of the Comprehensive Phase II Work Plan.

Scott Storment, EAHCP Program Manager, briefed the committee on the comments that were provided and applied to the final draft of the Comprehensive Phase II Work Plan. Action to approve the Comprehensive Phase II Work Plan will be determined by the Implementing Committee at the May 23, 2019 meeting.

7. Future Meetings

8. Questions from the Public

9. Adjourn

There being no further business to discuss, the meeting adjourned at 11:50 AM.

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

EAHCP Implementing Committee

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

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

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

AGENDA

1. Call to Order

2. Public Comment

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

4. Reports
   4.1 Receive report from Chuck Ahrens, Edwards Aquifer Authority, on 2018 Edwards Aquifer authorized pumping withdrawals.
   4.2 Receive report from Scott Storment, EAHCP Program Manager, on Joint Base San Antonio’s use of the Edwards Aquifer and the impact on the EAHCP.

5. Individual Consideration
   5.1 Consider staff recommendation to approve the EAHCP Comprehensive Phase II Work Plan.
   5.2 Consider staff recommendation to approve EAHCP Resolution No. 05-19-001.
   5.3 Consider staff recommendation to approve the EAHCP Nonroutine Adaptive Management Process Proposal.
5.4 Consider recommendation to direct EAHCP Program Manager to submit the necessary documentation regarding the approved Nonroutine Adaptive Management Process Proposal to the U.S. Fish and Wildlife Service on behalf of the Implementing Committee.

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

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

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

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

6. Future Meetings

7. Questions from the Public

8. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

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

Thursday, May 23, 2019 10:00 AM
City of New Braunfels Live Stream:
https://newbraunfels.legistar.com/Calendar.aspx

1. Call to Order

Chairman Enders called the meeting to order at 2:30 PM.

Present: Mark Enders, Melani Howard, Roland Ruiz, Darren Thompson, and Robert Mace.

2. Public Comment

There were no citizens who requested to address the implementing Committee.

3. Approval of Minutes

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

A motion was made by Darren Thompson, seconded by Roland Ruiz, to approve meeting minutes from March 21, 2019. The motion was approved.

4. Reports

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

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

5. Individual Consideration

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

A motion was made by Mark Enders, seconded by Melani Howard, to approve the EAHCP Comprehensive Phase II Work Plan. The motion was approved.
5.2 Consider staff recommendation to approve EAHCP Resolution No. 05-19-001.

A motion was made by Roland Ruiz, seconded by Darren Thompson, to approve the EAHCP Resolution No. 05-19-001. The motion was approved.

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

Roland Ruiz suggested that the motion to approve the Nonroutine Adaptative Management Process Proposal was made with an understanding that the EAHCP Program Manager will provide updates to the Implementing Committee on the Stakeholder Committee's recommendation to create a springflow Work Group. Scott Storms, EAHCP Program Manager, assured the Implementing Committee that a report will be provided on the Work Group's discussions regarding the Stakeholder Committee concerns with springflow related issues.

The motion was made by Roland Ruiz, seconded by Robert Mace, to approve the Nonroutine Adaptive Management Process Proposal. The motion was approved.

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

A motion was made by Robert Mace, seconded by Roland Ruiz, to direct the EAHCP Program Manager to submit the necessary documentation regarding the Nonroutine Adaptive Management Process Proposal to the U.S. Fish and Wildlife Service on behalf of the Implementing Committee. The motion was approved.

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

A motion was made by Robert Mace, seconded by Roland Ruiz, to approve the 2020 City of New Braunfels EAHCP Work Plan. The motion was approved.

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

A motion was made by Mark Enders, seconded by Roland Ruiz, to approve the 2020 City of San Marcos/Texas State University EAHCP Work Plan. The motion was approved.
5.7 Consider staff recommendation to approve the 2020 Edwards Aquifer Authority Work Plan.

A motion was made by Mark Enders, seconded by Roland Ruiz, to approve the 2020 Edwards Aquifer Authority EAHCP Work Plan. The motion was approved.

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

A motion was made by Darren Thompson, seconded by Roland Ruiz, to approve the amendments to the 2019 City of New Braunfels EAHCP Work Plan. The motion was approved.

6. Future Meetings

7. Questions from the Public

8. Adjourn

There being no further business to discuss, the meeting adjourned at 3:55 PM.

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

[Signature]

Robert Mace
Secretary, Implementing Committee
NOTICE OF OPEN MEETING

EAHCP Implementing Committee

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

Thursday, October 3, 2019 10:00 AM EAA Board Room

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

AGENDA

1. Call to Order

2. Public Comment

3. Approval of Minutes

3.1 Approval of previous committee meeting minutes
   - May 23, 2019

4. Reports

4.1 Receive report from Jamie Childers, EAHCP Manager, on the 2019 Annual Report timeline.

4.2 Receive report from Scott Storment, EAHCP Program Manager, on the 2019 EAHCP Budget Work Group Report.

4.3 Receive report from Scott Storment, EAHCP Program Manager, regarding comments provided by the Stakeholder Committee related to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan.

5. Individual Consideration

5.1 Consider staff recommendation to approve the Edwards Aquifer Authority EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.

5.2 Consider staff recommendation to approve the City of New Braunfels EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.
5.3 Consider staff recommendation to approve the City of San Marcos amendments to the 2019 Work Plan and Funding Application.

5.4 Consider staff recommendation to approve the City of San Marcos EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.

6. Future Meetings

7. Questions from the Public

8. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

AGENDA

1. Call to Order

Chairman Enders called the meeting to order at 12:05 PM.

Present: Mark Enders, Tom Taggart, Roland Ruiz, Darren Thompson, and Robert Mace.

2. Public Comment

There were no citizens who requested to address the Implementing Committee.

3. Approval of Minutes

3.1 Approval of previous committee meeting minutes
- May 23, 2019

A motion was made by Darren Thompson, seconded by Tom Taggart, to approve meeting minutes from May 23, 2019. The motion was approved.

4. Reports

4.1 Receive report from Jamie Childers, EAHCP Manager, on the 2019 Annual Report timeline.

4.2 Receive report from Scott Storment, EAHCP Program Manager, on the 2019 EAHCP Budget Work Group Report.
4.3 Receive report from Scott Storment, EAHCP Program Manager, regarding comments provided by the Stakeholder Committee related to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan.

Tom Taggart requested a process for future communications between the Implementing Committee and EAHCP staff regarding correspondence to the U.S. Fish and Wildlife Service.

5. **Individual Consideration**

5.1 Consider staff recommendation to approve the Edwards Aquifer Authority EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.

A motion was made by Tom Taggart, seconded by Roland Ruiz, to approve the Edwards Aquifer Authority EAHCP 2020 Funding Application and amendments to the 2020 Work Plan. The motion was approved.

5.2 Consider staff recommendation to approve the City of New Braunfels EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.

A motion was made by Roland Ruiz, seconded by Robert Mace, to approve the City of New Braunfels EAHCP 2020 Funding Application and amendments to the 2020 Work Plan. The motion was approved.

5.3 Consider staff recommendation to approve the City of San Marcos amendments to the 2019 Work Plan.

A motion was made by Mark Enders, seconded by Roland Ruiz, to approve the City of San Marcos amendments to the 2019 Work Plan. The motion was approved.

5.4 Consider staff recommendation to approve the City of San Marcos EAHCP 2020 Funding Application and amendments to the 2020 Work Plan.

A motion was made by Roland Ruiz, seconded by Tom Taggart, to approve the City of San Marcos EAHCP 2020 amendments to the 2020 Funding Application and Work Plan. The motion was approved.

6. **Future Meetings**

The Implementing Committee (IC) expressed interest in being involved with the permit rollover options consultant at an early stage. EAHCP program management agreed with the proposal to involve IC members early in the process, specifically to conduct individual interviews with each IC member. Consensus was reached by the IC to participate in early stage individual interviews with the consultant. IC input will be integrated from the inception of the consultancy. Also, the IC will have a workshop with the consultant several months after the initial interviews to discuss the working draft of the report.
7. Questions from the Public

None.

8. Adjourn

There being no further business to discuss, the meeting adjourned at 1:00 PM.

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

_____________________________________________
Robert Mace
Secretary, Implementing Committee
NOTICE OF OPEN MEETING
EAHCP Implementing Committee

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

Thursday, December 19, 2019 10:00 AM EAA Board Room

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

AGENDA

1. Call to Order

2. Public Comment

3. Approval of Minutes

3.1 Approval of previous committee meeting minutes
   - October 3, 2019

4. EAHCP Program Manager Announcements

5. Reports

5.1 Receive report from Jamie Childers, EAHCP Manager, on the 2019 National HCP Coalition Annual Meeting attended by EAHCP staff.

5.2 Receive report from Chuck Ahrens, EAA Director of Water Resources, on the EAA Emergency First Responders Project.

6. Individual Consideration

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

6.2 Consider staff recommendation to approve the Edwards Aquifer Authority amendments to the 2020 Work Plan.

6.3 Consider staff recommendation to appoint new officers to the 2020 Implementing Committee.
7. Future Meetings

7.1 EAHCP 2020 Committee Meetings

8. Questions from the Public

9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

AGENDA

1. Call to Order

Chairman Enders called the meeting to order at 12:17 PM.

Present: Mark Enders, Tom Taggart, Roland Ruiz, Darren Thompson, Robert Mace, and Nathan Pence.

2. Public Comment

There were no citizens who requested to address the Implementing Committee.

3. Approval of Minutes

3.1 Approval of previous committee meeting minutes
- October 3, 2019

A motion was made by Tom Taggart, seconded by Roland Ruiz, to approve the meeting minutes from October 3, 2019.

4. EAHCP Program Manager Announcements

Scott Storment, EAHCP Program Manager, provided the Committee with updates on the permit options analysis with ICF Consulting, the Springflow Habitat Protection Work Group, and the USFWS communication strategy.

5. Reports

5.1 Receive report from Jamie Childers, EAHCP Manager, on the 2019 National HCP Coalition Annual Meeting attended by EAHCP staff.
6. Individual Consideration

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

A motion was made by Darren Thompson, seconded by Roland Ruiz, to approve the City of New Braunfels EAHCP 2019 Work Plan and Funding Application amendments.

6.2 Consider staff recommendation to approve the Edwards Aquifer Authority amendments to the 2020 Work Plan.

A motion was made by Tom Taggart, seconded by Mark Enders, to approve the Edwards Aquifer Authority amendments to the 2020 Work Plan.

6.3 Consider staff recommendation to appoint new officers to the 2020 Implementing Committee.

A motion was made by Mark Enders, seconded by Darren Thompson, to approve the appointment of the new officers for the 2020 Implementing Committee. There were no objections.

7. Future Meetings

7.1 EAHCP 2020 Committee Meetings

At the request of the Implementing Committee, an additional Committee meeting was added to the 2020 calendar. The Committee will convene on August 20, 2020.

8. Questions from the Public

None.

9. Adjourn

There being no further business to discuss, the meeting adjourned at 12:50 PM.
Olivia Ybarra
Habitat Conservation Plan Coordinator

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

Robert Mace
Implementing Committee - Secretary
Edwards Aquifer Habitat Conservation Plan

Report of the 2018 Phase II Work Plan Work Group
Table of Contents

Overview .................................................................................................................................................. 3

Discussion ............................................................................................................................................. 4

Review of the Draft Phase II Work Plan ............................................................................................... 5

Table 1: Work Group Comments on Phase II Work Plan and EAHCP Responses ............................ 7

Additional Concerns and Considerations .............................................................................................. 8

Appendix A: Work Group Charge ......................................................................................................... 9

Appendix B: Work Group Meeting Agendas ......................................................................................... 12

Appendix C: Presentations .................................................................................................................... 15

Appendix D: EAHCP Strategic Adaptive Management Whitepaper .................................................. 38

Appendix E: EAHCP NAS Report 3 Matrix ............................................................................................ 48

Appendix F: Comprehensive Phase I Work Plan .................................................................................. 51
Overview:

At the October 18, 2018 EAHCP Joint Stakeholder and Implementing Committee meeting, the EAHCP Program Manager called for the creation of a Work Group to review and discuss a draft of the Comprehensive Phase II Work Plan. This initial assessment was a precursor to the review required by the EAHCP Implementing Committee (FMA § 4.3). The charge of the Phase II Work Plan Work Group (“Work Group”) consisted of the following tasks (Appendix A):

- To review the draft Comprehensive Phase II Work Plan.
- To participate in coordination conference calls and attend Work Group meetings.
- To provide comments and recommendations on the draft Comprehensive Phase II Work Plan to the EAHCP Program Manager.
- To review and approve the Phase II Work Group Report.

On November 29, 2018, a meeting of the Edwards Aquifer Habitat Conservation (EAHCP) Phase II Work Group was held to review and discuss the draft Comprehensive Phase II Work Plan.

A second Phase II Work Group meeting was held on December 5, 2018 as a continuation of the draft Phase II Work Plan review and to address the comments and recommendations made during the initial Work Group meeting.

Members of the Phase II Work Group include:

- Cindy Loeffler, Texas Parks and Wildlife Department (Chair)
- Mark Enders, City of New Braunfels (Co-Chair)
- Patrick Shriver, San Antonio Water System
- Melani Howard, City of San Marcos
- Nathan Pence, Guadalupe-Blanco River Authority
- Julia Carrillo, Edwards Aquifer Authority

The Work Group operated by consensus and attendees actively participated in the discussion. The agendas, meeting materials and presentations are included as appendices to this report. The Work Group’s comments and recommendations to the draft Comprehensive Phase II Work Plan are summarized below.

Work Group Discussion:

The EAHCP Strategic Adaptive Management Process (SAMP), as defined in the Funding and Management Agreement (FMA), represents the transition from Phase I (2013-2020) to Phase II (2020-2028) of the program and associated Incidental Take Permit (ITP). The purpose of the SAMP is to identify
specific Conservation Measures to be implemented during Phase II of the ITP (FMA § 7.6.3). In other words, SAMP is defined as the formal use of adaptive management (FMA § 7), as the EAHCP transitions from Phase I to Phase II, to answer the following questions (FMA § 7.13.7):

- Are any of the current Biological Objectives not necessary to meet the Biological Goals?
- Are the current Biological Objectives adequate to meet the Biological Goals?
- Are any of the current Phase I Conservation Measures not necessary to meeting the Biological Objectives?
- Are the current Phase I Conservation Measures meeting the Biological Objectives?

EAHCP staff and the Phase II Work Group utilized the National Academy of Sciences’ Review of the Edwards Aquifer Habitat Conservation Plan: Report 3 (hereafter referred to as Report 3), the EAA Drought of Record MODFLOW simulations, and the first six years of EAHCP monitoring and management experience to resolve those questions.

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

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

The members of the Work Group agreed that the development of the Phase II Work Plan will consist of the second potential outcome, the “continuation of Phase I Conservation Measures with changes or expansion.”

This determination was followed by a discussion of the predominant conclusions identified in the National Academy of Sciences’ (NAS) Report 3. The Science Review Panel reviewed the effectiveness of EAHCP Conservation Measures meeting the Biological Objectives and the likelihood of the Biological Objectives meeting the long-term biological goals. In summation, the findings of the NAS consensus report determined the following: 1) Phase I Conservation Measures and activities are achieving the biological goals; and 2) the Science Review Panel was unable to reach a determination on the effectiveness of the Conservation Measures relating to the Comal Springs riffle beetle.

In regard to the Funding and Management Agreement, the outcome of the Science Review Panel’s (SRP) assessment of EAHCP activities subscribed to the following actions:

- **If Phase I Measures are Achieving Objectives:** FMA § 7.13.7 (d)

  If the SRP determines that the Scientific Record establishes the Phase I Conservation Measures are achieving the Biological Objectives, then neither the Presumptive Phase II Conservation Measure nor any other Phase II Conservation Measures...
Measure will be pursued.

- If Review Fails or is Inconclusive: FMA § 7.13.7 (f)

If, contrary to its duties as set out in Subsection 7.10.3, the SRP fails to make a determination or determines that the Scientific Record is inconclusive about whether the Phase I Conservation Measures are achieving the Biological Objectives, the Implementing Committee will coordinate with the Service as part of the AMP, and attempt to reach a conclusion that the Presumptive Phase II Conservation Measure or another Phase II Conservation Measure either is or is not necessary to achieve the Biological Objectives.

The Work Group agreed by consensus that the actions defined in the FMA will be used to dictate the direction of the Conservation Measures and management activities described in the draft Comprehensive Phase II Work Plan.

Additionally, EAHCP staff presented a summary of the draft MODFLOW simulation results to the Work Group. Results of the draft MODFLOW Drought of Record (DOR) simulations – with EAHCP activities “as implemented” and VISPO forbearance – demonstrated 29.6 cfs springflow at the Comal Springs, which is short of the 30.0 cfs target. However, the final MODFLOW DOR simulations and conclusions are to be completed in Spring 2019 and will be presented at that point.

One item important to note, as described in Report 3, the Science Review Panel arrived at an ‘effective’ ranking for the ability of the springflow protection measures to meet the springflow objectives. This evaluation was provided given the examination of aquifer and springflow response during the 2013-2014 drought, the conservative nature of the MODFLOW model and the review of the MODFLOW DOR, calibration and validation. The Additional Concerns and Considerations portion of this report includes the Work Groups concerns regarding the outcome of the MODFLOW simulations.

Review of the Draft Phase II Work Plan

A review of the draft Comprehensive Phase II Work Plan was included in the charge of the Work Group. EAHCP staff provided the initial draft and used the NAS consensus report, draft MODFLOW model, FMA and EAHCP program management experience to revise and/or update the Phase I Conservation Measures for Phase II implementation. Furthermore, in the event that the comprehensive Work Plan conflicts with the EAHCP, the EAHCP stands as the binding document.

The following Conservation Measures were completed during Phase I or determined not pertinent to Phase II implementation; therefore, not included in the draft Phase II Work Plan:

- Science Review Panel (FMA § 7.10) – Completed; Report 3 submitted in Fall 2018.
- Ecological Modeling (EAHCP § 6.3.3) – Completed; Ecological Model submitted in Spring 2018.
- Groundwater Modeling (EAHCP § 6.3.2) – Will be completed in Spring 2019.
• Applied Research Facility Experimental Channel at the USFWS National Fish Hatchery and Technology Center (EAHCP § 6.3.4) – Determined not pertinent to Phase II implementation.

• Sessom Creek Sand Bar Removal (EAHCP § 5.4.6) – Removed through nonroutine adaptive management. Funding has been transferred to implement the Impervious Cover and Water Quality Protection Conservation Measure in San Marcos (EAHCP § 5.7.6).

Table 1 is a summary of the comments and revisions provided by the Work Group on the draft Phase II Work Plan Conservation Measures.
<table>
<thead>
<tr>
<th>Item</th>
<th>EAHCP Section Number*</th>
<th>Conservation Measure</th>
<th>Work Group Comment</th>
<th>EAHCP Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.3.1</td>
<td>Biological Monitoring</td>
<td>EAA biological monitoring should include invasive species monitoring to address NAS concerns on Zebra Mussels and other non-native invasive species.</td>
<td>Added invasive species monitoring to biological monitoring.</td>
</tr>
<tr>
<td>2</td>
<td>6.3.1</td>
<td>Biological Monitoring</td>
<td>Based on NAS recommendations, issues with the Comal Springs Riffle Beetle should be addressed.</td>
<td>Included the efforts of the Comal Spring Riffle Beetle Work Group to address NAS concerns.</td>
</tr>
<tr>
<td>3</td>
<td>5.2.3</td>
<td>Management of Public Recreational Use of Comal Springs and River Ecosystems</td>
<td>Add Certificate of Inclusions (COI) and indicate that is a &quot;voluntary effort&quot;.</td>
<td>Voluntary language included in the COI initiative.</td>
</tr>
<tr>
<td>4</td>
<td>5.2.5</td>
<td>Control of Harmful Non-Native Animal Species</td>
<td>Add language to incorporate removal of non-native animal species not otherwise noted.</td>
<td>Added &quot;including, but not limited to&quot; language to be more inclusive of non-native animals species not noted in the conservation measure.</td>
</tr>
<tr>
<td>5</td>
<td>5.2.6</td>
<td>Monitoring and Reduction of Gill Parasites</td>
<td>Reduce the effort of gill parasite monitoring.</td>
<td>Cited BIO-WEST research on the effects of gill parasites on fountain darters in the Comal watershed. Increased monitoring will occur during low flow conditions (&lt;100 cfs).</td>
</tr>
<tr>
<td>6</td>
<td>5.2.8</td>
<td>Native Riparian Habitat Restoration (Comal Springs Riffle Beetle)</td>
<td>Fine sediment removal covering the springs will occur in coordination with TPWD, as necessary.</td>
<td>Added language to address Work Group's comment.</td>
</tr>
<tr>
<td>7</td>
<td>5.2.9</td>
<td>Reduction of Non-native Species Introduction and Live Bait Prohibition</td>
<td>Include outreach and education as a component in the effort to reduce non-native species.</td>
<td>Added language to address Work Group's comment.</td>
</tr>
<tr>
<td>8</td>
<td>5.7.1</td>
<td>Native Riparian Habitat Restoration</td>
<td>Coordination with private landowners should occur on a volunteer basis.</td>
<td>Added language to address Work Group's comment.</td>
</tr>
<tr>
<td>9</td>
<td>5.3.2, 5.4.2</td>
<td>Management of Recreation in Key Areas</td>
<td>Include establishment of access points on the east and west banks of the San Marcos River near Spring Lake Dam; update conservation crew efforts to occur &quot;as needed&quot;; include installation and maintenance of exclusion barriers by conservation crew</td>
<td>Added language to address Work Group's comments.</td>
</tr>
<tr>
<td>10</td>
<td>5.3.2.1</td>
<td>Management of Public Recreational Use of San Marcos Springs and River Ecosystem</td>
<td>Add Certificate of Inclusions and indicate that is a &quot;voluntary effort&quot;</td>
<td>Voluntary language included in the COI initiative.</td>
</tr>
<tr>
<td>11</td>
<td>5.7.6</td>
<td>Impervious Cover/Water Quality Protection</td>
<td>Include tracking the efforts of BMPs and LID to determine the efficacy of WQPP and Impervious Cover projects</td>
<td>Added language to address Work Group's comments.</td>
</tr>
<tr>
<td>12</td>
<td>5.4.3.1</td>
<td>Management of Submerged and Floating Aquatic Vegetation in Spring Lake</td>
<td>Include tracking SAV maintenance around spring orifices in Spring Lake to address NAS concern.</td>
<td>Added language to address Work Group's comments.</td>
</tr>
<tr>
<td>13</td>
<td>5.5.1</td>
<td>Use of SAWS ASR for Springflow Protection</td>
<td>Work Group provided language referencing the Interlocal Agreement between EAA and SAWS.</td>
<td>Added the language provided to the Work Plan draft.</td>
</tr>
<tr>
<td>14</td>
<td>5.5.1</td>
<td>Use of SAWS ASR for Springflow Protection</td>
<td>The Work Group requested to confirm the frequency of the Regional Advisory Group meetings.</td>
<td>EAHCP Staff confirmed, with Regional Advisory Group documents, that the group is to convene annually, or as needed.</td>
</tr>
<tr>
<td>15</td>
<td>5.6</td>
<td>State Scientific Areas</td>
<td>Include the creation of a state scientific area in the Comal Springs ecosystem, if necessary.</td>
<td>Added language to address Work Group's comments.</td>
</tr>
<tr>
<td>16</td>
<td>N/A</td>
<td>N/A</td>
<td>Use common names to identify species</td>
<td>Common names of species have been included in the Work Plan.</td>
</tr>
</tbody>
</table>

* EAHCP section numbers correspond to the section numbers used in the draft Phase II work plan.
**Additional Considerations:**

In addition to commenting on the Conservation Measures presented in the draft Phase II Work Plan, the Phase II Work Plan Work Group discussed the following concerns for EAHCP Committees to consider throughout their review of the draft Work Plan:

- The costs associated with each Conservation Measure during Phase I (EAHCP § 7.1) were utilized as the basis for Phase II cost estimates. The Work Group suggests a formal review of the Phase II Work Plan costs by the EAHCP Budget Work Group, under the direction of the Implementing Committee.

- EAHCP staff provided a matrix summarizing the National Academy of Sciences’ (NAS) third and final review of the program. EAHCP staff presented the NAS Report 3 matrix to the Work Group and provided an open discussion on each issue. The matrix also included EAHCP plans to address each NAS concern. The Work Group provided comments and made recommendations on the NAS summary. The matrix was updated as a product of that discussion (Appendix E).

- Research indicates that gill parasites (*C. formosanus*) are not a significant threat to fountain darter populations (BIO-WEST, 2017). Based on this report and program management experience, the significance of the “Monitoring and Reduction of Gill Parasites” Conservation Measure in the City of New Braunfels work plan (EAHCP § 5.2.6) should be reevaluated during the transition to the second EAHCP Incidental Take Permit.

- Activity under the “Minimizing Impact of Contaminated Runoff” (EAHCP § 5.7.4) Conservation Measure in the City of San Marcos work plan will likely be completed before the final Phase II Work Plan is approved. The Work Group suggests summarizing the work completed under this measure throughout Phase I or removing it from the Phase II Work Plan.

- In addition to reviewing the National Academy of Sciences’ concerns regarding the Comal Springs riffle beetle (CSRB), the Phase II Work Group recommends that the CSRB Work Group include a discussion to incorporate quantitative monitoring of native habitat restoration and sedimentation rates in the efforts to improve the Conservation Measures relating to the Comal Springs riffle beetle.

- The Work Group discussed concerns of the springflow deficit between the draft MODFLOW simulations and the 30 cfs minimum springflow target requirement for Comal Springs. The Work Group considered this an issue to the development of the Phase II Work Plan and the springflow protection measures. EAHCP staff are investigating additional springflow forbearance scenarios to meet the minimum springflow targets for Comal Springs.
APPENDIX A
WORK GROUP CHARGE
Charge of the Comprehensive Phase II Work Plan Work Group ("Phase II Work Group")
November 21, 2018

Overview

Pursuant to the Funding and Management Agreement (Section 4.3), the Implementing Committee will develop and approve a Comprehensive Phase II Work Plan ("Work Plan"). The EAHCP Program Manager will produce the Work Plan to be presented to Implementing Committee for approval in Spring 2019. The Work Plan will be provided a comment period in early 2019 that will seek specific input from members of the Implementing Committee, Stakeholder Committee, Science Committee, and general public.

As a precursor to this public comment phase, the EAHCP Program Manager has called for a work group to be formed that will review and provide comment to the draft Comprehensive Phase II Work Plan. The Phase II Work Group will be made up of members from the Report 2 NAS Work Group and two additional members from the City of San Marcos and the Guadalupe Blanco River Authority.

Work Group Charge

The Phase II Work Group’s charge consists of the following tasks:

- Review the draft Comprehensive Phase II Work Plan
- Participate in coordination conference calls and attend Work Group coordination meetings
- Provide comments and recommendations to the EAHCP Program Manager
- Review and approve the Phase II Work Group Report

Work Group Administration

The Work Group will be constituted of the following individuals: Cindy Loeffler (Texas Parks & Wildlife Department), Mark Enders (City of New Braunfels), Patrick Shriver (San Antonio Water System), Julia Carrillo (Edwards Aquifer Authority), Nathan Pence (Guadalupe Blanco River Authority), and Melani Howard (City of San Marcos). Ms. Loeffler and Mr. Enders will serve as co-chairs of the Phase II Work Group.

The Work Group will operate by consensus. In the event that consensus is not reached in proposing specific recommendations to the EAHCP Program Manager, the opposing rationales will be identified and recorded for incorporation into a Phase II Work Group Report.

The Work Group will hold their first meeting on November 29, 2018 and a second meeting on December 5, 2018. The intent will be to have a set of recommendations and guidance comments by December 7, 2018 that will be developed into the Phase II Work Group Report. The approval of the Phase II Work Group Report will be targeted for late December 2018.

The draft Phase II Work Plan, that includes the Work Group's comments and recommendations, will be presented to the Implementing and Stakeholder Committee on January 24, 2019. A public comment period will begin on January 24, 2019 and extend until February 15, 2019. The final Comprehensive
Phase II Work Plan is proposed to be presented to the Implementing Committee for approval on March 21, 2019.
APPENDIX B
WORK GROUP MEETING AGENDAS
As requested by the EAHCP Program Manager, the **2018 EAHCP Comprehensive Phase II Work Plan Work Group** (“Phase II Work Group”) has been formed to review and provide comments regarding the EAHCP Draft Comprehensive Phase II Work Plan. A meeting of this Phase II Work Group is scheduled for **Thursday, November 29, 2018 from 12:00pm – 5:00pm at the Edwards Aquifer Authority, 900 E. Quincy St. San Antonio, TX 78215**.

Members of this work group include: Cindy Loeffler (TPWD), Mark Enders (City of New Braunfels), Melani Howard (City of San Marcos), Patrick Shriver (SAWS), Julia Carrillo (EAA), Nathan Pence (GBRA)

At this meeting, the following business may be considered and recommended for the Phase II Work Group action:

1. Call to order - Establish that all members are present or represented.

2. Phase II Work Group Introduction.

3. Presentation of the draft EAHCP Comprehensive Phase II Work Plan
   - **Purpose:** To provide an overview of the draft Phase II Work Plan to the Work Group for comment and recommendations.
   - **Action:** No action required.

4. Consider future meetings, dates, locations, and agendas.
   - The next Phase II Work Group meeting is scheduled for December 5, 2018 at the Edwards Aquifer Authority.

5. Questions and comments.

6. Adjourn.
As requested by the EAHCP Program Manager, the **2018 EAHCP Comprehensive Phase II Work Plan Work Group** (“Phase II Work Group”) has been formed to review the and provide comments regarding the content and direction of EAHCP Draft Comprehensive Phase II Work Plan. A meeting of this Phase II Work Group is scheduled for **Wednesday, December 5, 2018 from 10:00 a.m. – 3:00 p.m. at the Edwards Aquifer Authority, 900 E. Quincy St. San Antonio, TX 78215**.

Members of this work group include: Cindy Loeffler (TPWD), Mark Enders (City of New Braunfels), Melani Howard (City of San Marcos), Patrick Shriver (SAWS), Julia Carrillo (EAA), Nathan Pence (GBRA)

At this meeting, the following business may be considered and recommended for the Phase II Work Group action:

1. **Call to order - Establish that all members are present or represented.**

2. **Presentation of the revised draft EAHCP Comprehensive Phase II Work Plan.**  
   Purpose: To provide an overview of the comments and recommendations made to the revised draft Phase II Work Plan.  
   Action: No action required.

3. **Presentation of the recommendations provided by the National Academies of Sciences’ (NAS) and EAHCP Staff analysis of NAS considerations.**  
   Purpose: To provide the analysis and overview of the recommendations provided by NAS in Report 3.  
   Action: No action required.

4. **Consider future meetings, dates, locations, and agendas.**

5. **Questions and comments.**

6. **Adjourn.**
APPENDIX C
PRESENTATIONS
Comprehensive Phase II Work Plan
Work Group
EAHCP Staff • November 29, 2018

Phase II Work Group Charge

The Phase II Work Group’s charge consists of the following tasks:

- Review the draft Comprehensive Phase II Work Plan
- Participate in coordination conference calls and attend Work Group coordination meetings
- Provide comments and recommendations to the EAHCP Program Manager
- Review and approve the Phase II Work Group Report
What is the Phase II Work Plan?

- “… Phase II Work Plan, which will include descriptions, schedules, and cost estimates for ongoing Phase I Conservation Measures, for Phase II Conservation Measures, and for all Program activities … from January 1, 2020 until expiration of the permit (FMA 4.3)"
- The Comprehensive Phase II Work Plan will be approved by the Implementing Committee by March 1, 2019*.

*requirement of the FMA

Phase II Work Plan

- Pence (5-11-2019), identified four potential outcomes during the Strategic Adaptive Management Process leading to development of the Phase II Workplan:
  1. Continuation of Phase I CMs without change
  2. Continuation of Phase I CMs with changes or expansion
  3. Continuation of Phase I CMs, plus a new Phase II CM(s)
  4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)
Phase II Work Plan Development

- Three primary pieces of information were used in developing the draft Phase II Work Plan.
  - National Academies of Sciences' Consensus report
  - EAA Drought of Record MODFLOW simulations
  - The first 6 years of program management experience

NAS Consensus Report

- FMA 7.13.7 covers actions on Science Review Panel determinations.
  - If some Objectives not necessary (7.13.7a)
  - If Objectives are not adequate (7.13.7b)
  - If Conservation Measures not needed (7.13.7c)
  - If Phase I Measures are achieving objectives (7.13.7d)
  - If Phase I Measures are not achieving objectives (7.13.7e)
  - If review fails or is inconclusive (7.13.7f)
NAS Consensus Report

Conservation Measures
- Springflow Protection: Effective
- Water Quality Protection: Somewhat Effective
- Submerged Aquatic Vegetation (SAV) Management: Effective
- Recreation Management: Effective
- Riparian Management: Effective/Unable to determine

Biological Objectives
- Minimum spring flows or higher
- Minimal water quality deviation
- Establish restoration reaches
- Minimum spring flows or higher
- Minimal water quality deviation
- Restore riparian habitat
- Minimum spring flows or higher
- Acreage during Drought of Record
- Recreation awareness
- Recreational control at low flow
- Minimum spring flows or higher
- Recreational control below
- Spring Lake Dam
- Riparian protection

NAS Consensus Report

Biological Objectives
- Flow
- Water Quality
- Habitat

Long-Term Biological Goals
- Habitat
- Population

Likely, Somewhat Likely
NAS Consensus Report

- The National Academies of Sciences' Consensus report did not find any:
  - Objectives not necessary (7.13.7a) or not adequate (7.13.7b)
  - Phase I Measures not achieving objectives (7.13.7a) or Phase I Measures not needed (7.13.7c)
- The National Academies of Sciences’ Consensus report did find:
  - Phase I Measures are achieving goals (7.13.7e)
  - Failure to make a determination (7.13.7f) on the Comal Springs riffle beetle

MODFLOW Simulations

- Results of the MODFLOW DOR simulations with the HCP ‘as-implemented’ and VISPO forbearance of 40,921 acre-feet:
  - 29.6 cfs at Comal Springs
  - 48.3 cfs at San Marcos Springs
- Pence 6-21-18 and Winterle 10-18-18 detail model assumptions
NAS arrived at an ‘effective’ ranking for the ability of the flow protection measures to meet the springflow objectives given the:

- Examination of aquifer and springflow response during 2013-2014.
- Examination of MODFLOW DOR, calibration, and validation simulations.
- The conservative nature of the MODFLOW model.

"Underprediction of the indicator well levels and prediction of a slower recovery during wet periods means that the model is conservative – in the sense of protecting the listed species and the spring ecosystems – because it overpredicts the impacts of dry conditions on water levels in the wells."
Phase II Work Plan decision point

1. Continuation of Phase I CMs without change
2. Continuation of Phase I CMs with changes or expansion
3. Continuation of Phase I CMs, plus a new Phase II CM(s)
4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)

*Review of the Riffle Beetle was inconclusive.

EAA Phase II Work Plan
Conservation Measures

- San Marcos Aquatic Resources Center and Uvalde National Fish Hatchery–Refugia (§ 5.1.1)
- Voluntary Irrigation Suspension Program Option (§ 5.1.2)
- Regional Water Conservation Program (§ 5.1.3)
- Critical Period Management – Stage V (§ 5.1.4)
EAA Phase II Work Plan
Conservation Measures

- Expanded Water Quality Monitoring (§ 5.7.2)
- Recharge Monitoring (§ 6.2.3)
- Biological Monitoring (§ 6.3.1)
- Coal Tar Sealants (§ 5.7.6)

CONB Phase II Work Plan

- Flow-Split Management in the Old and New Channel (§ 5.2.1)
- Native Aquatic Vegetation Restoration and Maintenance (§§ 5.2.2; 6.3.4.3)
- Management of Public Recreational Use of Comal Springs and River Ecosystems (§ 5.2.3)
- Decaying Vegetation Removal and Dissolved Oxygen Management (§ 5.2.4)
- Control of Harmful Non-Native Animal Species (§ 5.2.5)
- Monitoring and Reduction of Gill Parasites (§ 5.2.6)
- Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries (§ 5.2.7)
**CONB Phase II Work Plan**

- Native Riparian Habitat Restoration (Comal Springs riffle beetle) (§ 5.2.8)
- Reduction of Non-Native Species Introduction and Live Bait Prohibition (§ 5.2.9)
- Litter Collection and Floating Vegetation Management (§ 5.2.10)
- Management of Golf Course Diversions and Operations (§ 5.2.11)
- Management of Household Hazardous Wastes (§ 5.7.5)
- Impervious Cover/Water Quality Protection (§ 5.7.6)
- Native Riparian Habitat Restoration (§ 5.7.1)

**TXST/COSM Phase II Work Plan**

- Texas Wild-Rice Enhancement and Restoration (§§ 5.3.1, 5.4.1)
- Management of Recreation in Key Areas (§§ 5.3.2, 5.4.2)
- Native Riparian Habitat Restoration (§ 5.7.1)
- Control of Non-Native Plant Species (§§ 5.3.8, 5.4.12)
- Control of Harmful Non-Native and Predator Species (§§ 5.3.9, 5.4.13)
- Reduction of Non-Native Species Introduction (§§ 5.3.5, 5.4.11)
- Sediment Removal below Sewell Park (§§ 5.3.6, 5.4.4)
COSM Phase II Work Plan

- Minimizing Impacts of Contaminated Runoff (§ 5.7.4)
- Management of Public Recreational Use of San Marcos Springs and River Ecosystem (§ 5.3.2.1)
- Management of Aquatic Vegetation and Litter below Sewell Park (§ 5.3.3)
- Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (§ 5.3.4)
- Designation of Permanent Access Points/Bank Stabilization (§ 5.3.7)
- Septic System Registration and Permitting Program (§ 5.7.3)
- Management of Household Hazardous Wastes (§ 5.7.5)
- Impervious Cover/Water Quality Protection (§ 5.7.6)

TXST Phase II Work Plan

- Management of Submerged and Floating Aquatic Vegetation in Spring Lake (§ 5.4.3.1)
- Management of Aquatic Vegetation from Sewell Park to City Park (§ 5.4.3.2)
- Diversion of Surface Water (§ 5.4.5)
- Diving Classes in Spring Lake (§ 5.4.7)
- Research Programs in Spring Lake (§ 5.4.8)
- Boating in Spring Lake and Sewell Park (§ 5.4.10)
SAWS Phase II Work Plan

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

TPWD Phase II Work Plan

- State Scientific Areas (§ 5.6)
How are we addressing NAS/MODFLOW comments

- Abiding by FMA § 7.13.7 on the “Action of Science Review Panel Determinations”. Objectives and Conservation measures were all achieving, or in the case of the CSRB, ‘cannot be determined’.
- The EAA has engaged with the USGS to determine the uncertainty surrounding the MODFLOW model.
- The EAHCP program has identified issues with SAV, Salamander, and LTBGs.

Comprehensive Phase II Work Plan Timeline

- **November 29th:** Phase II Work Group (Part 1)
- **December 5th:** Phase II Work Group (Part 2)
- **December 7th:** Final comments from the Work Group submitted to EAHCP Program Manager.
- **January 24th:** Draft Phase II Work Plan presented to the Implementing Committee. Public comment period begins.
- **February 15th:** Public comment period ends.
- **March 21st:** Implementing Committee approval of final Comprehensive Phase II Work Plan
The Phase II Work Group’s charge consists of the following tasks:

- Review the draft Comprehensive Phase II Work Plan
- Participate in coordination conference calls and attend Work Group coordination meetings
- Provide comments and recommendations to the EAHCP Program Manager
- Review and approve the Phase II Work Group Report
A comprehensive biological monitoring plan (Variable Flow Study) was established by the EAA in 2000 to gather baseline and critical period data to fill important gaps in the ecological condition of the Comal and San Marcos springs and river ecosystems. The EAA will continue this comprehensive sampling plan for the term of the Incidental Take Permit and provide a means of monitoring changes to habitat availability and the population abundance of the Covered Species that may result from Covered Activities. Presently, the Biological Monitoring program contains the following components:

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

The scope of the Biological Monitoring Program can be modified on a yearly basis, as provided in the FMA with agreement with the USFWS.

The National Academies of Sciences’ Consensus report was unable to determine whether riparian management related conservation measures will contribute to achieving the biological objectives of the Comal Springs riffle beetle. This finding was directly related to the lack of quantitative population monitoring undertaken as part of the Biological Monitoring Program. In 2018, the EAHCP formed a Work Group to examine the methodology surrounding the CSRB biological monitoring in addition to other CSRB management issues. The Work Group is anticipated to conclude in 2019, and the final product will likely result in changes to the monitoring methodology of the CSRB conducted during Biological Monitoring surveys.
CONB – Management of Public Recreation – (pg. 4)

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

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

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce local regulations, including:
   a. Limiting recreation on Landa Lake to Paddle Boats;
   b. Prohibiting recreational access to the Spring runs in Landa Park and to the Wading Pool in Spring Run 2; and,
   c. Prohibiting on water recreation on the Old Channel with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue, on a volunteer basis, Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section.

CONB – Decaying Vegetation Removal and DO Management – (pg. 5)

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

In 2017, the City of New Braunfels adopted the Landa Lake and Dissolved Oxygen Management Plan to be implemented during low-flow conditions and/or when dissolved oxygen data indicates a potential threat to fountain darter populations. Dissolved oxygen management strategies include continuous monitoring of DO concentrations during low-flow conditions and displacement and/or removal of decaying vegetation and algal mats within Landa Lake. During low-flow conditions, nine additional DO sensors will be installed throughout Landa Lake, Upper Spring Run, Old Channel ERPF and near Spring Island to collect continuous DO data. Additionally, floating vegetation, decaying vegetation and algal mats will be removed, as necessary, to prevent vegetation impacts on fountain darter habitat. If appropriate, the program may also include removal of decaying vegetation. Removal techniques for decaying vegetation may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal.
5. Control of Harmful Non-Native Animal Species (§ 5.2.5)

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

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

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

The City of New Braunfels will continue to restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (i.e., root structures and associated biofilms). Methods for riparian zone establishment includes the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and other riparian vegetation with extensive root systems are given preference to create maximum riffle beetle habitat. Fine-sediment covering springs will also be removed. The riparian zones will be monitored (at least annually) for continued success and removal of reestablished non-native vegetation.
CONB – Reduction of Non-Native species introduction and Live Bait Prohibition— (pg. 6)

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

COSM/TxState: Management of Recreation in Key Areas (pg. 8)

In accordance to Phase I efforts, Texas State University and the City of San Marcos will continue to control recreation in Spring Lake and the San Marcos River, within Texas State University campus boundaries.

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

To minimize the impacts from recreation, the City of San Marcos has established and will manage permanent river access points—permanent access points are located at City Park, one across from Lions' Club Tubing Rental and one just below pedestrian bridge, Hopkins Street bridge, Biocentennial Park, Hopkins Bridge, Rio Vista Park, the Wildlife Arroyo and two at Ramon Lucio Park. Riparian areas between access points will behave as densely planted and will be maintained with native, dense vegetation that discourages streamside access.

To support the TPWD’s creation of the State Scientific Area in the San Marcos River (§ 5.5.3), the City of San Marcos and Texas State University will establish exclusion zones in critical areas to protect Texas wildrice and San Marcos salamander habitat from recreational impacts, as well as continue to maintain kiosks at key areas along the river that show access points, exclusion zones, and associated educational components at key locations.

The City of San Marcos will continue to employ a group called the Conservation Crew to help educate and monitor recreational use, and other activities, as needed, in the San Marcos River. Activities include, but are not limited to, employees will pick up collecting trash, educate recreationists about threatened and endangered species that live in the river, installing and maintaining exclusion barriers, as well as monitoring vulnerable stands of Texas wildrice and San Marcos salamander habitat to reduce adverse impacts from recreation.
COSM/TxState: Native Riparian Habitat Restoration (pg. 8-9)

The City of San Marcos will continue to undertake a program to increase the area of the riparian zone on public lands along the banks of the river using native vegetation. Texas State University will continue to restore the riparian zone with native vegetation in upper-Sewell Park-North and Spring Lake. Phase I activities focused on non-native removal and planting of native riparian species. While some areas may require new riparian plants over time, Phase II riparian activities will be focused more on non-native removal and maintenance. If non-native plant treatment is needed on riparian private property, the City of San Marcos will work with private landowners to coordinate methods for removal and planting of native species. Areas that need more riparian planting will be planted with drought-tolerant, native vegetation species such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, buttonbush, or other native plants, as needed.

COSM/TxState: Control of Non-native Plant Species (pg. 9)

Texas State University and the City of San Marcos will continue to implement a non-native plant replacement program from Spring Lake to city limits. Non-native species of aquatic, littoral, and small caliper riparian plants (less than 4") will be replaced with native species to enhance Covered Species habitat. The quantity and location of areas restored in this program are provided in Table 34 of the Submerged Aquatic Vegetation Analysis and Recommendations Report (BIO-WEST, Watershed Systems Group, Inc, 2016). The non-native aquatic plants will be shaken, checked for aquatic fauna, and bagged for removal from the system in the same manner described in Section 5.4.3. Transported to the Texas State composting facility. Aquatic fauna that are recovered will be documented and returned to the system. Areas will be “weeded” until the area is suitable to plant native aquatic vegetation.
COSM/TxState: Control of Harmful Non-native and Predator Species (pg. 9)

In accordance to Phase I efforts, The City of San Marcos and Texas State University will continue to implement non-native and predator species control for the San Marcos River and Spring Lake on a periodic basis with expanded effort of control, if needed, at low flows. The targeted species include, but are not limited to, suckermouth catfish, tilapia, nutria, and Melanoides and Marisa snails. Routine biological monitoring will be conducted by EAA and EAHCP contractors to monitor and assess the distribution of new or existing harmful non-native and invasive species. If a threat is identified, EAHCP staff will work with the contractor to identify areas of concern and potential methods for removal.

COSM: Management of Public Recreational Use of San Marcos Springs and River Ecosystem (pg. 9)

Public recreational use of the San Marcos Spring and River ecosystems include, but are not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving, snorkeling and fishing. In accordance to Phase I efforts, the City of San Marcos will continue to implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix P of the EAHCP). In addition, pursuant to Section 9.2 of the IA, the City of San Marcos will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River (Outfitters) that comply with the requirements of the COI program established in section 5.3.2.1 of the HCP.
COSM: Designation of Permanent Access Points/Bank Stabilization (pg. 11)

To minimize the impacts of recreation, permanent access points were combined with bank stabilization at various locations during Phase I. They serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. The City of San Marcos has stabilized banks in eroded areas that include **two in** City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, and **two in** Ramon Lucio Park, and Cheatham Street underpass.

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

COSM: Impervious Cover/Water Quality Protection (pg. 12)

In 2017, the City of San Marcos approved the San Marcos WQPP, a comprehensive program to protect water quality and reduce the impacts of impervious cover (John Gleason LLC., 2017). Criteria and incentives for the program were based upon the WQPP and the EAHCP LID/Water Quality Work Group Final Report (Appendix Q of the EAHCP) recommendations for Implementation Strategies and BMPs. The WQPP has identified Sessom Creek tributary as a priority watershed (John Gleason LLC., 2017). LIDs and BMPs will be implemented in this watershed during Phase II. **Efficacy of the LIDs and BMPs may be assessed through water quality sampling, funded through grants and other sources.**
TxState: Management of Public Recreational Use of San Marcos Springs and River Ecosystem (pg. 12)

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

TxState: Diving Classes in Spring Lake (pg. 14)

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates and supervises all volunteer diving. No more than 10 volunteer divers will be allowed in the lake per day, with no more than eight at one time.

Any individual diving outside of the Dive Training Area must have completed the Diving for Science Program.
Except for the eastern spillway immediately below Spring Lake Dam, none of the protected areas will extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river. In their 3rd report, the National Academy of Sciences recommended controlling the footprint of recreation in the 50m reach below Spring Lake Dam. San Marcos salamanders have been found in abundance in the eastern spillway, so the majority of the spillway will may be excluded from recreation. Exclusion zones in the remainder of the 50m reach will may be established primarily around the Texas wild-rice stands.

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

In order to protect existing and restored fountain darter habitat, TPWD may pursue the creation of a state scientific area in the Cornal Springs ecosystem. An interlocal agreement between the City of New Braunfels and TPWD will be pursued, if necessary, for local in-water enforcement of the protected zones.

The San Antonio Water System (SAWS) ASR facility will continue to be used to store and deliver Aquifer water leased by the EAA in exchange for actions outlined in an Interlocal Contract between the EAA and SAWS for the purposes of springflow protection. When triggers are reached, SAWS will use water stored in the ASR to serve as a base load supply for base usage initially in its North East service area large primary groundwater pumping facilities. These facilities from a regional perspective are considered nearest to the springs and provide groundwater pumping relief during extreme drought. As described below, an amount equivalent to the water recovered from the ASR will be used to offset SAWS’s Edwards aquifer demands.

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery and or forbearance developed by HDR Engineering (HDR 2011). However, the actual pattern of delivery of water from the ASR and or forbearance may differ from that HDR used in its modeling simulations depending on the actual course of the drought. The two agencies entered an Interlocal Contract for the use of the Aquifer Storage and Recovery capabilities to support Springflow Protection covering Phase I of the HCP Program. From time to time the Interlocal Contract is brought up to date through adaptive management and or necessary contractual amendments but will continue to support protections throughout Phase II of the HCP Program.
APPENDIX D

EAHCP Strategic Adaptive Management Whitepaper
To: EAHCP Committees

From: Nathan Pence, EAHCP Program Manager

Date: May 11, 2018

Subject: EAHCP Strategic Adaptive Management Process

The EAHCP is quickly approaching the Strategic Adaptive Management Process, which bridges Phase I (2013-2020) of the program to Phase II (2020-2028). The information contained in this memo is intended to inform all Committee members of the baseline information involved in the process, frame the relevant questions for consideration, identify the decisions to be made by the Committees, and provide a timeline for planning, decision-making and implementation.

Definitions:

- Conservation Measures (habitat restoration & springflow protection)
- Biological Objectives (flow rates, habitat condition & WQ)
- Biological Goals (available habitat & species population)

Executive Summary and Introduction

The EAHCP Implementing, Stakeholder, and Science Committees are about to embark on the transition from Phase I to Phase II of the EAHCP, known as the Strategic Adaptive Management Process (SAMP). The primary deliverable from SAMP is the identification of the specific conservation measures (CM) to be implemented during Phase II of the ITP (FMA § 7.6.3). The potential outcomes include:

1. Continuation of Phase I CMs without change
2. Continuation of Phase I CMs with changes or expansion
3. Continuation of Phase I CMs, plus a new Phase II CM(s)
4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)

The SAMP is formally defined by the Funding and Management Agreement (FMA) and represents a structured review period built into the EAHCP (FMA § 7.14). Specifically, the review is focused on ensuring the EAHCP is meeting its biological objectives (both minimum springflows and habitat) and biological goals (habitat and population). If the EAHCP is meeting these biological objectives and goals, then the current Phase I implementation continues unchanged; if not, then all three Committees will make decisions on addition of our package of Phase II conservation measures to ensure we achieve the biological objectives. There are two primary sources of input that will assist the EAHCP Committees in determining if the biological objectives are met:

1. The EAA modeling team will perform a series of model runs to evaluate whether the springflow protection conservation measures\(^1\) are meeting the minimum springflow objectives (Tables 1 and 2), and
2. The National Academies of Sciences Report #3 will evaluate whether the conservation measures achieve the habitat-oriented biological objectives and thus, the biological goals.

\(^1\) These conservation measures are: (1) the Voluntary Irrigation Suspension Program option under EAHCP § 5.1.2; (2) the Regional Water Conservation Program under EAHCP § 5.1.3; (3) Critical Period Management – Stage V under EAHCP § 5.1.4; and (4) the SAWS ASR Springflow Protection Program under EAHCP § 5.5.
The detailed timeline for SAMP as set out in the FMA and expanded by staff, is outlined in Appendix A. Below is a summary of the milestones:

2018
- Conduct groundwater modeling.
- Receive Report 3 from the National Academy of Sciences.
- Committees make determination: are Biological Objectives meeting the Biological Goals, and are the current Phase I Conservation Measures meeting the Biological Objectives. (EAHCP § 7.13.7)

2019
- If the Biological Objectives are not being met, Program Manager initiates SAMP.
- Committees make decision on specific conservation measures to be expanded or added.
- Additional Groundwater modeling, if needed

2020:
- Finalize approach for implementation of expanded or additional conservation measures.
- Communicate all decisions to USFWS.
- Begin implementation of additional conservation measures, if required to meet Objectives.

2021
- By March, finalize implementation of additional conservation measures not yet completed in 2020.

Strategic Adaptive Management Process

SAMP is the transition from Phase I (2013-2020) to Phase II (2020-2028) of the EAHCP and associated Incidental Take Permit. Specifically, the decisions made through (SAMP) relate to the selection of Conservation Measures for Phase II of the EAHCP implementation. In other words, SAMP is defined as the formal use of non-routine AMP (FMA § 7), as the EAHCP transitions from Phase I to Phase II, to answer the following questions (FMA § 7.13.7):

- Are any of the current Biological Objectives not necessary to meet the Biological Goals?
- Are the current Biological objectives adequate to meet the Biological Goals?
- Are any of the current Phase I Conservation Measures not necessary to meeting the Biological Objectives?
- Are the current Phase I Conservation Measures meeting the Biological Objectives?

As illustrated in Figure 1, during the transition between Phase I and Phase II, in addition to the questions presented immediately above, the SAMP specifically must be able to answer the following questions:

1. Does a springflow shortfall exist at Comal Springs or San Marcos Springs? If so, what would be an appropriate Phase II Conservation Measure(s) to make up the springflow deficit?
2. Do the Phase I Conservation Measures achieve the quantity and quality of habitat required?

To answer these questions, the EAHCP Committees will need to utilize the information and data produced by the Hydrologic Model, EAHCP monitoring programs and the National Academy of Sciences Report 3.
During the EARIP process, the Science Subcommittee established minimum springflows that are required to maintain sufficient areal coverage of suitable aquatic vegetation and related habitat so that any incidental take of the Covered Species that may occur during a repeat of the Drought of Record (DOR) (Table 1 and Table 2) would not appreciably reduce the likelihood of the survival and recovery of the species in the wild once the DOR was over. HDR was then engaged to conduct initial predictive hydrological modeling, that established the amount of springflow protection provided by the EAHCP Springflow Protection CMs. These springflow measures were designed and implemented with the goal of achieving the required minimum springflows. At the conclusion of the EARIP planning process, the Steering Committee decided to move forward with the submittal of an application for an incidental take permit to USFWS and implementation of the EAHCP, even though they were aware that the EAHCP, as modeled by HDR, did not quite achieve the required minimum springflows represented in Table 1 and Table 2 during a repeat of the DOR. Tables 3 and 4 below, identify the deficits in required minimum springflows as originally modeled by HDR during the EARIP process. The EARIP Steering Committee chose to move forward despite awareness of this modeled shortfall, as they knew at some point in Phase I, there would be a revised MODFLOW model from EAA that would provide a more refined modeled result. Moreover, the Steering Committee agreed to wait and see how the implementation of the Springflow Protection CMs actually came together (i.e. specific geographic locations of forbearance and

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2 The actual permitting criteria for the issuance of the EAHCP ITP was that any incidental take that may occur including during a repeat of the Drought of Record, resulting from the Covered Activities would “not appreciably reduce the likelihood of the survival and recovery of the [Covered] species in the wild” once the Drought of Record was over. See 16 U.S.C. § 1539(a)(2)(B)(iv); and 50 C.F.R. §§ 17.22(b)(2)(D); 17.32(b)(2)(D). Additionally, any such incidental take could not “jeopardize the continued existence of any [of the Covered] species or result in the destruction or adverse modification of [the designated critical] habitat of such species …” See 16 U.S.C. § 1536(a)(2); and 50 C.F.R. § 402.14(h)(3). As defined, the “jeopardize the continued existence of” is substantially similar to the “appreciably reduction” standard for ITP issuance. 50 C.F.R. § 402.02. See also EAHCP § 4.0.
actual acft enrolled). In short, the Steering Committee agreed to better quantify the springflow levels achieved by the EAHCP Springflow Protection CMs and ensure successful implementation of the CMs, before expending additional resources to make up modeled springflow deficits that may or may not actually exist.

The revised MODFLOW model (2017) will be used to model the amount of springflow protection (daily (1947-1958) and long-term (1947-2000)) provided by Springflow Protection CMs during a repeat of the DOR. Should the amount of modeled springflow be less than the required minimum springflows established by the EAHCP as set out in Tables 1 and 2, and the deficits in Table 3 are not made up, then the model will be used to establish the amount of additional springflow protection provided by expanded Phase I CMs and/or new Phase II CMs. Specifically, the following model runs will be made with the updated MODFLOW model (2017), as needed:

   a. The purpose of this is to examine minimum daily springflows at Comal and San Marcos through the DOR
   b. This is completed per Liu et al. 2017 (ASR AMP)

   a. The purpose of this is to examine long term average springflows at Comal and San Marcos over a minimum 50-year modeling period including the DOR

   a. The purpose of this is to examine minimum daily springflows at Comal and San Marcos through DOR with our current Phase I measures as implemented. This model run will be used to determine if additional conservation measures may be needed to meet the Biological Objectives. Differences between model run 1 (described above) and this run include:
      i. VISPO – geographical distribution of forbearance and actual volume enrolled.
      ii. ASR – geographical distribution of EAA forbearance; new two tier system and trigger.
      iii. RWC – geographical distribution of forbearance.

   a. This is the same run as for #3 above, with longer time period

5. Phase I CMs + Phase II CM(s) *(if needed to achieve minimum springflows)*

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³ The Phase II CMs referenced here could be changes/expansion of Phase I CMs, or the addition of new CMs unrelated to the current Phase I CMs.
Table 1: Comal Springs Biological Objectives

<table>
<thead>
<tr>
<th>Long-term Daily Average (50 year; 1947-2000)</th>
<th>225cfs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Daily Average (1947-1960) - not to exceed 6 months in duration; followed by 3 months of 80cfs</td>
<td>30cfs</td>
</tr>
</tbody>
</table>

Table 2: San Marcos Springs Biological Objectives

<table>
<thead>
<tr>
<th>Long-term Daily Average (50 years; 1947-2000)</th>
<th>140cfs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Daily Average (1947-1960) - not to exceed 6 months in duration; followed by 3 months of 80cfs</td>
<td>45cfs</td>
</tr>
</tbody>
</table>

Table 3: Comal Springs Modeled Springflow compared to Biological Objective Springflows

<table>
<thead>
<tr>
<th>Required Minimum Springflows</th>
<th>Springflow Achieved</th>
<th>Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term</td>
<td>225</td>
<td>196&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Daily</td>
<td>30</td>
<td>27&lt;sup&gt;b,c&lt;/sup&gt; / 29.7&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Table 4: San Marcos Springs Modeled Springflow compared to Biological Objective Springflows

<table>
<thead>
<tr>
<th>Required Minimum Springflows</th>
<th>Springflow Achieved</th>
<th>Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term</td>
<td>140</td>
<td>155&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Daily</td>
<td>45</td>
<td>51&lt;sup&gt;f&lt;/sup&gt; / 48&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

National Academy of Sciences Report 3
For the most part, the EAHCP habitat restoration efforts that have occurred since the inception of the ITP have been successful. Moreover, there have not been any observed impairments to surface water quality that have arisen. Therefore, it is anticipated that our habitat related and water quality related conservation measures are achieving our biological goals. Thus, the focus for SAMP has been springflow centric. However, the NAS Report 3 will look at both springflow protection and habitat restoration. To conduct their analysis, NAS will use the information learned during the 6 EAA NAS collaborative meetings held from 2013-2018 and the EAHCP scientific record that has been continually provided to NAS as it was developed.

Depending on comments received from NAS in Report 3, a habitat quality/quantity component to SAMP may be required. Specifically, I could potentially foresee NAS providing comments on our submerged aquatic vegetation restoration and riparian restoration conservation measures.

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<sup>4</sup> EAHCP Table 4-2
<sup>5</sup> EAHCP Table 4-13
<sup>6</sup> EAHCP Table 4-30
<sup>7</sup> Minimum flow for only 2 months of DOR
<sup>8</sup> 2017 Updated MODFLOW Model Output
<sup>9</sup> EAHCP Table 4-52
As specified in their contract, NAS will determine the following: (NAS contract 2014 and FMA § 7.13.7)

- Whether the biological objectives are likely to achieve the biological goals for all Covered Species, and if not, how might flow rates, amounts of habitat and water quality objectives be amended to achieve the biological goals.
- Whether the Phase I conservation measures are adequate to meet the biological objectives, if not, does the presumptive Phase II conservation measure (expanded ASR) achieve the biological objectives.
- If neither Phase I conservation measures nor the Presumptive Phase II conservation measure meet the biological objectives, NAS will determine the extent of the deficit.
- Whether any biological objectives for any Covered Species or Phase I conservation measures are not needed to achieve the Biological Goals.

Simply put, it is anticipated that the NAS Report 3 will evaluate our Springflow Protection Measures and Habitat Restoration, and ultimately determine if they achieve the EAHCP’s required minimum springflows and habitat quantity/quality.

As the Report has yet to be received and it is unknown what if any issues will be identified, it is hard to plan for specific incorporation of the Report results into the SAMP process at this time. However, it is a given, that information in the Report will be utilized and incorporated in some manner. In past years, when NAS Reports have been submitted to the EAHCP process, workgroups have been used to evaluate and incorporate NAS recommendations into the overall EAHCP effort to the extent appropriate. As this Report is so important and the main reason NAS was engaged, at this point staff plans to utilize the Implementing, Stakeholder and Science Committees in the role of the previous workgroups to review and assess this report. Thus, presenting all relevant information in the Report to all appropriate Committees.

**Ecological Model**

The EcoModel for the Fountain Darter and Submerged Aquatic Vegetation, was built specifically as a predictive tool to “evaluate potential adverse ecological effects from Covered Activities and to the extent that such effects are determined to occur, to quantify their magnitude.” (EAHCP § 6.3.3). In so doing, the model results would be used to “develop alternative approaches or possible mitigation strategies, if necessary.” (EAHCP § 6.3.3). The EcoModel has been run to predict whether the incidental take of the Fountain Darter during a repeat of the DOR would appreciably reduce the likelihood of the survival and recovery of the Covered Species in the wild once the DOR was over, if the Conservation Measures, and specifically the Springflow Protection CMs, have been fully implemented. This model run was performed by BIOWEST as part of their EcoModel contract with EAA; and the results were that the incidental take of Fountain Darter during a repeat of the DOR with mitigation fully in place did not appreciably reduce their likelihood of survival and recovery in the wild when drought conditions ended. Therefore, no additional work with the EcoModel is required for SAMP.

**Springflow Protection Phase II Conservation Measure(s), if Needed**

The purpose of the Phase II CMs, either through an expanded Phase I CM(s) or a new Phase II CM(s), would be to ensure the modeled achievement of the springflow-related Biological Objectives. Specifically, an additional or expanded springflow protection CM may be needed to achieve the continuous minimum springflows set by the EAHCP in Tables 1 and 2 and makeup the deficits represented in Table 3. The EAHCP and FMA give the Stakeholder Committee and Implementing Committee the ability to choose and design that CM(s) based on the best available science. Should an additional CM be needed but the Committees cannot agree upon what the CM would be or how to best implement a new CM, the EAHCP defaults to the Presumptive Phase II CM, expanded use of the SAWS ASR (EAHCP § 5.5.2: Phase II Expanded Use of SAWS ASR and Water Resources Integration Program
Pipeline). Below is a brief description of the Expanded ASR and a listing of potential alternative Phase II CMs to achieve the continuous minimum springflows, if needed.

Presumptive Phase II CM – Expanded Use of SAWS ASR (EAHCP § 5.5.2)
The presumptive action for Phase II of the HCP, if needed, involves the use of the SAWS ASR with the expanded Water Resources Integrated Pipeline (WRIP) that is now operational. The WRIP consists of approximately 45 miles of water transmission pipeline and a pump station that conveys water from the SAWS ASR, Carrizo, and Brackish Desalination programs located at the Twin Oaks Facility property in south Bexar County to new and existing facilities in western and northwestern Bexar County. The WRIP links the existing facilities and new water supplies located at the ASR site in southern Bexar County with the southwestern and western portions of San Antonio.

SAWS’ ability to expand the use of the ASR as a presumptive Phase II measure, if required, assumes that: (1) no additional water beyond that required for the Phase I use of the ASR will need to be stored; (2) the total amount of water to be returned from the ASR over the term of the permit will not exceed 126,000 ac-ft during the drought and 46,300 ac-ft in the worst year; and (3) no more than 40 percent of the capacity of the WRIP distribution system will be utilized at any time for HCP purposes.

The additional springflow benefit from expanded ASR would come from management and timing of recovery, rather than additional water storage or forbearance. Basically, rather than spreading forbearance across the year, it would be more focused on times of peak demand (summer).

Potential Alternatives to the Presumptive Phase II CM
At this point, based on preliminary modeling conducting during ASR AMP, it is likely that if additional springflow protection is needed to achieve the Minimum Daily Averages, it will not need to be as grand in scale as expanded use of the ASR. However, modeling will be needed to confirm this assumption. Seeking cheaper and smaller in scale Phase II CMs or a small increase in an already existing Phase I CM, seem to be a more reasonable approach.

Potentially Feasible Alternative Phase II CMs
1. Additional VISPO forbearance
2. Additional ASR forbearance by EAA
3. ASR Pooling by EAA for credited forbearance
4. Precipitation Enhancement by EAA

Funding
Strategic Adaptive Management planning process funding: In every budget year, the Program Manager has a budget related to professional contracting services and adaptive management. In years 2018, 2019 and 2020, the portion of that budget not already committed, would be earmarked to pay for any costs associated with SAMP. Anticipated expenditures include: 1) documentation of SAMP and production of a summary report, 2) facilitator services if needed, and 3) 3rd party review if needed.

Phase II Conservation Measure funding (EAHCP § 7.2): It is important to remember that a Phase II CM may or may not be needed. Because of this, the original EARIP Steering Committee did not set a budget or revenue source for a Phase II CM. If the presumptive Phase II CM is implemented, it is anticipated that no significant additional cost will be associated, as ASR is already included in Phase I. However, there could be additional cost if a CM other than the presumptive use of ASR is implemented, and funding will have to be identified at that time. The most likely funding source would be the use of existing EAHCP funding, by utilizing savings or transferring costs between CMs. Currently, there is no identified funding for Phase II conservation measures.
Summary and Recommendations

Over the next two years, with important decisions to make in 2018, the EAHCP will transition from Phase I to Phase II. Modeling will be used to determine if the daily and long-term minimum continuous springflows will be met by the current springflow protection measures. If a Springflow deficit does exist, it is likely to be in the range of only a couple of cfs. Therefore, the Committees should think simple and cost effective when selecting additional mitigation to achieve springflow targets. Point being, we probably do not need a brand new, large scale, springflow protection measure. But rather, probably only need to add acft to an existing forbearance program or something else small in scale, if at all. Again though, modeling results will drive these determinations and decisions.

The National Academy of Sciences will provide us input to our habitat restoration measures and we should remain open minded and flexible until the NAS report is received (Fall 2018). It is possible that the focus of these NAS recommendations will be focused on aquatic vegetation management, a subject that EAHCP staff and permittees are already working on.

Lastly, I believe that we should engage a consultant, as early in 2018 as possible, to document the SAMP process for communication to USFWS and the administrative record and also, have the contractor prepare a standalone exec summary to communicate SAMP decisions to all interested parties.
## Appendix A – Timeline for the EAHCP Strategic Adaptive Management Process

<table>
<thead>
<tr>
<th>Year</th>
<th>Action</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2017</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>EAA finalized updated MODFLOW model</strong></td>
<td>Reviewed by GWMAP and NAS</td>
</tr>
<tr>
<td></td>
<td><strong>Committees attended Ecological Model Workshop</strong></td>
<td>Results of the EcoModel Fountain Darter survival were presented to Committees in July 2017</td>
</tr>
<tr>
<td></td>
<td><strong>Committees reviewed rerun of &quot;Bottom Up Package&quot; from updated MODFLOW model.</strong></td>
<td>Joint meeting held in December 2017</td>
</tr>
<tr>
<td></td>
<td><strong>Science Committee reviewed Scientific Record</strong></td>
<td>Done continuously from 2013-2018</td>
</tr>
<tr>
<td></td>
<td><strong>Program Manager provided Scientific Record to NAS</strong></td>
<td>Done continuously from 2013-2018</td>
</tr>
<tr>
<td><strong>2018</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>EAA conducts SAMP hydro modeling</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Program Manager provides any remaining scientific information to NAS</strong></td>
<td>Fulfilling NAS data, info and report requests</td>
</tr>
<tr>
<td></td>
<td><strong>NAS delivers Report #3 to Program Manager</strong></td>
<td>September 30</td>
</tr>
<tr>
<td></td>
<td><strong>Committees review NAS Report #3 conclusions and SAMP hydro modeling</strong></td>
<td>October – December</td>
</tr>
<tr>
<td></td>
<td><strong>Committees determine the following:</strong></td>
<td>December 20 Joint meeting of Committees</td>
</tr>
<tr>
<td></td>
<td>• If Biological objectives are or are not adequate to meet the Biological Goals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If phase I Conservation Measures are or are not meeting the Biological Objectives</td>
<td></td>
</tr>
<tr>
<td><strong>2019</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Implementing Committee directs Program Manager to initiate SAMP proposal to establish Phase II Conservation Measures</strong></td>
<td>By January 2019, if Phase I Conservation Measures are determined to not be adequate to meet the Biological Objectives.</td>
</tr>
<tr>
<td></td>
<td><strong>Implementing Committee directs Program Manager to initiate SAMP proposal to change Biological Objectives</strong></td>
<td>If Biological Objectives are determined not to be adequate to meet the Biological Goals. (No date specified in the FMA)</td>
</tr>
<tr>
<td></td>
<td><strong>Science Committee to meet and consider SAMP proposal(s) and draft recommendation to the Stakeholder Committee</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Stakeholder Committee to review Science Committee report, consider SAMP proposal(s) and draft recommendation to IC</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Implementing Committee to meet to consider the SH report on SAMP proposal(s)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>PM completes Phase II Work Plan</strong></td>
<td>March 1</td>
</tr>
<tr>
<td></td>
<td><strong>Committees make final decision to implement Phase II conservation measure</strong></td>
<td>if no decision is made, default is the Presumptive Phase II ASR</td>
</tr>
<tr>
<td><strong>2020 &amp; 2021</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Implement Phase II Conservation Measure(s) by March 18, 2021.</strong></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E

EAHCP

NAS REPORT 3 MATRIX
<table>
<thead>
<tr>
<th>Reference (chapter:pg.)</th>
<th>Program/Species Component</th>
<th>Ways to improve</th>
<th>Description</th>
<th>Recommendation</th>
<th>Staff response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:39-40, 3:73</td>
<td>CSRB</td>
<td>BO=LTBG</td>
<td>Biological goals for CSRB are to maintain silt-free gravel and cobble substrate in &gt;90% of three areas in the Connel system. No quantitative studies that associate variation in silt-free gravel with CSRB population status.</td>
<td>Conduct a study to determine how sedimentation of habitat directly and indirectly affects CSRB population, and how sedimentation rates are related to silt-free buffer conditions</td>
<td>The EAHCP Science Committee suggested not pursuing. Additionally, the effects of sedimentation on Conn Springs riffle beetle (see Sept 9, 2016 meeting minutes). The issue of how best (or at all) to pursue sedimentation monitoring in CSRB habitats will be addressed under CSRB WR charge question 3.</td>
</tr>
<tr>
<td>2:42</td>
<td>CSRB</td>
<td>BO=LTBG</td>
<td>Spring eelgrass selection is not described in detail in biomonitoring reports, and the number of years used to generate the annual median value is highly variable among year. Are spring eelgrass stopped prior to late deployment and are they randomly selected? Are flowing spring openings selected in sequence that they are found?</td>
<td>These are important questions that influence low data generated from each sampling event should be analyzed and interpreted for compliance purposes.</td>
<td>CSRB WG charge questions 1 &amp; 2.</td>
</tr>
<tr>
<td>2:42</td>
<td>CSRB</td>
<td>BO=LTBG</td>
<td>The current method to calculate CSRB median densities per hour is to pool all samples from all sampling events. This could be problematic if sampling effort is not equal and consistent.</td>
<td>A well-designed and articulated approach to calculating the annual median values is needed.</td>
<td>CSRB WG charge questions 1 &amp; 2.</td>
</tr>
<tr>
<td>2:51</td>
<td>CSRB</td>
<td>BO=LTBG</td>
<td>The density goals were based on data derived from the VFS, which used unstandardized sampling methodology with no SOP.</td>
<td>The CSRB beetle density should be updated to reflect more quantitative and standardized monitoring methods.</td>
<td>CSRB WG charge questions 1 &amp; 2.</td>
</tr>
<tr>
<td>3:72</td>
<td>CSRB</td>
<td>BO=LTBG</td>
<td>Studies needed to validate the HS models from Hardy 2009 in areas where CSRB populations are monitored.</td>
<td>No plans to pursue; the utility of conducting another Habitat Suitability Index model will be discussed with the CSRB WG.</td>
<td>No plans to pursue; the utility of conducting another Habitat Suitability Index model will be discussed with the CSRB WG.</td>
</tr>
<tr>
<td>2:30, 3:64</td>
<td>Fountain darter</td>
<td>BO=LTBG</td>
<td>Several actions to take the determination of somewhat likely toward likely for reaching CSRB biological goals.</td>
<td>The use of continuous medium density is very insensitive to year to year changes. Its possible that the habitat quality decreases, only extreme decreases in FD densities would be detectable without seasonal densities.</td>
<td>Issues 1 &amp; 2 will be addressed by the CSRB WG. There are no plans to address issue 3.</td>
</tr>
<tr>
<td>3:63-64</td>
<td>Fountain darter</td>
<td>BO=LTBG</td>
<td>The recent addition of the restoration reaches causes concern on the capacity of the two systems. A sign that habitat is not limiting the FD population would be decreasing median densities in some reaches as individuals move to new habitats.</td>
<td>The HCP already addresses each of these topics in some form or fashion. There are no plans to pursue additional measures.</td>
<td>No plans to pursue.</td>
</tr>
<tr>
<td>3:65</td>
<td>Fountain darter</td>
<td>BO=LTBG</td>
<td>Some caution is needed for false negatives in the fountain darter densities by SAV type.</td>
<td>Further analyses of the ability to detect events and trends in FD monitoring data (power analysis) would determine what magnitude of trends is detectable and likelihood of false negatives.</td>
<td>No plans to pursue, however, staff is regularly engaged with contracted field support, and periodically reviews monitoring data.</td>
</tr>
<tr>
<td>3:72</td>
<td>Fountain darter</td>
<td>BO=LTBG</td>
<td></td>
<td>The flow and habitat conditions during the VFS are comparable to today and into the future 2) update the HS model with current data of the systems 3) expand FD monitoring into restoration reaches 4) analyze the FD data for temporal trends in population abundances that reflect each year</td>
<td>No plans to pursue.</td>
</tr>
<tr>
<td>2:47, 3:78</td>
<td>San Marcos salamander</td>
<td>BO=LTBG</td>
<td>Salamander surveys are conducted in small aquatic macrophyte free transects. It is possible that density estimates are inflated because of the current sampling protocol. The current sampling design does not allow density estimates to be extrapolated across Spring Lake area or the spillway area.</td>
<td>To supplement current sampling, an additional protocol that uses occupancy estimation could be designed for SAV. Statistical methods by Denes et al. (2015) could shed light on the extent of error associated with current sampling method.</td>
<td>The EAHCP intends to review salamander management activities.</td>
</tr>
<tr>
<td>3:77-78</td>
<td>San Marcos salamander</td>
<td>BO=LTBG</td>
<td></td>
<td>The EAHCP intends to review salamander management activities.</td>
<td>The EAHCP intends to review salamander management activities.</td>
</tr>
<tr>
<td>3:78</td>
<td>San Marcos salamander</td>
<td>BO=LTBG</td>
<td></td>
<td>The EAHCP intends to review salamander management activities.</td>
<td>The EAHCP intends to review salamander management activities.</td>
</tr>
<tr>
<td>5:140</td>
<td>SAV</td>
<td>BO=LTBG</td>
<td>Committee suggest relaxation of species-specific targets. Two lines of argument: 1) small differences in FD densities among SAV species, 2) better understand the ecological-biological control on SAV distribution.</td>
<td>Committee suggest relaxation of species-specific targets. Two lines of argument: 1) small differences in FD densities among SAV species, 2) better understand the ecological-biological control on SAV distribution.</td>
<td>The EAHCP intends to review SAV management activities.</td>
</tr>
<tr>
<td>2:36, 51</td>
<td>TWR</td>
<td>BO=LTBG</td>
<td>C4 species (Hydrilla/Hebrooma) outcompeting C3 species (TWR) when CO2 levels are low (and pH is high)</td>
<td>The current SAV management program pursues eradication of these non-native species from both systems, additional mesocosm studies are planned. The EAHCP intends to review SAV management activities.</td>
<td>The EAHCP intends to review SAV management activities.</td>
</tr>
<tr>
<td>3:67</td>
<td>TWR</td>
<td>BO=LTBG</td>
<td>Hardy (2009) and current velocity and depth to develop habitat suitability model</td>
<td>The habitat suitability modeling may be out of date since its was completed almost 10 years ago and the system has changed.</td>
<td>No plans to pursue. TWR hasicones has greatly expanded under HCP management activities.</td>
</tr>
<tr>
<td>3:67, 69</td>
<td>TWR</td>
<td>BO=LTBG</td>
<td>C4 species (Hydrilla/Hebrooma) outcompeting C3 species (TWR) when CO2 levels are low (and pH is high)</td>
<td>Create a water quality objective for TWR, especially during low-flow conditions. A good starting point is 25C.</td>
<td>Water quality objectives are already in place for the Fountain Darter in the SM system and effectively serve as water quality objectives for TWR.</td>
</tr>
</tbody>
</table>
3.68 4.105 TWR BO−LTBG improvement

| 3:68 4.105 | TWR BO−LTBG improvement | The recent decision to remove nonnative SAV species should have a positive effect on TWR with reducing competition. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The current SAV management program pursues eradication of these non-native species from both bodies, systems, no mesocosm studies are planned. The EAIRP intends to review SAV management activities. |

4:120 130 CSRB CM−BO improvement

| 4:120 130 | CSRB CM−BO improvement | Removal and pruning of riparian has occurred to no quantitative measure of success for erosion control. A quantitative evaluation of the role that native riparian planting strategies of listed organisms that can help inform future management. | CSRIR WG question 3. |

4:130 CSRB CM−BO improvement

| 4:130 | CSRB CM−BO improvement | The committee doesn’t suggest EAA should undertake a formal high-quality to adverse effects on organisms and use that information to define the objectives. For example, Harding (2016) and Funder et al. (2017) used approaches as quantitative regression or conditional probability analysis. | CSRIR WG question 3. |

4:104 Fountain darter CM−BO improvement

| 4:104 | Fountain darter CM−BO improvement | The recent decision to remove nonnative SAV species should have a positive effect on TWR with reducing competition. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

4:113 Fountain darter CM−BO improvement

| 4:113 | Fountain darter CM−BO improvement | Further exploration of FD abundance, could help determine viable population abundance. One approach is population viability analysis. There is little description of how the 10% deviation from historic conditions came to be applied and there are no actual lists of the water quality parameters being considered and their historical values. | The EAIRP intends to review SAV management activities. |

4:114 Fountain darter CM−BO improvement

| 4:114 | Fountain darter CM−BO improvement | The current SAV management program pursues eradication of these non-native species from both bodies, systems, no mesocosm studies are planned. The EAIRP intends to review SAV management activities. | The EAIRP intends to review SAV management activities. |

4:113 Fountain darter CM−BO improvement

| 4:113 | Fountain darter CM−BO improvement | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

4:123 TWR and San Marcos salamander CM−BO improvement

| 4:123 | TWR and San Marcos salamander CM−BO improvement | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

3:79 All species general

| 3:79 | All species general | Further analyses of the monitoring data and process studies for the FD are warranted. There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

4:132 All species general

| 4:132 | All species general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

5:147 Catastrophic events general

| 5:147 | Catastrophic events general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

5:138-139 FD general

| 5:138-139 | FD general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

2:33 Fountain darter general

| 2:33 | Fountain darter general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

5:146 Invasive species control general

| 5:146 | Invasive species control general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |

5:142 Macroinvertebrates general

| 5:142 | Macroinvertebrates general | There is a high degree of similarity between the refugia program and the CSRB. This is most likely because the refugia program is essentially an extension of CSRB. The refugia program has been successful in reducing competition for TWR. Field plans should be used to confirm this but more of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR management activities. | The EAIRP intends to review SAV management activities. |
APPENDIX F

COMPREHENSIVE PHASE I WORK PLAN
COMPREHENSIVE PHASE I WORK PLAN

Section 4.2 of the Funding and Management Agreement requires the Implementing Committee to develop and approve by March 1, 2012, a Comprehensive Phase I Work Plan (the “Comprehensive Plan”). The Comprehensive Plan must include descriptions, schedules, and cost estimates for the Phase I Conservation Measures and all Program activities conducted or managed by the Parties and Program Manager that are to be funded from the HCP program Account for the Phase I period through December 31, 2019. This document is intended to satisfy that requirement. The description, schedules, and cost estimates contained herein are taken largely from Chapters 5, 6, and 7 of the Habitat Conservation Plan (“HCP”). The description of the measures is not intended to reiterate all of the details in the HCP. To the extent this Comprehensive Plan conflicts with the HCP, the HCP controls. The measures briefly described below are organized by the Party or Parties responsible for that measure.

I. Conservation Measures

A. Edwards Aquifer Authority

1. San Marcos National Fish Hatchery and Technology Center, Uvalde National Fish Hatchery, and Inks Dam National Fish Hatchery – Refugia (§ 5.1.1)

EAA will support and coordinate the work of the USFWS San Marcos NFHTC’s operation and maintenance of a series of off-site refugia at USFWS’s San Marcos, Uvalde, and Inks Dam facilities. A series of refugia, with back-up populations at other facilities, will preserve the capacity for these species to be re-established in the event of the loss of population due to a catastrophic event such as the unexpected loss of springflow or a chemical spill. EAA’s support of the refugia will augment the existing financial and physical resources of these facilities, and provide supplementary resources for appropriate research activities, as necessary, to house and protect adequate populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques. The use of this support will be limited to the Covered Species in this HCP.

2. Voluntary Irrigation Suspension Program Option (§ 5.1.2)

The Voluntary Irrigation Suspension Program Option (VISPO) program is intended to minimize and mitigate the impacts of incidental take from low springflows by suspending the withdrawal of Aquifer water for irrigation purposes during drought. This measure will require EAA irrigation permit-holders who voluntarily participate in the program to suspend the use of Aquifer water for irrigation purposes during drought to maintain springflow. The volume goal for the VISPO program is to remove 40,000 ac-ft/yr from pumping during periods of drought. Irrigation permit-holders in Atascosa, Bexar, Comal, and Hays counties will be approached for enrollment in the program. It is hoped that at least 10,000 ac-ft can be
enrolled in these counties. Assuming that this goal can be obtained, the goal is to enroll 15,000 ac-ft/yr each in Medina and Uvalde counties.

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

Irrigators will be offered the option of committing to the program for either five- or ten-year programs. The following payment structure will be offered for the voluntary commitments.

Five-year program:

- A standby fee of $50/acre-foot that increases 1.5 percent per year will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and
- A fee of $150/acre-foot that increases 1.5 percent per year will be paid for each year when temporary pumping suspensions are required.

Ten-year program:

- A standby fee of $57.50/acre-foot for years 1-5 and $70.20/acre-foot for years 6-10 will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and
- A fee of $172.50/acre-foot for years 1-5 and $210.60 for years 6-10 will be paid for each year when temporary pumping suspensions are required.

3. **Regional Water Conservation Program (§ 5.1.3)**

The Regional Water Conservation Program will minimize and mitigate the impacts of pumping from the Aquifer by building on the expertise of the successful programs to realize savings throughout the Edwards Aquifer region. The goal of the Regional Water Conservation Program is to conserve 20,000 ac-ft/yr of permitted or exempt Edwards Aquifer withdrawals. In exchange for technical assistance and incentives for implementing the various measures, one-half of the conserved water (10,000 ac-ft) will remain in the Aquifer unpumped, but still owned by participating permit-holders, for 15 years to benefit springflow levels and contribute to species protection. The other one-half of the conserved water will remain available to the participating entity.

To ensure that the benefit from this program is reasonably certain to be realized, SAWS and certain municipal purveyors will initially commit not to withdraw an amount equal to 10,000 ac-ft/yr from the Aquifer.

The EAA will administer the Regional Water Conservation Program targeting municipal water users and owners of exempt domestic wells. The Regional Water Conservation Program will focus on implementation of incentive programs encouraging: (1) reduction of “lost water” through leak detection; (2) installation of high-efficiency plumbing fixtures and high-efficiency
toilets; (3) large-scale commercial/industrial retrofit rebate; and (4) water reclamation for efficient water use. The EAA will organize a Regional Conservation Monitoring Committee to be initially comprised of one representative knowledgeable in water conservation from SAWS, the City of San Marcos, the City of New Braunfels, and a small water purveyor which utilizes the Edwards Aquifer.

4. Critical Period Management – Stage V (§ 5.1.4)
By December 31, 2012, EAA will amend its Critical Period Management Program to add a new emergency Stage V reduction of 44 percent applicable in both the San Antonio and Uvalde pools. Stage V is designed to be triggered only when other measures have not proven sufficiently effective in maintaining springflow during drought conditions. For the San Antonio Pool, Stage V would be triggered by a combination of monthly average J-17 levels below 625 feet or springflows of either 45 cfs based on a ten-day rolling average at Comal Springs or 40 cfs based on a three-day rolling average. The Uvalde Pool would trigger Stage V using the Uvalde County Index Well (J-27) water level of 840 ft-MSL.

5. Expanded Water Quality Monitoring (§ 5.7.2)
The EAA and its predecessor agency have conducted a program of water quality data collection since 1968. The EAA will continue to maintain a network of groundwater and surface water monitoring sites, including sites in the Comal and San Marcos springs. EAA will manage and oversee the expanded monitoring of water quality around Landa Lake and the Comal River, and Spring Lake and the San Marcos River to include stormwater sampling and additional groundwater and surface water sampling as necessary. Particular focus will be placed on point and non-point sources. Areas that are to be targeted include, but are not limited to, large areas of impervious cover, golf courses, swimming pools, and industrial runoff areas. In the event that certain constituents of concern are detected at levels indicating the potential for adverse effects, Best Management Practices (BMPs) will be evaluated to reduce and/or eliminate the constituent of concern if potential sources can be identified. Examples of constituents that could lead to BMP implementation and/or modifications include, but are not limited to, polycyclic aromatic hydrocarbons (PAHs), pesticides, ash, herbicides, turbidity, fertilizers, and bacteria from human and animal/pet waste. EAA will consult with the cities of New Braunfels and San Marcos regarding sampling locations within their respective jurisdictions.

6. Recharge Monitoring (§ 6.2.3)
The EAA will accurately measure the amount of water (in ac-ft) recharging the Edwards Aquifer in the area described in Section 1.2 of this Plan. EAA will publish this measurement not later than June 1st of each year for the purposes of guiding the activities in Section 5.5.1 of the HCP. EAA will then maintain this information on an ongoing basis in an appropriate publication.

7. Biological Monitoring (§ 6.3.1)
A comprehensive biological monitoring plan (Variable Flow Study) was established by the EAA in 2000 to gather baseline and critical period data to fill important gaps in the ecological condition of the Comal and San Marcos springs and river ecosystems. The EAA will continue this comprehensive sampling plan for the term of the ITP (with modifications as identified through the AMP process) and will provide a means of monitoring changes to habitat availability and the
population abundance of the Covered Species that may result from Covered Activities. The current Variable Flow Study has the following monitoring components:

- Aquatic vegetation mapping for select reaches;
- Fountain darter sampling (drop nets, dip nets, visual);
- San Marcos salamander sampling;
- Texas wild-rice physical observations and annual mapping;
- Comal Springs riffle beetle monitoring;
- Comal invertebrate sampling;
- Comal Springs salamander sampling;
- Parasite evaluations concerning the fountain darter; and
- Ramshorn and other exotic snail monitoring.

Additional components to be incorporated into the Variable Flow Study upon permit issuance will include sampling for two additional non-listed species, the Edwards Aquifer diving beetle, and Texas troglobitic water slater. The monitoring will also increase in magnitude, including increased frequency and number of parameters examined, as discharge falls to specific levels. In addition to long-term monitoring efforts that increase in intensity in response to the specified trigger events, a critical period monitoring component is incorporated into the Variable Flow Study that initiates full-scale sample efforts at specified trigger levels.

The scope of the Variable Flow Study currently can be modified on a yearly basis as provided in the FMA with agreement by the USFWS.

8. Groundwater Modeling (§ 6.3.2)
The MODFLOW model was used during the EARIP process to provide the model results for assessing the efficacy of the minimization and mitigation measures identified in Chapter 5 of the HCP. Like all groundwater models, the MODFLOW model has limitations and data gaps that manifest uncertainty in model results. By December 31, 2014, the EAA will take appropriate steps to reduce the level of uncertainty in the MODFLOW model by filling in the data gaps to the extent practicable and by reducing the number of structural limitations in the model. As part of the adaptive management commitment, the EAA will create another model to reduce uncertainty in the model results for use during the AMP and to provide assurance/confirmation that modeling results for the Aquifer and springflows are more reliable and defensible. This additional groundwater model is expected to be a finite element model. This additional model will be developed and ready for use by December 31, 2014.

9. Ecological Modeling (§ 6.3.3)
The EAA will oversee and retain a contractor to develop a predictive ecological model to evaluate potential adverse ecological effects from Covered Activities and to the extent that such effects are determined to occur, to quantify their magnitude. The model will provide the ability to investigate potential impacts to these ecosystems from extreme short-term and sustained long-term impacts from natural and anthropogenic factors, including local and regional groundwater withdrawals.
10. Applied Research Facility Experimental Channel at the USFWS National Fish Hatchery and Technology Center (§ 6.3.4)

a. Description of the Applied Research Facility (§ 6.3.4.1)

The EAA will support and coordinate the NFHTC’s construction and maintenance of the Applied Research Center. EAA will contract for the research activities in the Applied Research Center identified in this Section or developed as part of the AMP. The Program Manager will coordinate, supervise and oversee the implementation of all such research. An applied research experimental facility will be constructed at the USFWS National Fish Hatchery and Technology Center (NFHTC) in San Marcos, Texas. The NFHTC has the existing infrastructure (Aquifer exempt wells, ponds, containment areas, recirculation and reuse capabilities, etc.) to allow for construction and operation of an applied research facility to inform Phase II decisions regarding the Covered Species and, to the extent possible, adjustments to Conservation Measures during Phase I.

The conceptual design is a series of man-made channels with earthen substrate intertwined with the existing ponds available at the NFHTC. This will allow water use and reuse through the plumbing already in place while allowing the flexibility to pump water through several research channels for experimentation. To recreate the natural environment to the extent possible, considerable effort will be needed to simulate channel configuration, substrate, instream debris, riparian zone structure (trees, shrubs, grass), aquatic vegetation, and other natural and anthropogenic conditions present in the Comal River. These components will be carefully designed and constructed to provide the most authentic simulation practicable. A riffle beetle upwelling and spring run area will be created at the headwaters of two of the research channels.

b. Research in the Experimental Channels (§ 6.3.4.2)

The main focus of the research channels will be to evaluate the effects of low-flow on Covered Species and their habitat. This evaluation will include springflow conditions that bracket the range of 5 cfs to 100 cfs. The applied research at the NFHTC facility for Phase I will focus on the fountain darter relative to Comal and the Comal Spring riffle beetle, as these are the two species with the greatest potential for impact relative to the Phase I package. This applied research will be further divided into three tiers. Tier A will focus on habitat requirements and responses; Tier B will focus on low-flow impacts directly on the fountain darter and Comal Springs riffle beetle; and Tier C will investigate the implications of the timing, frequency, and duration of multiple events in varying sequences and include specific research efforts designed to assess ecological model predictions (e.g., model validation). The research projects are enumerated below:

- Tier A – Fountain Darter Habitat and Food Supply
  - Low-flow effects on native aquatic vegetation
  - Low-flow effects on macroinvertebrates (fountain darter food source)

- Tier A – Comal Springs Riffle Beetle Habitat Associations and Movement
  - Effects of flow levels on Comal Springs riffle beetle movement
• Extended Low-flow period effects on Comal Springs riffle beetles

• Test spring run connectivity

Tier B – Direct Impacts to Covered Species
• Low-flow effects on fountain darter movement, survival, and reproduction
• Low-flow effects on Comal Springs riffle beetle survival and reproduction

Tier C – Testing repeat occurrences of low-flow or combination of effects.
• System Memory
• Ecological Model Validation

11. Coal Tar Sealants (§ 5.7.6)
The EAA will put together materials regarding the value of a ban on the use of coal tar sealants and work with local governments to explore and encourage their consideration of such a ban.

12. Science Review Panel (FMA § 7.10)
Not later than December 31, 2013, the EAA will enter into a contract with the National Academy of the National Academies of Science to establish an independent Science Review Panel, select its members, and undertake the ongoing role of overseeing the Panel’s activities.

13. Program Management

B. City of New Braunfels

1. Flow-Split Management in the Old and New Channel (§ 5.2.1)
To minimize and mitigate the impacts of low flows, the City of New Braunfels staff will manipulate at least once monthly the valves and culverts to the Old Channel and New Channel of the Comal River for the protection of existing and restored native aquatic vegetation in the river, based on EAA’s real-time flow gauges in these channels and as often as appropriate for the maintenance of a beneficial hydrologic condition of the Old Channel habitat. Prior to this, the City of New Braunfels will replace and repair existing gates and control mechanisms to restore the operability of all four water paths to the Old Channel from Landa Lake: the two small culverts, the one large culvert, and the Springfed Pool inlet.

2. Native Aquatic Vegetation Restoration and Maintenance (§§ 5.2.2; 6.3.4.3)
To minimize and mitigate the impacts of incidental take from low-flow events by providing better habitat conditions for the ecological community, the City of New Braunfels will undertake a program of native aquatic vegetation restoration within key, sustainable reaches of the Comal River by planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal.

The amounts and types of vegetation removed and restored in this program will be established by Table 4-5 and 4-6 of the HCP respectively. Prior to initiating restoration activities, models and other studies will be used to evaluate the potential for success of the native vegetation restoration.
The focus of native vegetation restoration will be on Landa Lake downstream of Spring Run 3 but above the New Channel USGS weir and on the portions of the Old Channel bordered on both sides by City of New Braunfels’ property, including the Old Channel ERPA. Restoration efforts will also include establishing additional *Cabomba* along the eastern shoreline of Landa Lake and along the New Braunfels’ golf course property to create valuable fountain darter habitat.

### a. Old Channel Environmental Restoration and Protection Area (Old Channel ERPA) (§§ 5.2.2.1, 6.3.4.3)

To minimize and mitigate the impacts of recreation and pumping during periods of low flow, the City of New Braunfels will remove problematic non-native vegetation, restore native habitat (per Table 4-6), undertake limited channel modification to enhance fountain darter habitat, and remove a small sediment island. The Old Channel Environmental Restoration and Protection Area (ERPA) includes the EAA Variable Flow Study reach below Elizabeth Avenue upstream to the culverts feeding the Old Channel from Landa Lake where the preferred native aquatic vegetation of the fountain darter, native has been scoured and replaced over time with less-preferred non-native aquatic vegetation.

One specific area of targeted sediment removal is a small island that has formed just behind the Springfed Pool and immediately downstream of Landa Lake. This sediment island continues to grow, has established destructive non-native cane, and has displaced/destroyed fountain darter habitat.

### b. Comal River Restoration (§ 5.2.2.2)

Upon final determination of locations suitable for fountain darter habitat for restoration in the Comal River proper (below the USGS gauging weir, aka Stinky Falls), the City of New Braunfels will conduct native vegetation restoration and yearly maintenance to establish additional fountain darter habitat. Areas for targeted restoration preferred by the City of New Braunfels include the portion of the Comal River between Last Tubers Exit and the confluence of the Guadalupe River and portions of the Comal River that allow for protection on one side of the river and safe passage of recreators on the other side of the river. Once the habitat has been established, City of New Braunfels will work with the TPWD will to pursue the creation of State Scientific Areas to protect fountain darter habitat.

### c. Native Aquatic Vegetation Maintenance (§ 5.2.2.3)

To sustain the restored native vegetation within the Comal system, the City of New Braunfels will conduct yearly maintenance of native aquatic vegetation restoration sites in Landa Lake and the Old Channel, and the flow-split management discussed above in Section 5.2.1 of the HCP.

Native aquatic vegetation maintenance consists of actively monitoring and maintaining planted stands of native vegetation. Temporal monitoring will incorporate some form of quantitative measurement system to assess whether plantings are increasing, decreasing, or remaining stable. Additionally, intensive non-native vegetation control in the adjacent areas will be implemented until the native vegetation is well-established. It will include additional activities following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism. Anytime a disturbance is
observed, the monitoring/maintenance schedule will be modified temporarily in order to provide the stability for the native vegetation re-establishment.

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

To minimize and mitigate the impacts of recreation, the City of New Braunfels will manage recreational use of the Comal Springs and Comal River Ecosystem through two methods:

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce these regulations, including:
   a. Limiting recreation on Landa Lake to Paddle Boats
   b. Prohibiting recreational access to the Spring Runs in Landa Park to the Wading Pool in Spring Run 2.
   c. Prohibiting on water recreation on the Old Channel; with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section.

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

To minimize and mitigate the impact of incidental take from low-flow events, upon receipt of DO data indicating a water quality concern created by decaying vegetation and the total Comal springflow drops below 80 cfs, the City of New Braunfels will implement a dissolved oxygen management program. The program will be focused on ensuring adequate DO levels for the ecosystem. Techniques to accomplish this objective may include artificial aeration of areas of Landa Lake or other solutions. If appropriate, the program may include removal of decaying vegetation. Removal techniques for decaying vegetation, if necessary, may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal.

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

To minimize and mitigate the impacts of low flows, the City of New Braunfels will conduct non-native animal species control on an annual basis. Initial control efforts will be intense and take place during the winter’s first freeze, with continued control every winter. Control of non-natives will include annual maintenance and monitoring and non-natives will be disposed of out of the floodplain. The non-native species animal species that will be addressed include the suckermouth catfish, tilapia, nutria, and ramshorn snail.

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

To minimize and mitigate for the impact of low flows, the City of New Braunfels will retain and oversee the work of a contractor to establish a gill parasite monitoring and reduction. The
program may consist of non-native snail removal based on the pilot study conducted by USFWS and BIO-WEST (Id.).

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.

Additionally, although cercarial densities may be abating in the Comal system (Johnson et al. 2011), *C. formosanus* still poses a threat to fountain darters in the Comal River, especially during low-flows. As such, continued monitoring is essential and the following activities are included within this HCP conservation measure:

- A system-wide survey of snail population density and cercarial concentrations will be conducted to provide a baseline condition;
- Based on that system-wide survey, a decision will be made following the process set out in the AMP Agreement as to whether an initial system-wide removal effort is necessary, and if so, how to facilitate the performance of that effort;
- Based on the system-wide survey, a gill parasite monitoring program will be designed and implemented. Cercarial concentrations will be monitored in multiple areas along the Comal River on at least a semi-annual basis, and more frequently when spring flow drops initially below 150 cfs or other springflow triggers that are developed. Corresponding fountain darter sampling to examine correlations between cercariae densities and fountain darter impacts in the wild will also be part of that monitoring effort.

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

The City of New Braunfels will coordinate with the Texas Department of Transportation (TDOT) to prohibit transportation of hazardous materials on routes that cross the Comal River and its tributaries. This effort may include legislation, City of New Braunfels ordinances, additional signage, and TDOT approval.

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

To minimize and mitigate the impacts of low flow, the City of New Braunfels will restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). The method of riparian zone establishment will include the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and plants with extensive root systems will be given preference to create the maximum beetle habitat. Fine sediment covering exposed roots and springs will also be removed. The riparian zone will be monitored (at least annually) for continued success and removal of reestablished non-natives. Riparian zones will be protected until the preferred riparian zone is established. Riparian habitat zones will be created along both sides of Spring Run 3 and along the portion of the western shoreline that is owned by City of New Braunfels.
In addition, riparian restoration also benefits the system through bank stabilization and nutrient and sediment processes. The City of New Braunfels will develop a program to incentivize private landowners on the Comal River and its tributaries to establish riparian zones along the western shoreline.

9. Reduction of Non-Native Species Introduction and Live Bait Prohibition (§ 5.2.9)
To mitigate the impacts of recreation and pumping from the Aquifer during drought, the City of New Braunfels will undertake measures to stop or substantially reduce the introduction of non-native species from aquarium dumps and prohibit the use of live bait species.

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

10. Litter Collection and Floating Vegetation Management (§ 5.2.10)
To minimize and mitigate the impacts of recreation and pumping during low flow periods, the City of New Braunfels will clean litter and debris from and manage floating vegetation in the Comal Springs, Landa Lake, and Old and New Channels of the Comal River. Litter and debris collection both flood-related and routine, will utilize self-contained underwater breathing apparatus (SCUBA). Debris removal also includes the removal of litter from floating vegetation mats before dislodging the vegetation mat and allowing it to continue downstream.

11. Management of Golf Course Diversions and Operations (§ 5.2.11)
The City of New Braunfels will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the Covered Species. Expanded water quality sampling targeted at Golf Course operations will be conducted per Section of 5.7.2. of the HCP.

12. Management of Household Hazardous Wastes (§ 5.7.5)
To reduce the potential for future water quality problems, the City of New Braunfels will initiate a hazardous household waste (HHW) program that will include accepting prescription drugs and Freon, through the TCEQ and/or the waste disposal division of the City of New Braunfels. The City of New Braunfels will establish a four-times-a-year program that could be recognized in the City's anticipated MS4 compliance and storm water permit as a contributing activity.

13. Impervious Cover/Water Quality Protection (§ 5.7.6)
The City of New Braunfels will establish criteria related to desired impervious cover and provide incentives to reduce existing impervious cover on public and private property in New Braunfels. The City of New Braunfels will establish criteria and incentives for the program based upon the

14. **Native Riparian Habitat Restoration (§ 5.7.1)**
The City of New Braunfels will undertake a program to increase the area of the riparian zone along the Old Channel, the golf course and in the vicinity of Clemens Dam. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

**C. City of San Marcos and Texas State University**

1. **Texas Wild-Rice Enhancement and Restoration (§§ 5.3.1, 5.4.1, 6.3.5)**
Based on BIO-WEST and TPWD monitoring data collected over the past decade and Hardy (2011) model results, the City of San Marcos, in partnership with Texas State University, will implement a Texas wild-rice enhancement and restoration program.

Initially, these activities will involve an applied research component. Methods for Texas wild-rice enhancement will need to be investigated to understand the potential for increased areal coverage of Texas wild-rice through implementation of this measure. Non-native vegetation mixed in with Texas wild-rice or surrounding existing Texas wild-rice plants but still located within optimal habitat areas will be removed to see if areal coverage of Texas wild-rice will expand in those areas. The specific areas chosen for evaluation will include only areas that would be suitable over the full range of discharges between the long term average and Phase I minimum flows.

2. **Management of Recreation in Key Areas (§§ 5.3.2, 5.4.2)**
Texas State University and the City of San Marcos will control recreation in Spring Lake and the San Marcos River within Texas State University campus boundaries.

To minimize the impacts from recreation, Texas State University will establish permanent access points on the east and west banks of the San Marcos River between Spring Lake dam and the Aquarena Drive bridge, and other areas as determined during the AMP. These areas will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc. Areas between access points will be planted with vegetation that discourages streamside access (e.g., prickly pear and acacia).

To minimize the impacts from recreation, the City of San Marcos will establish permanent river access points. Permanent access will be located at Dog Beach, Lion’s Club Tube Rental, Bicentennial Park, Rio Vista Park, the Wildlife Annex, and potentially other areas (as determined through the AMP). Areas between access points will be densely planted with vegetation that discourages streamside access.
To support the TPWD’s creation of State Scientific Areas in the San Marcos Springs ecosystem and River, the City of San Marcos and Texas State University will install kiosks showing access points, exclusion zones, and associated educational components at key locations.

3. **Native Riparian Habitat Restoration (§ 5.7.1)**

The City of San Marcos will undertake a program to increase the area of the riparian zone on public lands from City Park to IH-35 using native vegetation. Texas State University will undertake a similar program to restore the riparian zone with native vegetation in upper Sewell Park. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

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

Texas State University and the City of San Marcos will implement a non-native plant replacement program from Spring Lake to city limits. Non-native species of aquatic, littoral, and riparian plants will be replaced with native species to enhance Covered Species habitat. The divers that will be conducting sediment control will first remove non-native aquatic plant species from the area to be worked that day. Removal will initially focus on hydrilla (*Hydrilla verticillata*) as this species causes sediment deposition and adds turbidity to the water column when disturbed. The non-native aquatic plants will be shaken and bagged for removal from the system in the same manner described in Section 5.4.3.1. Areas will be “weeded” until the natives become established at the site.

The riparian zone will be restored to at least 15 meters in width where possible. Areas will be planted at a ratio of three hard mast trees to one soft mast tree, with 20 percent of the vegetation consisting of fruit-bearing shrubs. Vegetation such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, and buttonbush will be used. Fencing may be required for the first two years to allow for the establishment of the species.

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

To mitigate the impacts of incidental take by pumping and recreational activities, the City of San Marcos and Texas State University, will implement non-native and predator species control for the San Marcos River on a periodic basis with expanded effort of control, if needed, at low flows. The species include suckermouth catfish, tilapia, and *Melanoides* and *Marisa* snails.

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

To mitigate the impacts of recreation and pumping from the aquifer during drought, Texas State University and the City of San Marcos to undertake a program of non-native and predator species control for Spring Lake and the San Marcos River within the University’s campus boundaries as described in Section 5.3.9 of the HCP. Dumping aquariums into the San Marcos River and its tributaries will be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. The
City of San Marcos and Texas State University will partner with the River Systems Institute, and local citizen groups to help distribute educational materials. Partnerships with the school districts will also be considered. Educational materials will also be provided to local pet shops.

7. Sediment Removal below Sewell Park (§§ 5.3.6, 5.4.4)
The City of San Marcos will remove sediment from the river bottom at various locations from City Park to IH-35. These areas include but are not limited to reaches of the river in City Park, Veramendi Park, Bicentennial Park, Rio Vista Park and Ramon Lucio Park. To minimize and mitigate the impacts of incidental take from recreation and pumping during low flow periods, the City of San Marcos will remove sediment from key areas of Texas wild-rice habitat below Sewell Park. Texas State University will mitigate the impacts of incidental take from diving activities, research activities, recreation and pumping during low flow periods by removing sediment from key areas of Texas wild-rice habitat in Spring Lake and from Spring Lake Dam to City Park.

Sediment samples will be sent to TCEQ for contaminant testing per TCEQ requirements.

D. City of San Marcos

1. Minimizing Impacts of Contaminated Runoff (§ 5.7.4)
The City of San Marcos will construct two sedimentation ponds along the river to help reduce the amount of contaminated materials that enters the river as a result of rain events. The ponds will also reduce runoff velocity which will help to reduce bank erosion, and subsequently the amount of sediment that enters the river. The sedimentation ponds will be constructed by excavating and stabilizing a specified area, and building a controlled-release structure. Water source for the ponds is solely runoff from rain events. Specific details for all ponds will be submitted through the AMP as each pond is contracted for design. Each construction area will be surrounded by silt fence/rock berm to minimize runoff. Sediment controls will be monitored daily during construction and the construction area will be covered with a tarp in the event of rain.

The first pond will be located in Veramendi Park beside Hopkins Street bridge. The first pond will be designed to remove sediment and street pollutants from runoff prior to entering the river. The size, shape, and depth will be determined based on an analysis of the volume of water discharging from the storm drains. The City of San Marcos will detain as much as possible for treatment purposes. The City of San Marcos will undertake required maintenance of the sedimentation ponds on a regular basis.

The second pond will be created by widening of drainage ditches that run alongside Hopkins Street and cut directly to the San Marcos River. Widened areas will be designed to store water for a short period of time, but long enough to collect sediments and associated pollutants from roadway runoff.

2. Management of Public Recreational Use of San Marcos Springs and River Ecosystem (§ 5.3.2.1)
Public recreational use of the San Marcos Spring and River ecosystems include, but are not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving,
snorkeling and fishing. To minimize the impacts of incidental take resulting from recreation, the City of San Marcos will implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix N of the HCP). In addition, pursuant to Section 9.2 of the IA, the City of San Marcos will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River) (Outfitters) that comply with the requirements of the COI program established in section 5.3.2.1 of the HCP.

3. Management of Aquatic Vegetation and Litter below Sewell Park (§ 5.3.3)
To minimize the impacts of recreation on Texas wild-rice and other Covered Species from Sewell Park to IH-35, the City of San Marcos will perform activities to manage floating vegetation and litter to enhance habitats for Covered Species. Management activities will include removal of vegetation mats that form on top of the water surface as well as on top of Texas wild-rice plants, particularly during low flows, and removal of litter.

The City of San Marcos will push floating vegetation downstream of any Texas wild-rice stands. The City will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation.

Inorganic litter will be removed from the San Marcos River from City Park to IH-35 during the recreational season (May through September) and less often during offseason. Litter in or around Texas wild-rice stands will not be removed.

4. Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (§ 5.3.4)
Hazardous materials transported by truck across the watershed of the San Marcos River and its tributaries presents the possibility of accidental spills or releases into the environment. The limited geographic distribution of the endangered species at San Marcos Springs could cause the species to be highly impacted by such a spill.

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

5. Designation of Permanent Access Points/Bank Stabilization (§ 5.3.7)
To minimize the impacts of recreation, permanent access points will be combined with bank stabilization at various locations. They will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. The City of San Marcos will stabilize banks in eroded areas, to include City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and Cheatham Street underpass.

Natural rock will be used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation will be planted.
in areas adjacent to the access/stabilization areas in order to discourage river users from entering the river in places other than the access point. Prior to each construction period, the area will be swept clean of darters and enclosures will be put into place to keep darters out of the construction area.

6. **Septic System Registration and Permitting Program (§ 5.7.3)**
The City of San Marcos will undertake an aerobic and anaerobic septic system registration, evaluation, and permitting program to prevent subsurface pollutant loadings from potentially being introduced to the San Marcos Springs ecosystem within its city limits.

7. **Management of Household Hazardous Wastes (§ 5.7.5)**
The City of San Marcos will maintain a HHW program that involves the periodic collection of HHW and its disposal.

8. **Impervious Cover/Water Quality Protection (§ 5.7.6)**
The City of San Marcos will establish a program to protect water quality and reduce the impacts of impervious cover (such as through LID). The City of San Marcos will develop criteria and incentives for the program based upon the LID/Water Quality Work Group Final Report (Appendix Q) recommendations for Implementation Strategies and BMPs.

### E. Texas State University

1. **Management of Submerged and Floating Aquatic Vegetation in Spring Lake (§ 5.4.3.1)**
To mitigate the impacts of incidental take on Covered Species from recreation, Texas State University will manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake.

   Each week about five springs will be cut, thus returning to cut the same springs every two to three weeks. During summer algal blooms, the springs will be managed more frequently (up to four springs per day), but mostly to remove algae. Texas State employees and supervised volunteers will fin the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they will shear vegetation to a height of 30 cm, and then to one meter over the following three meter radius. Plant material will not be collected, but carried away by the current. Cumulatively, about six meters of vegetation around each spring opening will be modified. Mosses will not be cut. The volume of plant material to be removed will vary by the amount of time between cuttings, and season.

   The harvester boat will remove a range of 15-to-20 boatloads of plant material a month from Spring Lake. The harvester will clear the top meter of the water column, cutting vegetation from sections one, two, and three once a week. The harvested vegetation will be visually checked by driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake if appropriate. Texas State employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science program, and avoid contact with them.
Vegetation mats will be removed from zones four and five on an as-needed basis. The total area cut will equal about nine surface acres.

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

2. Management of Aquatic Vegetation from Sewell Park to City Park (§ 5.4.3.2)
To mitigate the impacts of incidental take from recreational activities, Texas State University will push floating vegetation downstream of any Texas wild-rice stands. Inorganic litter will be picked up weekly from the San Marcos River from Sewell Park to City Park during the recreational season (Memorial Day to Labor Day) and monthly during offseason.

Texas State University will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation. Divers will not pick up litter in or around Texas wild-rice stands.

University employees or others will be trained by the TPWD to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. On Texas wild-rice stands, Texas State University employees will lift (not push) the floating material from the top of the Texas wild-rice stands and allow it to float downstream. Downstream accumulations of plant material will be removed by the City of San Marcos to avoid impacts to Texas wild-rice further downstream.

3. Diversion of Surface Water (§ 5.4.5)
Under TCEQ Certificates 18-3865 and 18-3866, Texas State University’s total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs. The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs. To minimize the impacts of these diversions, when flow at the USGS gauge at the University Bridge reaches 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, i.e., to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam in order to maximize the benefits to salamanders, Texas wild-rice, and other aquatic resources in the San Marcos River below Spring Lake Dam. The University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 49 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when the springflow reaches 45 cfs.

The reductions in Texas State University’s total diversion rate for consumptive use is summarized in the Table below:
<table>
<thead>
<tr>
<th>Streamflow (cfs)</th>
<th>Spring Lake Diversions (cfs) Cert. No. 18-3865</th>
<th>San Marcos River Diversions (cfs) Cert. No. 18-3866</th>
<th>Total Diversion Rate (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;80</td>
<td>4.9</td>
<td>3.2</td>
<td>8.1</td>
</tr>
<tr>
<td>80 – 60</td>
<td>2.9</td>
<td>3.2</td>
<td>6.1</td>
</tr>
<tr>
<td>60 – 49</td>
<td>0.9</td>
<td>3.2</td>
<td>4.1</td>
</tr>
<tr>
<td>49-45</td>
<td>1.0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>&lt;45</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

4. Sessom Creek Sand Bar Removal (§ 5.4.6)

For decades, a sand and gravel bar has been building with each major rain event at the confluence of Sessom Creek and the San Marcos River. The bar is about two-thirds meter deep, 7 meters wide, and 21 meters long (98.5 m³). Over time it has widened, deepened, and constricted the river channel; furthermore, the continued expansion has covered a stand of Texas wild-rice. The bar has become vegetated with both littoral and terrestrial plants, and is used heavily by recreationists as it provides a shallow swimming area.

To minimize and mitigate the impacts of incidental take from recreation, Texas State University and the City of San Marcos will conduct a study of sediment removal options to determine the best procedure to remove this sand and gravel bar that minimizes impacts to listed species. Texas State University will submit the study for review through the AMP and implement the actions coming out of that process.

A separate sediment retention pond has been constructed to minimize additional deposition to this area and will be maintained to maintain an effective level of performance.

5. Diving Classes in Spring Lake (§ 5.4.7)

a. The Diving for Science Program

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae, and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat.
The Diving Supervisor coordinates and supervises all volunteer diving. No more than sixteen volunteer divers will be allowed in the lake per day, with no more than eight at one time.

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

b. Texas State University Continuing Education
Texas State University Continuing Education classes for check-out dives will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

C. Texas State SCUBA Classes
Texas State SCUBA classes will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

6. Research Programs in Spring Lake (§ 5.4.8)
To minimize the impacts of its research programs, all proposals to conduct research in Spring Lake will be reviewed by the River Systems Institute to ensure there is no impact on Covered Species or their habitat. If incidental take cannot be avoided, it will be minimized by educating the researchers as to the area where the listed species are located and by requiring measures to minimize any potential impacts. All diving in support of a research study will be provided by individuals who have completed the Diving for Science program.

7. Management of Golf Course and Grounds (§ 5.4.9)
To minimize any impacts of the use of fertilizers and pesticides to maintain the golf course and grounds, Texas State University will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the ecosystem. Expanded water quality sampling targeted at Golf Course operations will be conducted as described in Section of 5.7.2. of the HCP.

8. Boating in Spring Lake and Sewell Park (§ 5.4.10)
To minimize the impacts of boating on the Covered Species’ habitat in Spring Lake, boats in Spring Lake will be confined to areas that are mowed by the harvester, thereby not impacting vegetation and specifically avoiding Texas wild-rice stands. Individuals will enter and exit boats at specified access points to avoid impacting the flora and fauna along the bank. All boats launched into Spring Lake will undergo a USFWS-approved process for cleaning.

Further, canoeing/kayaking classes in the lake will be limited to no more than 2 classes per day and each class will be in the water no more than 1 hour. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

To minimize the impacts of boating on the Covered Species’ habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will be confined to the region between Sewell Park
and Rio Vista dam. Students will enter/exit canoes/kayaks at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

**F. San Antonio Water System**

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

To minimize the impacts of incidental take from extended drought, the SAWS ASR facility will be used to store and deliver Aquifer water leased by the EAA. When triggers are reached, SAWS will use water stored in the ASR to serve as a baseload supply in its service area near to the springs. As described below, an amount equivalent to the water recovered from the ASR will be used to offset SAWS’s Edwards demand.

EAA will acquire through lease and option 50,000 ac-ft/yr of EAA-issued Final Initial Regular Permits. The leases and options will used to fill, idle, and maintain a portion of the capacity of the SAWS ASR Project for subsequent use to protect springflows.

The lease program is comprised of three components. The first one-third, approximating 16,667 acre-feet of permits, will be leased for immediate storage in the ASR. The remaining pumping rights will be placed under a lease option. One-third (16,667 ac/ft) of the total will be options exercised in the year after the 10-year moving annual average of Edwards recharge falls below 572,000 ac-ft/yr, as determined by the EAA, and is likely to continue to decrease. The last one-third will be options exercised when the 10-year moving recharge average is less than 472,000 ac-ft/yr, as determined by the EAA. When the leases are in place, this water will either be pumped to fill the SAWS ASR or not pumped for any reason. When the ASR is in recovery mode (i.e., when water is being returned from the ASR), the leased water will not be pumped.

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

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery developed by HDR Engineering (HDR 2011). However, the actual pattern of delivery of water from the ASR may differ from that HDR used in its modeling simulations depending on the actual course of the drought.

The use of the SAWS ASR is predicated on an assumption informed by HDR Engineers’ groundwater modeling that the SAWS ASR will be utilized to deliver approximately 126,000 ac-
ft of water to SAWS distribution system during a decadal drought similar to the drought of record. It is further predicated on the assumption from HDR 2011 that the maximum amount of HCP water that will be delivered in a given year is 46,300 ac-ft. SAWS will make the day-to-day decisions necessary to fulfill the ASR commitment. A 12-person Regional Advisory Group consisting of four representatives of SAWS, the Program Manager, and one representative each from EAA, EAA permit holder for irrigation purposes, small municipal pumpers, the Spring cities, environmental (including Texas Parks and Wildlife), industrial pumpers, and downstream interests will provide advice to SAWS regarding the implementation of the program. The Advisory Group will meet as needed but no less than quarterly. SAWS will organize and facilitate the Advisory Group.

G. Texas Parks and Wildlife Department

1. State Scientific Areas (§ 5.6)

Texas Parks and Wildlife Department (TPWD) has the authority to establish state “scientific areas” for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value. (TPW Code § 81.501). To minimize the impacts of recreation, TPWD will pursue creation of state scientific areas in the San Marcos Springs ecosystem. The scientific areas will be designed to protect Texas wild-rice by limiting recreation in these areas during low flow conditions. The regulations are intended to preserve at least 1,000 m² of Texas wild-rice.

With the exception of the eastern spillway immediately below Spring Lake Dam, none of the protected areas will extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river.

Interlocal agreements between the City of San Marcos and TPWD and Texas State University and TPWD will be used to allow for local in-water enforcement of the protected zones.

In order to protect existing and restored fountain darter habitat, TPWD will pursue creation of state scientific areas in the Comal Springs ecosystem. The goal of the regulations will be to minimize impacts to habitat from recreation activities. An interlocal agreement between the City of New Braunfels and TPWD will be used to allow for local in-water enforcement of the protected zones.

II. Costs

The estimated cost of the HCP and the schedule by which those costs are expected to be realized are set out in Table 7.1 of the HCP and are hereby incorporated by reference in this Comprehensive Plan. The cost estimates are arrayed in the Table below according to the entity assigned by the HCP.
APPENDIX F3

EAHCP Comal Springs Riffle Beetle Work Group Report
Edwards Aquifer Habitat Conservation Plan

Comal Springs Riffle Beetle Work Group Report
## Table of Contents

Background: Development of the CSRB workgroup .......................................................... 1

Background: EAHCP Biological monitoring, refugia collections, and LTBGs for the CSRB .......................................................... 3

Discussion and Recommendations for Charge 1: Cotton Lure Sampling Methodology .... 5

Discussion and Recommendations for Charge 2: Biological monitoring, Refugia collections, and Applied Research collections .......................................................... 7

Discussion and Recommendations for Charge 3: CSRB Long-term Biological Goals ...... 9

Conclusion and Workgroup Recommendations ................................................................. 11

### Appendices

- Appendix A: Comal Springs Riffle Beetle Work Group Charge
- Appendix B: Agendas and Meeting Minutes of the Work Group
- Appendix C: Presentations of the Work Group
Background: Development of the Comal Springs riffle beetle work group

The Comal Springs Riffle Beetle (*Heterelmis comalensis*) is a federally endangered species and among the eleven covered species managed under the Edwards Aquifer Habitat Conservation Plan (EAHCP). The Comal Springs riffle beetle (CSRB) is primarily encountered in the Comal springs system and is highly associated with springs and spring orifices. They are known to occur in areas of flowing water over gravel and cobble substrates. Several program areas within the EAHCP are committed to protecting the CSRB through monitoring, research, and refugia.

The EAHCP underwent a multi-year review by the National Academies of Sciences (NAS) which sought to determine whether the Conservation Measures prescribed in the EAHCP would achieve Biological Objectives which in turn would achieve species Long-Term Biological Goals (LTBGs). During review of the CSRB with NAS, it became apparent there were issues with the overall knowledge of the species and monitoring of the beetle that would make it difficult for NAS to determine whether LTBGs could be achieved. In the third and final consensus report from NAS, the committee was “unable to determine” whether the conservation measures surrounding the CSRB would be able to achieve the Biological Objectives for the beetle. It should be noted, the committee determined the Biological Objectives are “somewhat likely” to meet the LTBGs for the CSRB.

In response to the issues highlighted during the three-part review of the EAHCP by NAS and issues expressed by members of the EAHCP Science Committee and Stakeholder groups, a work group was formed in early 2018 to address concerns around a specific set of questions regarding CSRB activities contained within the EAHCP. The charge of the Comal Springs riffle beetle workgroup (CSRBWG) focused on three primary areas: 1) sampling methodology, 2) field activities (Biomonitoring, refugia collections and Applied Research), and 3) EAHCP LTBGs. The specific set of questions from the charge are shown below in Table 1, the full version of the CRBWG Charge can be found in Appendix A.
Table 1. Charge questions tasked to the CSRBWG.

<table>
<thead>
<tr>
<th>Charge Topic</th>
<th>Topic Question</th>
</tr>
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<tbody>
<tr>
<td>Cotton lure sampling methodology</td>
<td>Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?</td>
</tr>
<tr>
<td></td>
<td>If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?</td>
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<tr>
<td></td>
<td>If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions?</td>
</tr>
<tr>
<td>Biological monitoring, Refugia collections, and Applied Research collections</td>
<td>What changes are recommended for the Biological monitoring sampling program? What are the stated goals behind those changes?</td>
</tr>
<tr>
<td></td>
<td>What changes are recommended for Refugia removal efforts? What are the stated goals behind those changes?</td>
</tr>
<tr>
<td></td>
<td>Are the current and proposed levels of physical activity in the CSRB habitat protective of the species? If not, what level of activity is appropriate?</td>
</tr>
<tr>
<td>Long-term biological goals</td>
<td>Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?</td>
</tr>
<tr>
<td></td>
<td>What is an appropriate means to monitor the habitat quality goal?</td>
</tr>
<tr>
<td></td>
<td>How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs?</td>
</tr>
</tbody>
</table>

The CSRBWG was comprised of members from the EAHCP Science Committee as well as external experts: Butch Weckerly (Science Committee & Texas State University), Chad Norris (Science Committee & Texas Parks and Wildlife Department, Conrad Lamon (Science Committee), and Kenneth Ostrand (U.S. Fish and Wildlife Service). Additionally, Tom Arsuffi (Science Committee) participated in the work group. The CSRBWG was moderated by Chad Furl meeting six times over 2018-2019. Agendas, minutes, and presentations from each meeting are included in Appendix B.
Background: EAHCP Biological monitoring, refugia collections, and LTBGs for the CSRB

Cotton lure methodology

The current capture technique for CSRBs was developed during the EAA variable flow study (present day EAHCP Biological monitoring program) and consists of placing a folded cotton cloth lure contained within a wire cage in a spring orifice for approximately thirty days. Over the course of thirty days, the lures become inoculated with local organic matter and invertebrates. Since 2004, several entities not associated with the Biological monitoring program have completed CSRB collections. In 2016, a CSRB standard operating procedure was developed through the EAHCP to provide consistencies in construction of cotton lures, their placement, and standardized metadata requested during placement and retrieval.

Biological monitoring procedures

CSRB sampling conducted as part of the Biological monitoring program occurs during the Spring and Fall as well as during critical flow periods described in the EAHC. For the routine biannual sampling, 10 cotton lures are placed into spring openings/upwellings in the Comal system at three reaches (30 lures total): Spring Run 3, Western Shoreline of Landa Lake, and Spring Island (Figure 1). After 30 days, the lures are retrieved and all invertebrates collected on the cotton lures are identified, counted, and returned to the spring of capture. Environmental variables (i.e., depth and current velocity) are measured at the time of lure placement and retrieval. Since 2016, additional environmental variables have been recorded, including spring type, substrate composition, and general water quality parameters (i.e., DO, temperature, specific conductance, TDS, and pH). Presence of biofilm, percent coverage, and color has also been recorded since 2016.

Refugia collection procedures

The Refugia program for the CSRB requires that wild-caught adults are kept in captivity during all times to serve as standing stock. The program started collecting CSRBs in January 2017 to achieve the required standing stock numbers. USFWS utilizes the cotton lure method to collect CSRB as described in the CSRB SOP. Wooden dowel lures are also co-located with the cotton lures as a secondary attractant for the CSRB. Cotton lures and wooden dowels are placed into springs at several locations: Spring Runs 1 – 3, Western Shoreline of Landa Lake, and Spring Island. Cotton lures and dowels are retrieved after 30 days and no more than 25% of CSRB collected per lure are retained for refugia stock. The remaining 75% of the catch is returned to the spring orifice. Environmental variables (i.e., depth and current velocity) are measured at the
time of lure placement and retrieval including spring type, substrate composition, and general water quality parameters (i.e., DO, temperature, specific conductance, TDS, and pH). Individuals kept for the refugia stock are placed in quarantine for approximately 30 days before being incorporated into the refugia stock population. Census and mortality of the CSRB refugia population is completed every other month.

Beginning in Fall 2018, the Refugia staff collected CSRB from cotton lures set for the Biological monitoring program. The coordination between the Biological monitoring sampling and Refugia collections was developed to reduce the level of physical disturbance within the CSRB habitat.

Figure 1. Comal Spring riffle beetle study reaches for EAHCP Biological monitoring program.

**CSRB Long-term Biological Goals**

The CSRB LTBGs include a population measurement and a qualitative habitat component that are shown in Table 2 (Table 4-7 of the EAHCP). Three representative reaches (i.e., Spring Run 3, Western Shoreline, and Spring Island, refer to Figure 1) were selected to monitor the CSRB
for LTBGs. The Biological monitoring program is the means to assess whether median densities are maintained.

CSRB have been found highly associated with coarse substrates that remain silt-free. The qualitative habitat goal component states that ≥ 90% of the LTBG reaches should contain silt-free gravel and cobble.

Table 2. EAHCP CSRB long-term biological goals (Table 4-7 of EAHCP).

<table>
<thead>
<tr>
<th></th>
<th>Comal Springs Riffle Beetle Long-Term Biological Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Habitat</td>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
</tr>
<tr>
<td>Density (# of CSRB/Lure)</td>
<td>≥20</td>
</tr>
</tbody>
</table>

**Charge question 1. Cotton Lure Sampling Methodology**

There is a fundamental information gap that limits the interpretation of the cotton lure data. Currently, it’s unclear whether the number of beetles on a lure is representative of the number of beetles in the immediate area available for sampling. Put another way, does the cotton lure data tell us anything about the number of beetles living in a specific area. NAS had a similar criticism in their review of the program citing a “lack of quantitative monitoring” for the beetle.

The initial charge question posed to the committee seeks to understand 1) whether the cotton lure is appropriate to determine abundance at a location, 2) whether there are better sampling alternatives available, and 3) what would be an appropriate study design to aid interpretation of the lure data.

The first two sub-questions in charge question number one were addressed simultaneously by the committee. The committee reviewed summary analyses on the cotton lure dataset provided by Dr. Furl. The data set consists of routine and critical period biological monitoring from 2004 – 2019 and refugia cotton lure collections from 2017 – Feb 2019.

Summary statistics were presented on the distribution of raw beetle counts at each location by adults and larva, time series plots by reach, and time series plots by individual orifices that had been determined to have been repeatedly sampled over the course of the biological monitoring program.
Additionally, the committee heard from Dr. Arsuffi on topics related to stream ecology and the hyporheic zone, disturbance and recolonization patterns, sampling methodologies of the CSRB and other riffle beetle species, and life history aspects of the CSRB.

**Outcome of CSRBWG for Charge 1: Experimental Design: CSRB preference/Cotton lure efficiency study**

The CSRBWG decided to move forward with the cotton lure sampling method at the present time. However, the need was recognized to create a better understanding of what the lure data indicates about CSRB occupancy and their population. A basic laboratory study was proposed to satisfy this need. The study design described below is the outcome of multiple discussions by the work group and is the recommendation for addressing Charge 1 of the CSRBWG. The proposed study is scheduled to occur in 2020. At the conclusion of the study, results will be presented to the EAHCP Science Committee and the annual meeting of the CSRBWG.

In order to conduct the experiment, 5 circular tanks approximately 24 inches in diameter will be plumbed such that water emanates from the bottom of the tank approximately 3 inches from the tank sides. This will be achieved by drilling out PVC (or other tubing material) and fashioning into a circle. Water will exit a standpipe located in the center of the circular tank in an attempt to distribute flow evenly across the tank. Flow circulating in the tank will be approximately 0.5 L/min.

The experiment will be housed in an area with low-light conditions. Tank material will consist of wood, leaves, limestone gravel, and a cotton lure. Well-conditioned woody material will be harvested from Landa Lake, split into 5 equal proportions, and kept in flowing well water until tank construction is complete. Leaves will be collected from the bank along western shoreline and conditioned in flowing well water for approximately 4-12 weeks. It is anticipated that Anaqua or Sycamore leaves will be used for the experiment. Both the woody material and leaves will be placed into a wire-frame cage like the cotton lure. This will be done to standardize the approximate amount of each material and allow for easier collection when the experiment is finished. Gravel in the tank will consist of store-bought limestone primarily in the size range of ~ 1.5 inch. Larger pieces of cobble (3-5 inches) will also be interspersed throughout the tank. The limestone will be thoroughly washed and conditioned for _ weeks prior to tank set up. The cotton lure placed in the tank will follow protocol described by BIO-WEST.

The depth of the gravel in the tank will be as thin as possible and still allow for covering up the drilled out piping in the bottom of the tanks and allow for burial of the 3 wire cages on top of the
piping. Once the hydraulics are functioning correctly and the gravel is in place, the woody debris and leaf packets will be gently buried on the perimeter of the tanks just inside of the drilled-out piping. These two packets will be left in place for approximately one week before gently burying the cotton lure packet. To avoid potential toxicity issues, the cotton lure will be thoroughly flushed with Deionized water before placing into the tank. When all three packets are in place, they will be located equidistant from each other. Once all three packets are in place, 20 adult beetles will be randomly selected and added near the center of the tank with a baster or other piping device. Beetles will be held for a period of 3-7 days at the research facility prior to being placed in a tank.

The cotton lure will be checked at 10, 20, and 30 day intervals, and the number of beetles in the lure will be recorded. An attempt will be made to check the lure with as little disturbance as possible and return to the microcosm as quickly as possible. Standard water quality parameters will be monitored throughout the 30 day study period. On day 30, beetles will be enumerated in the cotton lure, leaf packets, woody debris packets, and substrate within the tank. The sex of the beetles will be determined at this point and the number of individuals that did not survive the experiment will be noted. Notes will be taken on the condition of the packets within the tanks.

**Charge 2: Biological monitoring, Refugia collections, and Applied Research collections**

*Biological monitoring*

The first objective of Charge 2 of the CSRBWG was to examine the current Biological monitoring program and develop any changes recommended for the sampling program. The goals of the EAHCP biological monitoring program are two-fold: 1) monitor changes to habitat availability and the population abundance of the covered species and 2) provide information to assess whether the conservation measures are achieving the biological goals and objectives. Specific topics presented to the CSRBWG for consideration included:

- Maintaining repeated sampling of individual orifices at the three LTBG reaches.
- Randomizing spring orifice selection.
- Expanding outside of the historical LTBG sampling areas.
- Adjusting the number of lures set for each survey.
- Adjusting the frequency of surveys.
Outcome of CSRBWG for Charge 2: Biological monitoring program

The CSRBWG ultimately decided to leave the current Biological monitoring program in place. The program will continue to sample 10 orifices at each of the three historical LTBG locations during Spring and Fall. No changes were made to the current sampling frequency and number of cotton lures set for the biological monitoring program.

The CSRBWG agreed that additional sampling should occur beyond the LTBG reaches in order to better understand system-wide abundance and near-surface populations. Currently (2019), an occupancy and abundance study is underway through a Texas State University master’s student in Dr. Weston Nowlin’s lab (not funded by EAHCP). The study methodology includes using the cotton lure approach for four repeated sampling events of 85 orifices that were selected randomly. This study will provide occupancy and population estimates and serve as the basis for additional system-wide studies.

The CSRBWG recommends two additional occupancy and population studies be conducted through the EAHCP program before the end of the current permit. It is anticipated these studies will be conducted in 2022 and 2025. The EAA anticipates contracting for study design after results from the Texas State University occupancy and site abundance study are made available.

Refugia collections

The Refugia program is required to maintain wild individuals for standing, refugia, and salvage stock populations. Since the inception of the Refugia program in 2017, maintaining a standing stock of 500 adults has proven difficult. To date, approximately 100-300 adult beetles have been maintained in Refugia standing stocks (as of Sept 2019). Unknown ages of the beetles during collections and the relatively short life span are contributing factors to the low survivability rates in captivity (~ 50% survival rate at 4-5 months). On-going research through the Refugia program is being conducted to improve CSRB husbandry and propagation techniques that will hopefully lead to increased CSRB survival rates in captivity.

Based on the high number of beetles collected to date, low survival rates in captivity, and active research on the topic the committee considered the following topics:

- Appropriate standing stock size.
- Refugia removal locations and total amount of beetles removed from system each year.
- System-wide and individual orifice disturbance from Refugia removals.
- Overlap and effect upon Biological Monitoring program.
• The percentage of beetles from a cotton lure that should be kept or returned to an orifice during collection events.

**Outcome of CSRBWG for Charge 2: Refugia collections**

The CSRBWG decided to adjust the standing stock number to 150 CSRBs, holding 75 at each of the Refugia facilities. To achieve this average standing stock number, it is estimated that 300-400 CSRBs will need to be collected annually. The CSRBWG will revisit standing stock numbers annually as population and husbandry studies become available and Refugia staff refines the level of effort needed to achieve this standing stock number.

Presently, the Refugia standard operating procedures state that only 25% of CSRB found on one lure will be retained while returning the other 75% to the site of collection. With the uncertainty on the survival rates of the 75% of individuals returned after lure collection and to further reduce disturbance, the CSRBWG approved the 100% collection of CSRB captured on a cotton lure. It is anticipated this will reduce overall system disturbance and lessen the level of effort. The increased collection percent was suggested with additional guidelines: alternating the use of spring orifices between sampling events, and all Refugia collections will occur separate from the Biological monitoring program (no longer collect beetles from the Biological monitoring lures). The decision to separate Refugia and Biological monitoring collection events was based on preventing any potential influence that 100% take might have on monitoring collection sites.

**Charge 3: CSRB Long-term biological goals**

The established EAHCP LTBGs for the CSRB are strongly tied to the cotton lure collection methodology (Table 2). Section 4.1.1.1 of the EAHCP states “The population measurement is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.” The Biological monitoring program samples twice a year to evaluate if median densities goals are being met.

The CSRBWG was charged with determining if the population LTBG for the CSRB was appropriate. In their discussions, the work group members agreed that changes should be made to LTBG population goals, but the absence of CSRB population and abundance data prevent the development of new ones. Their recommendation was to revisit the LTBGs after CSRB population studies have been completed. A comparison analysis can then be performed between the population survey and biological monitoring data to evaluate the appropriateness of the CSRB population LTBGs.
The other component of the LTBGs for the CSRB relates to maintaining adequate habitat for the species. The LTBG habitat stated in the EAHCP for the CSRB is to maintain silt-free gravel and cobble in ≥ 90% of each study area (Spring Run 3, Western Shoreline, and Spring Island). Discussion by the workgroup members on the CSRB habitat LTBG resulted in no alternations to the current goal.

**Outcome of CSRBWG for Charge 3: Long-term biological goals**

The consensus of the work group members was to postpone any changes to the LTBGs until more data becomes available with the completion of the CSRB system wide population and abundance study. At this time, the work group did not feel they had sufficient information available to evaluate the current population goal or develop a more appropriate population goal.
Conclusions and Work Group Recommendations

This report outlines the discussions by the CSRB work group members and other interested members of the community that resulted in recommendations to improve CSRB sampling techniques associated with the Biological monitoring and Refugia programs of the EAHCP. The work group provided several adjustments to current sampling efforts of the EACHP programs. To summarize, the recommendations include the following:

1) An in-situ experiment will be conducted to assess the sampling efficiency of the cotton lure.
2) The Biological Monitoring program will continue using the cotton lure method to monitor CSRB at the long-term biological goal reaches twice a year but will add two system wide population surveys before 2028.
3) The Refugia program will reduce standing stock numbers to 150 individuals (75 per refugia facility).
4) Refugia collections will retain 100% of CSRB captured on a cotton lure; however, sampling collection locations must be alternated between collection events and occur separate from Biological monitoring events.
5) An annual meeting will be held to discuss CSRB topics
COMAL SPRINGS RIFFLE BEETLE WORK GROUP REPORT – Appendix A Work Group Charge
Charge of the Comal Springs Riffle Beetle (CSRB) Work Group

Overview

As part of regular execution of the Edwards Aquifer Habitat Conservation Plan (EAHCP), multiple activities require physical sampling or removal of the CSRB in its habitat. A Work Group is being formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP.

Background

The EAHCP mandates Applied Research, Biological monitoring, and Refugia programs; all of which require in situ sampling or removal of the CSRB from the Comal system (cite). The Biological Monitoring program (Biomonitoring) has sampled the CSRB at least twice annually at three locations since 2004. The Applied Research program has required some removal of the CSRB since 2013 to conduct ex situ experiments. The Refugia program has required regular removal of the beetle since 2016.

Historically, the CSRB have been captured (for sampling or removal) using a passive cotton lure methodology. Results from cotton lure samples as part of Biomonitoring are used in part to examine the CSRB LTBGs provided in the HCP (cite). These LTBGs are written as number of CSRB per lure at three Comal locations, and to obtain silt-free gravel and cobble substrate (90%) at the locations. During the review of the EAHCP, the National Academies of Science expressed concern over the use of the cotton lure approach for monitoring the beetle. Additionally, members of the EAHCP Adaptive Management Science Committee have raised concern over the appropriateness of the cotton lure methodology and CSRB LTBGs.

Creation

The HCP Program Manager and the Science Committee jointly determined to create a Comal Springs Riffle Beetle Work Group comprised of members from the Science Committee as well as external experts to examine questions regarding the EAHCP handling of the CSRB.

Charge

The Work Group’s charge consists of examining questions related to three primary areas 1). sampling methodology, 2). field activities, and 3). EAHCP LTBGs.

1. Cotton lure sampling methodology

Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?

If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?

If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions?
2. **Biological monitoring, Refugia collections, and Applied Research collections**

What changes are recommended for the Biological monitoring sampling program? What are the stated goals behind those changes?

What changes are recommended for Refugia removal efforts? What are the stated goals behind those changes?

Are the current and proposed levels of physical activity in the CSRB habitat protective of the species? If not, what level of activity is appropriate?

3. **Long-term biological goals**

Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?

What is an appropriate means to monitor the habitat quality goal?

How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs?

**Administration**

The Work Group will meet on an as needed basis. The recommendations of the Work Group will be reported in the form of a written report and communicated to the full Science Committee. The Work Group will consist of the following members:

- Conrad Lamon (SC)
- Chad Norris (SC & TPWD)
- Floyd Weckerly (SC & TXSTATE)
- Ken Ostrand (USFWS)
- Eric Benbow (Michigan State University)*

*Dr. Benbow will begin serving on the Work Group following the conclusion of the NAS Report 3.
COMAL SPRINGS RIFFLE BEETLE WORK GROUP REPORT – Appendix B Agendas and Meeting Minutes
NOTICE OF OPEN MEETING
Available at eahcp.org

As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs riffle beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for Thursday, May 24, 2018, at 9 a.m. at the City of San Marcos Activity Center – Multipurpose Room, 501 E. Hopkins, San Marcos, Texas 78666. Lunch will be provided. Please RSVP to spayne@edwardsaquifer.org

1. Call to order--Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Review of the CSRB Work Group Charge:
   i. Cotton lure sampling methodology
   ii. Biological monitoring, Refugia collections, and Applied Research collections
   iii. Long-term biological goals

4. Presentation and discussion proposed CSRB Work Group meeting schedule.

5. Presentation of background regarding the current cotton lure sampling methodology and discussion on the major areas of literature review focus.

6. Presentation and discussion on the information needs pertaining to Refugia collections and Biological monitoring.

7. Questions from the public.

8. Adjourn.
CSRB WORK GROUP MEETING MINUTES
May 24, 2018

1. **Call to order--Establish that all Work Group members are present - 9:00 am.**
   Chad Furl began by introducing the Work Group members and communicating Dr. Arsuffi will be acting as an aid to the literature review process and not an active member on the work group. Work Group members present included Ken Ostrand, Chad Norris, Butch Weckerly, and Conrad Lamon.

2. **Public Comment.**
   There was no comment from the public.

3. **Introductions and communication of individual roles and Work Group process.**
   Dr. Furl provided the work group members a summary of the process, and presented work group operating rules.

   Dr. Arsuffi commented that “data” driven may not be solely the appropriate means of making decisions. Rather, it would be important to include other scientific means to make effective decisions that is determined by the literature.

4. **Review of the CSRB Work Group Charge as approved by the Science Committee on May 9th, 2018.**
   Dr. Furl provided a list of past and present efforts put forth to inform the EAHCP staff and committees about the CSRB.

   The first charge of the work group consists of analysis of whether the cotton lure sampling methodology is an appropriate means of sampling abundance at a specific location in the systems.

   The second charge of the work group consists of discussion about the collections done for all EAHCP programs (Biological Monitoring, Refugia, and Applied Research), and how to better coordinate these collections in order to be more protective of the current CSRB population.

   The third charge of the work group consists of how appropriate the current long-term biological goals, established in the EAHCP, are.

5. **Presentation and discussion proposed CSRB Work Group meeting schedule.**
   Dr. Furl quickly discussed the proposed schedule of the work group and how the work done over the next several months will provide direction in final recommendations to improve activity surrounding the CSRB in the EAHCP process.
6. **Presentation of background regarding the current cotton lure sampling methodology and discussion on the major areas of literature review focus.**

Dr. Furl provided a comprehensive summary of the EAHCP requirements in regard to the CSRB. There was discussion about the median numbers, that are intended to be maintained, were they come from, and the rationale regarding the set values.

Additionally, Dr. Weckerly asked about how sample locations are identified (ie. GPS). Chad Norris mentioned that establishing an accurate GPS location at the springs is difficult. Mr. Norris has been part of an effort to identify and tag major upwellings where CSRB have been sampled overtime. This effort was undertaken in order to provide more accurate determination of lure location.

Conrad Lamon discussed the importance of establishing what the information coming from the lure is telling us (ie. Density, abundance, population, distribution, etc). There was a discussion about distance between lures. Dr. Arsuffi communicated how knowing location of the lures, and their distance from other lures, helps understand if certain springs are “oversampled” over any period of time.

Dr. Furl communicated the difference in goal between the biological monitoring and refugia programs. Monitoring focuses on developing consistent running numbers from a specific location across time, and the refugia program looks to collect as many beetles as possible with each collection event.

Dr. Arsuffi asked the rationale for using median instead of mean. Dr. Weckerly responded that it would make sense to use median due to the relatively small sample size. Dr. Lamon mentioned median provides a more statistically useful figure to determine probability of collection. Mr. Norris also mentioned a possible reason could have been because the median was a slightly lower figure than the mean and could have been chosen to provide a more conservative figure.

Dr. Furl presented a series of analyses done with the current CSRB data. He stated to the work group that much of these effort is designed to look at the data in a variety of ways and determine if this type of analysis is appropriate given our current collection methodology and whether there needs to be a change in that collection or a change in how the data is analyzed.

Dr. Furl mentioned that the data collected thus far is not appropriate to run analyses. Dr. Weckerly suggested using estimation methods to account for imperfect detection due to these methodologies. He mentioned there are tools that can be used if a specific location is determined accurately. Dr. Furl mentioned one goal would be to be able to determine trends in the data over time. Dr. Lamon described that knowing the physical location of the lure for knowing distance between other sampling locations and distance from other physical features would be useful.

Dr. Lamon proposed the question of whether keeping track of locations used would be a difficult effort. Dr. Furl communicated much of that information should be able to be collected
accurately this fall. Dr. Ostrand mentioned that location should not be difficult to record and that variability in the collection data is what is the issue at hand. Dr. Weckerly asked what other options are out there in order to make less variable data. Dr. Arsuffi mentioned that variability is the name of the game in this type of work.

Dr. Furl presented feedback from NAS regarding the difficulty of sampling for organisms like the CSRB and possible alternatives as well as the issues that could be produced out of an inappropriate methodology to estimate population. There was discussion of the variety of methods attempted and how the lure has been the most effective. Dr. Arsuffi mentioned there was not a stream ecologist on the NAS committee when the previous two reports were produced. He identified there is now an ecologist who may be able to provide a different opinion. Dr. Ostrand commented that any organism that receives a population estimate, there is a huge amount of variation. Dr. Lamon commented that the current methodology provides a fairly reasonable detection probability and another variable of analysis can be useful (i.e., Accurate location of lure). He stated that the first step is to quantify what we have now from the data. Dr. Arsuffi proposed the question whether or not a lure is appropriate. Dr. Lamon stated that he would not be the one to determine the appropriateness of a method but give one method of collection there is a way to make the data useful.

Dr. Furl proposed the question: What are some of the problems with the cotton lure sampling methodology?

Dr. Arsuffi commented that aquatic fungi is the primary driver in colonization of the cotton lure. Mr. Norris communicated that the period of time found best for collection rates were examined. A four-week colonization time was found to be the most effective.

Dr. Furl asked the work group what their specific issues are regarding the current sampling methodology?

- Dr. Arsuffi mentioned that a collection method that was “non-lure” in order to estimate abundance. The issue with a lure is that it begs the question of whether the organisms that our found on the lure actually are found at that location or have traveled to the food source. Dr. Furl mentioned that the heterogeneity of the system is a major limiting factor in choosing a location specific methodology. He stated there would be variability in any method.
- Dr. Ostrand described a variety of methods that have been attempted.
- Dr. Arsuffi mentioned collecting a list of attempted methods in order to perform a literature review and construct a list of pros and cons.
- Dr. Lamon commented that whether or not we change the collection methods we should analyze the current data to get a better idea of what we have.
- Mr. Norris mentioned Joe Fry was an individual who has tried a variety of different methods of collection.
- Nathan Pence commented that looking into what other agencies in the country/world on collection of riffle beetles located elsewhere. Dr. Arsuffi commented that there is an abundance of sampling techniques out there to look at.
- Arsuffi proposed a question on whether the CSRB is specifically a hyporheic organisms.
• Dr. Ostrand mentioned possibly looking at genetics as a driving factor in sampling. Dr. Weckerly agreed that exploring genetic techniques could be a viable option.
• Dr. Ostrand mentioned sampling methodologies cannot be too intrusive.
• What are some of the recolonization studies done comparing various methods. This could be helpful in knowing the disturbance of various methods, as well as our current method.
• Dr. Weckerly commented that if you had special location data for each lure, and relative location to physical characteristics, you would be able to run an analysis on possible influences. Dr. Furl was tasked to look at sampling data from continual locations over time and measuring the space between the lures. If you have two nearby springs and are the same quality of habitat, and there are differences in the numbers you will be able to determine how far apart you should separate the lures in order to not influence the other lure.
• Dr. Ostrand commented that there is a section of the system that can be used for experimentation and not disturb current sampling locations.
• Dr. Arsuffi asked to look at the data regarding number of lures set in a location in a given month and compare it to the number of lures set in a period of time (1, 2, or 3 samples in a given month compared to 4, 5, or 6 in more intense sampling periods).
• Dr. Weckerly commented that flow could also be a helpful variable in understanding the data.

Mr. Norris discussed what the real purpose is of estimating population is and if the Biomonitoring program is intended to pursue those questions. He described the sampling currently compares data from locations in order to find trends from over time and not necessarily to know the population in the species.

The work group took an informal break and continued to discuss some of the possibilities of the current methods and any possible alternatives. The work group discussed presence/absence as a use of the data. There was a brief discussion regarding long-term biological goals. Mr. Norris commented that the spring runs are expected to go dry in a repeat of the drought of record (DOR) and how do the data that are being collected in the spring runs for CSRB matter.

• There was mention of reviewing Lucas et al. for an examination of genetic distribution from the DOR.
• Dr. Lamon mentioned it may be important to analyze larvae and adult data separately.
• Dr. Arsuffi asked the question on how long the CSRB can live outside of water. Mr. Norris mentioned there has been an informal examination of that but nothing official.
• Dr. Lamon commented that the usefulness of the current methodology may not be the right question right now without putting effort into a real analysis of the current data. For example, he discussed the use of non-detects or zero numbers in data being used in analysis rather than ignoring those figures.

7. **Presentation and discussion on the information needs pertaining to two critical aspects of CSRB activity.**

Dr. Furl began discussing the primary issues regarding the biological monitoring and refugia programs. These issues include: returning beetles, CSRB cage setup, water quality measures,
discharge measurements, sample location identification, sample a portion of range, no habitat quality component, data interpretation, cotton lure methodology. Topics discussed included:

- Issue of overlap of sampling, recolonization issues
- Need for coordination with other sampling efforts (inside and outside the EAHCP)
- Two studies are necessary for the lure; effectiveness, and beetle mortality
- Mr. Norris communicated that the handling issues regarding mortality would be more of an issue for refugia. If there were issues about handling and returning beetles to the system you would see that issue more when removing beetles for refugia. Dr. Furl commented that if coordination was increased we could minimize demand on the species if monitoring lures and refugia lures can be used interchangeably.
- There is a need to avoid sampling the same springs repeatedly in both programs.
- Mr. Norris says there may be data with water depth at specific spring locations.
- We want to be sure to sample the same spring location across time will be the best way to sample. If our goal is to identify where the beetles are in the system, a more random distribution of lures can be helpful. Mr. Norris and Dr. Weckerly communicated that it depends upon our goals.
- Before we go to data interpretation, we need to know what questions we are asking that are appropriate for data interpretation.

Dr. Furl asked about the “maintain silt-free environment component.” There was a discussion about optimal habitat/suitable habitat and using it to extrapolate out much like the SAV for fountain darter densities.

- If you’re after abundance than you will need a methodology with constraints (N mixture model – repeated sampling). Random selection of springs (even when habitat is not suitable and beetles will unlikely be collected) would be helpful for distribution.
- A model would help keep all variables or springs characteristics in order to make assumptions of suitable habitat.
- Presence/absence sampling can be used to assess distribution, environmental correlates. Does not tell you anything about abundance. Occupancy estimates require repeated samples for each spring in able to be used. Mark and recapture is the best method, but reality causes this to not be possible, or effective. N-mixture model can be used when mark and recapture cannot be used.

Dr. Furl will pull together all the current location data with characteristics as well as repeated sampling locations. He introduced the second topic of system disturbance with the work group.

- Dr. Weckerly mentioned that harm to the species seems unlikely considering refugia transport success.
- Dr. Arsuffi commented that the level of disturbance as a possible variable affecting the collection rate. There was a concern with the level of refugia collection and removal and the recent decline of beetles found through the monitoring program.
- There is a possibility that life history and/or genetic cohort distribution could affect sampling rate.
- We could look at intensity of sampling effort versus what was happening in the system.
• We need to look at who sampled what, where and when.
• Reducing the unaccounted-for variability is necessary to find a trend in the data.

Dr. Furl proposed the last topic to be discussed; whether the current long-term biological goals are appropriate, and do they need to be changed and what would be the criteria (not what will those goals be).

• Mr. Norris identified that median numbers as a goal separated by reaches does not seem to be the best method of establishing a metric.
• Dr. Arsuffi asked whether the number on the lure is representative of something that means anything.
• Dr. Weckerly proposed a variety of statistical methods that provide an analysis that can fit the current sampling methodology.
• LTBG seem to be constructed out of the data that had been collected (should be the other way around).

The work group had a brief discussion with Tanya Sommer (USFWS) about this issue in relation to other HCPs along presence/absence versus population studies.

8. **Questions from the public.**
   No comments from the public

9. **Adjourn.**
NOTICE OF OPEN MEETING
Available at eahcp.org

As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs riffle beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for **Tuesday, July 2, 2019, at 9 a.m. at the City of San Marcos Activity Center – Multipurpose Room, 501 E. Hopkins, San Marcos, Texas 78666.** Lunch will be provided. Please RSVP to kkollaus@edwardsaquifer.org

1. Call to order--Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Review of the CSRB Work Group Charge:
   i. Cotton lure sampling methodology
   ii. Biological monitoring, Refugia collections, and Applied Research collections
   iii. Long-term biological goals

4. Presentation and discussion of CSRB literature review and data analyses.

5. Questions from the public.

6. Adjourn.
Comal Springs riffle beetle Work Group  
07/02/2019 Meeting Minutes  
Available at eahcp.org

Members of this committee include: Conrad Lamon, Chad Norris, Butch Weckerly, Ken Ostrand, and Eric Benbow

1. Call to order.
All members were present except for Ken Ostrand and Eric Benbow.

2. Public comment.
There were no comments from the public.

3. Review of the Comal Springs riffle beetle (CSRB) Work Group Charge  
a.) CSRB Sampling Methodology: currently use cotton lures in spring orifices. The group will consider alternatives to the current sampling methodology and develop potential research projects that may inform and improve the sampling methodology.

b.) Biological Monitoring, Refugia and Applied Research collections: assess and develop recommendations to improve how and why we collect CSRB. Are we oversampling the CSRB?

c.) Long-term Biological Goals: how do we evaluate our long-term biological goals? NAS was unable to determine, how do we improve this or establish new long-term biological goals?

4. Presentation and discussion of the CSRB literature review and data analysis.
Dr. Tom Arsuffi presented an overview of his CSRB literature review (the presentation is available on the CSRB Work Group website). His research focused on stream ecology related to the hyporheic zone, disturbance and recolonization patterns, sampling methodologies of the CSRB and other riffle beetle species, and life history aspects of the CSRB. A summary on the topics discussed during the presentation are listed below.

Inductive and Deductive Enhancement

1.) Stream ecology and the hyporheic zone: Consider CSRB and Comal Springs at a broader-scale to inform our understanding of the empirical data and theories (Boulton et.al., 2010).

2.) Life-history research on other benthic macroinvertebrates: Used to inform how life-history information is applied through a species-trait approach (Resh and Rosenberg, 2010)
3. **Patch Dynamics**: How spatial patterns are created and are linked to the ecology of a species (Winemiller et. al., 2010). Why do we see different CSRB densities between spring orifices? Example: Is there a link between the riparian vegetation and CSRB densities (tree roots=food?).
   
a.) Landscape ecology perspective: how spatial patterns are created and effect ecological processes over different spatial and temporal scales.
   
b.) Metacommunity: The influence of periodic disturbances, refugia, and dispersal in maintaining nonequilibrium communities in patch mosaics. (Findlay, 2010)

4. **Disturbance**: The role of disturbance and recolonization in stream ecology (Resh et. al., 1988; Stanley et. al., 2010). How do we define disturbance and apply it to the CSRB? Are we looking at CSRB disturbance at the right spatial and temporal scales?
   
   *direct and indirect disturbances: flood, drought, habitat characteristics, and resource availability.
   
   *additional disturbances may include aquatic recreation, ducks and vultures, and even sampling. Sediment deposition from flooding and overland runoff could affect their respiration rates.
   
   *Dr. Lamon asked: Do we know if there is a lower count after a disturbance? Need to consider population estimates and identify trends within the data we currently have
   
   *Need to account for all disturbances (even time between sampling by all/different entities) when assessing the number of CSRB on lures.

Currently, sampling can be triggered by extreme drought and flood conditions to assess their numbers; however, sampling may exacerbate the disturbance from drought or flood. Members discussed postponing the sampling after an event to let the species recover; but, for how long? We need to document and consider the disturbances when sampling and improve our understanding of their resilience and recovery rates (life history studies).

5. **Resistance, resilience, and recolonization**

   *recolonization patterns: could establish in new areas (logs, adjacent springs, etc.). Need to combine data from other entities to assess spatial variation.
   
   *pathways: aerial, hyporheic, upstream migration, and downstream drift
   
   *what is the recovery time, how do we analyze that? Consider their fecundity and duration of life stages.

Members discussed adding more variables to the data collected during sampling events to help ascertain habitat conditions that influence the population and potentially develop population models to analyze and predict densities. CSRB population estimates would be ideal for analyzing observed trends, but the subterranean hyporheic zone is complex. Members then discussed what we do know about the CSRB –

**CSRB life history**

The CSRB live in the hyporheic zone, the conduits, spring orifices, and on logs and woody debris near springs. More info on slide 17 and 18. CSRB are K-strategist, which means they have slow
growth rates and low fecundity (“elephant” inverts), most of their biomass (females) is dedicated to egg production. As a K-strategist, they recover slowly from disturbances.

**CSRB and other riffle beetle sampling methodologies**

* Bore hole samples help assess the hyporheic zone, but they disturb the habitat significantly more than the cotton lure.
* Drift nets have been used in the past, but the cotton lures have proved more effective at capturing CSRB.
* Cotton strip is used in other systems. Some argued that the lack of folds (cotton lure is folded square) causes the strip to turn anoxic. Members discussed changing the duration from 30 days to 3 days to avoid the strip turning anoxic and reducing the travel time to assess those that are close to the strip.
* Currently sample the same three reaches (i.e., Spring Run 3, Westernshore at Landa Lake, and Spring Island) each sampling event (typically Spring and Fall). Members suggested collecting more information during sampling events and potentially adding new sampling areas.
* How far do they travel to the lure? Anecdotal evidence suggests that CSRB can travel 3 meters within 30 days and can be found up to 1 meter from a spring.
* What attracts them to the cotton lure? Does the conditioned lure, “lure” them or are they just stopping by, or are they just lost? US Fish and Wildlife refugia staff are working on a food preference study and Dr. Nowlin’s lab (Texas State) has analyzed the gut content of the CSRB. Dr. Kosnicki (Biowest) has found certain logs have a higher density of CSRB, these may offer some insight about their food preferences: shredder vs. scrapper.

Dr. Weckerly emphasized the need for a hierarchical framework to tease-out the abundance predictions vs. estimates which Dr. Nowlin’s research findings may provide.

We must be careful about making assumptions about the CSRB population based on the lure counts. Statistics would be difficult because we don’t have dependent variables.

The group collectively agreed that the current methodology works and consistency is important, but there are still many unknown factors.

**Questions:**

* What portion of the population within the sampled spring orifice/area is attracted to the lure? Is it 90% or just a small portion of the population?
* Why are the CSRB attracted to the lure? Is the microbial content on the conditioned lure and how does it compare to other food sources?
* What does the number of CSRB captured on the lure represent?
* How long does it take the CSRB to recover after a sampling event?
* Should we sample in other spring orifices?
Recommendations (pilot studies):
1.) Test cotton strip sampling method used by other riffle beetle researchers.
2.) Determine microbial content of the conditioned cotton lures
3.) Reduce sampling time from 30 days to 2-4 days
4.) Evaluate the effectiveness of the lure in a controlled environment

5. Questions from the public.
The public offered comments and questions during the discussion which were incorporated above.

6. Adjourn.
Meeting adjourned around noon.
NOTICE OF OPEN MEETING
Available at eahcp.org

As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs Riffle Beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for September 4, 2019, at 9:00 a.m. at the San Marcos Rec Hall (City Park), 170 Charles Austin Drive, San Marcos, Texas 78666. Lunch will be provided. Please RSVP to kkollaus@edwardsaquifer.org.

1. Call to order–Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Approve minutes from July 2, 2019 Work Group meeting (Attachment 1).

4. Review of the CSRB Work Group Meeting 2 held on July 2, 2019 to discuss Charge 1: Cotton lure sampling methodology.
   i. Presentation on proposed research project to address the question: What is the proportion of CSRB beetles found on the cotton lure compared to surrounding environment?

5. Discussion on CSRB Work Group Charge 2: Biological monitoring, Refugia collections and Applied Research collections associated with the CSRB.

6. Questions from the public.

7. Adjourn.
Comal Springs Riffle Beetle Work Group
Meeting Minutes
**Revised**
San Marcos Rec Hall
September 4, 2019

Members of this committee included: Conrad Lamon, Chad Norris, Tom Arsuffi, Butch Weckerly, and Ken Ostrand

Audience: Amelia Hunter, Lindsay Campbell, Ely Kosnicki, Ashley Jackson, Mark Enders, Phillip Quast, Rachel Sanborn, and Brandon Payne.

1. Call to Order: 9:00 am – All members of the work group were present.

2. Public Comment:
   There were no comments from the public.

3. Approve minutes from July 2, 2019 Work Group meeting.
   The Work Group approved the meeting minutes from July 2, 2019. There were no objections.

4. Review of the CSRB Work Group Meeting 2 held on July 2, 2019 to discuss Charge 1: Cotton lure sampling methodology.

Dr. Chad Furl discussed what was presented at the prior work group meeting and recapped the lessons learned. As a result of the last meeting, EAHCP staff developed a proposed research project aimed at understanding the efficiency of the cotton lure for sampling riffle beetles. The general concept of the proposed research project is to recreate cotton lure sampling in a controlled laboratory setting. Dr. Chad Furl presented the details of the proposed project, informing the Work Group of the ideas surrounding tank construction, materials in the tank and specific intervals to count the number of beetles on the lure.

Dr. Tom Arsuffi had concerns of replication with regards to the distances of the cotton lure and the position of the riffle beetle to other treatments (i.e. leaves, woody debris, etc.). Dr. Conrad Lamon expressed concerns of the utility of a laboratory sampling to help understand the natural environment. Dr. Ken Ostrand suggested simplifying the project by decreasing the number of treatments available to the riffle beetle in a lab setting. Dr. Butch Weckerly supported the proposed project and the overall evaluation of the cotton lure’s efficiency.

Treatment Types: Amelia Hunter suggested using one leaf type, one wood type and the cotton lure. Dr. Arsuffi noted the issue on decomposition rates of leaves and recommended prefacing the experiment with three types of substrates. Dr. Kosnicki and Ms. Hunter recommended using Sycamore leaves.
Ms. Hunter questioned the method of observing the riffle beetle and the possibility of disturbance (looking vs grabbing). Dr. Arsuffi recommended that the surface area of the substrate should be taken into consideration.

**Substrate:** Dr. Furl noted that the project would include wood, gravel and leaves in the tank and possibly buried 4 inches deep into the substrate. Dr. Campbell suggested that 4 inches is too deep and recommended to reduce the thickness just below the surface. Ms. Hunter noted that riffle beetles do not typically use rocks but rather gravel. The Work Group recommended using store bought gravel and condition it prior to experiment.

**Woody Debris:** Ms. Hunter recommended using conditioned balsam wood and offered to provide some that she has already prepared. Chad Norris had concerns using something that hasn’t been historically used and is not found in the field. Additionally, Mr. Norris commented that there are too many unknowns using woody debris, however, if there is a choice, natural wood would be the best option. Dr. Kosnicki noted that popular debris takes about three months to condition whereas balsam may take only a month to condition. Dr. Campbell suggested using harvest natural log cut into segments.

**Leaf Type:** Ms. Hunter noted that there has not been an experiment to determine which types of leaves riffle beetles prefer. Sycamore, anacua, and pecan leaves are most common near riffle beetle habitat. Dr. Kosnicki recommended using a single leaf type, conditioned, and in a cage. Dr. Arsuffi recommended keeping the leaf types separate.

**Number of Beetles:** The work group agreed that 20 beetles was sufficient. Dr. Campbell suggested a 50:50 sex ratio.

**Replication and frequency:** The work group recommended sampling five tanks at one time at 10/20/30 day intervals. Dr. Arsuffi recommended introducing the beetles at equidistant locations from a treatment type.

**Tank recommendation:** The work group suggested using a 10-gallon round tank.

Dr. Ostrand questioned if gravel was necessary and if not, could it be replaced with tile for easier observation. Dr. Kosnicki noted that substrate is used for mobility. Tile would work for this experiment, plastic mesh is not a good substrate, and gravel could take up too much space. Dr. Campbell had concerns with tile being too different from the field.

**Proposed measurements at the conclusion of experiment:** Dr. Arsuffi suggested research into the microbial biomass associated with substrates. The work group discussed the color change of the cotton lure; however, it was noted that observations can be subjective.

5. **CSRB Work Group Charge 2: Biological monitoring, Refugia collections and Applied Research collections associated with the CSRB.**

Dr. Furl reminded the work group of the goals of the biological monitoring program.
- “...will provide a means of monitoring changes to habitat availability and the population abundance of the Covered Species…”
“…will provide information to effectively determine whether the conservation measures are achieving the biological goals and objectives…”

In regard to sampling locations, the work group agreed that sampling should occur beyond the reaches that are typically measured. Sampling two times at three locations is insufficient. Dr. Furl proposed, due to duplications of efforts by multiple agencies, a population study every 3-5 years and to continue cotton lure sampling in the LTBG reach.

Dr. Weckerly suggested that the findings of the Texas State population study be duplicated in the future so that the results can be used for comparison with the concurrent biomonitoring studies.

Mr. Norris recommended adding more sampling locations at deeper spring depths in addition to the monitoring that is already occurring. Furthermore, Mr. Norris suggested studying migration and genetics.

Dr. Arsuffi recommended monitoring the fix sample sites every 2 years and random sampling of the 85 sites used in the Texas State population study using their methodology. Dr. Weckerly recommended using the same sampling times that are used in the Texas State study.

6. Questions from the public.
   None.

7. Adjourn – 11:42 am
NOTICE OF OPEN MEETING
Available at eahcp.org

As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs Riffle Beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for October 9, 2019, at 9:00 a.m. at the San Marcos Activity Center (Multipurpose Room), 501 E. Hopkins St., San Marcos, Texas 78666. Light refreshments will be provided. Please RSVP to kkollaus@edwardsaquifer.org.

1. Call to order--Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Approve minutes from September 4, 2019 Work Group meeting (Attachment 1).

4. Review the CSRB Work Group Meeting 3 held on September 4, 2019 and take any further comments on experimental design of the cotton lure efficiency tank study.

5. Review discussion from Meeting 3 on the Biological Monitoring Program and develop final recommendations.

6. Discuss Refugia CSRB collections to date and review of program goals.

7. Discuss habitat disturbance and develop recommendations regarding system disturbance.

8. Questions from the public.

Members of this committee included: Conrad Lamon, Chad Norris, Tom Arsuffi, Butch Weckerly, and Ken Ostrand

1. **Call to order:** 9:02 am – All members of the work group were present.

2. **Public Comment:**
   There were no comments from the public.

3. **Approve minutes from September 4, 2019 Work Group meeting.**
   Chad Norris requested a revision to the prefix of his name in the meeting minutes from September 4, 2019. A motion was made by Butch Weckerly to approve the meeting minutes with revisions. Chad Norris seconded the motion. There were no objections.

4. **Review the CSRB Work Group Meeting 3 held on September 4, 2019 and take any further comments on experimental design of the cotton lure efficiency tank study.**
   Dr. Chad Furl presented an overview of the cotton lure efficiency tank study. Five circular tanks will be used with wood, leaves, limestone gravel, and cotton lure material. Wood and leaves will be collected from the wild, conditioned appropriately, and kept in wireframe. Cotton lures will be washed thoroughly with DI water to remove any potential toxins before being placed in the tank. Twenty adult Comal Springs riffle beetles will be placed in the tank, and lures will be checked at 10, 20, and 30-day intervals. All food items will be inspected for beetles at 30 days and mortalities will be documented. Dr. Furl and EAHCP staff will be moving forward with this design. A report is expected to be presented at the 2020 Science Committee meeting.

5. **Review discussion from Meeting 3 on the Biological Monitoring Program and develop final recommendations.**
   Dr. Furl reminded the staff of the goals of the Biological Monitoring Program. As per the prior work group meeting, two recommendations were determined: 1) the continuation of monitoring in the three LTBG reaches and follow established sampling protocols and 2) the addition of system wide population surveys to be completed twice before the end of the incidental take permit.

The Work Group mentioned Weston Nowlin’s research on the Comal Springs riffle beetle. Dr. Furl and Butch Weckerly agreed that a review of Nowlin’s research should be
considered prior to commitment to his study designs. Chad Norris mentioned population genetic studies. Dr. Furl noted that genetic studies can be conducted through the refugia program, outside of the biological monitoring program.

The Work Group concluded that the final recommendations suggested at the September meeting would suffice.

6. **Discuss Refugia CSRB collections to date and review of program goals.**
   Dr. Furl presented to the Work Group a background on Refugia collections. Currently, the U.S. Fish and Wildlife Service is tasked with collecting 500 Comal Springs riffle beetles for a standing stock and 500 for salvage stock.

   Mr. Norris asked how many Comal Springs riffle beetles are actively kept at Refugia. Dr. Furl answered about 200-300 at both the San Marcos and Uvalde Refugia locations. Ken Ostrand recommended using a model, based on aquifer conditions and genetic diversity, to determine effective refugia populations in 2020. Mr. Norris commented that 500 individuals seems too high and 200 is too low. Tom Arsuffi recommended 250 individuals collected for standing stock, Butch Weckerly seconded that recommendation. Mr. Norris commented that 250 individuals may not be sufficient for standing stock.

7. **Discuss habitat disturbance and develop recommendations regarding system disturbance.**
   Ken Ostrand recommended a survivorship study to develop recommendations on habitat disturbance. Butch Weckerly noted, based on Dr. Furl’s data, any time the population falls below 25%, there is a problem with disturbance. Tom Arsuffi requested a disturbance table to better develop appropriate recommendations.

8. **Questions from the public.**
   None.

9. **Adjourn.**
   11:37 am
As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs Riffle Beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for **October 30th, 2019, at 9:00 a.m. at the Meadows Center for Water and the Environment, SLH 107 Conference Room, 201 San Marcos Springs Dr., San Marcos, TX 78666.** Breakfast items and lunch will be provided. Please RSVP to kkollaus@edwardsaquifer.org.

1. Call to order--Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Approve minutes from October 9th, 2019 CSRB Work Group Meeting 4 (Attachment 1).

4. Review discussion from Meeting 4 on Refugia CSRB collections and system disturbance and develop final recommendations.

5. Review and discuss CSRB Long-Term Biological Goals and develop recommendations.

6. Questions from the public.

7. Adjourn.
Comal Springs Riffle Beetle Work Group
Meeting Minutes
Meadows Center for Water and the Environment
October 30, 2019

Members of this committee included: Conrad Lamon, Chad Norris, Tom Arsuffi, Butch Weckerly, and Ken Ostrand

1. **Call to order:** 9:05 a.m. – All members of the work group were present.

2. **Public Comment:**
   There were no comments from the public.

3. **Approve minutes from October 9, 2019 Work Group meeting.**
   A motion was made by Ken Ostrand to approve the meeting minutes. Dr. Butch Weckerly seconded the motion. There were no objections.

4. **Review discussion from Meeting 4 on Refugia CSRB collections and system disturbance and develop final recommendations.**

   Chad Furl summarized the outcome of Meeting 4 of the CSRB Work Group. Tom Arsuffi clarified that the standing stock amount is subject to change as husbandry techniques improve. Ken Ostrand recommended, based on collection and husbandry studies, a standing stock of 50 would be adequate. Dr. Arsuffi recommended 75 individuals at each Refugia facility, 150 individuals total. Chad Norris recommended a genetic study to develop appropriate standing stock numbers. The Work Group determined that 150 CSRB individuals is sufficient for standing stock at Refugia and will revisit standing stock numbers in 2022 after population studies have concluded. Dr. Furl added, in 2021 a CSRB pupation study will continue and in 2022 the population study will be complete. To monitor the development of these studies, the Work Group agreed to convene on an annual basis. Dr. Furl informed the group that the next CSRB Work Group meeting will be in conjunction with the Research Work Group on December 11, 2019.

   Regarding CSRB collection sites, Lindsey Campbell clarified that collection for Refugia occurs beyond Spring Run 3. The Work Group determined that CSRB collection for Refugia purposes should be separate from collection for Biological Monitoring.

   Additionally, the Work Group determined that alternating collections should occur between spring orifices and that 100% of the CSRB captured on the cotton lure can be collected.
5. **Review and discuss CSRB Long-Term Biological Goals and develop recommendations.**

Dr. Furl presented the CSRB Long-Term Biological Goals as stated in Section 4.1.1.1 of the EAHCP. Mr. Norris noted that the Long-Term Biological Goals for the CSRB were intended to be similar to the goals for the fountain darter and Texas wild-rice. That said, there should be major changes to the overall goals. Dr. Furl recommended to meet again to discuss the issues and concerns with the CSRB Long-Term Biological Goals after studies have been concluded and more information is made available. The Work Group agreed with Dr. Furl's recommendation to suspend the discussion.

6. **Questions from the public.**
   
   None.

7. **Adjourn.**
   
   11:42 a.m.
NOTICE OF OPEN MEETING
Available at eahcp.org

As approved by the Edwards Aquifer Habitat Conservation Plan (EAHCP) Science Committee, the Comal Springs Riffle Beetle (CSRB) Work Group has been formed to provide input on a specific set of questions concerning management of the CSRB as part of implementation of the EAHCP. A meeting of this Work Group for the EAHCP is scheduled for December 11th, 2019, at 9:00 a.m. at the Meadows Center for Water and the Environment, SLH 107 Conference Room, 201 San Marcos Springs Dr., San Marcos, TX 78666. Breakfast items will be provided. Please RSVP to kkollaus@edwardsaquifer.org.

1. Call to order--Establish that all Work Group members are present - 9:00 am.

2. Public Comment.

3. Approve minutes from October 30th, 2019 CSRB Work Group Meeting 5 (Attachment 1).


5. Receive any final recommendations from the Work Group members.

6. Questions from the public.

7. Adjourn.
Members of this committee included: Conrad Lamon, Chad Norris, Tom Arsuffi, Butch Weckerly, and Ken Ostrand.

1. **Call to order**: 9:07 a.m. – All members of the work group were present.

2. **Public Comment**:
   There were no comments from the public.

3. **Approve minutes from October 30, 2019 Work Group meeting**.
   A motion was made by Butch Weckerly to approve the meeting minutes. Ken Ostrand seconded the motion. There were no objections.

4. **Review and receive comments on the CSRB Work Group Report**.
   Dr. Chad Furl recapped the overall discussion and recommendations provided at the previous CSRB Work Group meetings. Recommendations included continued use of the cotton lure for CSRB collection, a cotton lure mesocosm experiment to be completed in 2020, and to finalize CSRB population surveys expected to be completed in 2022 and 2025. Ken Ostrand asked if the mesocosm experiment was going to go through the RFP process. Dr. Furl responded that it will go through the formal Edwards Aquifer Authority’s bid process and that the experiment should start in Spring-Summer 2020. Nathan Pence asked what the mesocosm experiment entailed. Dr. Furl summarized the details of the experiment. Dr. Furl recapped the biological monitoring, Refugia, and Applied Research collection recommendations that were provided during the previous CSRB Work Group meetings. The work group member recommended refugia standing stocks be lowered to 150, 75 in each facility. The CSRBWG will revisit standing stock numbers annually as population and husbandry studies become available and Refugia staff refines the level of effort needed to achieve this standing stock number. Lastly, Dr. Furl reminded the Work Group the recommendation to maintain the present Long-Term Biological Goals and revisit the goals after population studies have been completed.

5. **Receive any final recommendations from the Work Group members**.
   There were no final recommendations from the Work Group members.

6. **Questions from the public**.
   None.

7. **Adjourn**.
   9:35 a.m.
COMAL SPRINGS RIFFLE BEETLE WORK GROUP REPORT – Appendix C Presentations of the Work Group
Comal Springs Riffle Beetle Work Group

May 9th Science Committee
The Work Group’s charge consists of questions related to three areas:

1). Cotton lure sampling methodology

2). Biological Monitoring, Refugia Collections and Applied Research

3). CSRB Long-term Biological Goals
The Work Group will consist of the following members:

- Conrad Lamon
- Chad Norris
- Ken Ostrand
- Eric Benbow*

*Dr. Benbow will join the Work Group following the completion of NAS Report 3.
Due to expressed concerns from the Science Committee as well as the National Academy of Sciences, EAHCP staff have determined a comprehensive look at these three areas charged to the Work Group.
The Work Group will meet on an as needed basis and will produce a written report documenting their recommendations.

- Solicit data requests
- Discuss literature review

Kick-off meeting will be held on **May 24th at the San Marcos Activity Center**
In order to better facilitate a productive conversation, Work Group members are asked to provide information requests regarding past data collection and analysis.
CSRB Work Group: Literature Review

Dr. Arsuffi will be tasked with compiling a robust literature review in order to provide the Work Group a better understanding of possible sampling methodologies used on similar species.
# CSRB WG Timeline

<table>
<thead>
<tr>
<th>Task</th>
<th>Date/Period</th>
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<tbody>
<tr>
<td>Solicit Science Committee input on charge questions</td>
<td>March 8 - March 23</td>
</tr>
<tr>
<td><strong>Finalize and approve work group charge through Science Committee</strong></td>
<td><strong>May 9 meeting</strong></td>
</tr>
<tr>
<td>Hold initial work group meeting</td>
<td>May 24</td>
</tr>
<tr>
<td>Conduct literature and other work group requests</td>
<td>May - August</td>
</tr>
<tr>
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<td>September 1</td>
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<td>Work group begins regular meetings</td>
<td>September - October</td>
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<td>Finalize and document work group results</td>
<td>November - December</td>
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<tr>
<td>Implement work group suggestions</td>
<td>2019</td>
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May 24, 2018

Comal Springs Riffle Beetle Work Group

May 24, 2018
AGENDA

1. Introductions
2. Work Group Charge Review
3. Meeting Schedule Review
4. Cotton lure methodology
   a. Current issues
   b. Major areas of literature review focus
5. Biological Monitoring and Refugia Collections
   a. Information needs
Individuals’ Process Roles

- Work Group members:
  - Conrad Lamon
  - Chad Norris
  - Ken Ostrand
  - Eric Benbow
- Staff
  - Chad Furl
  - Shaun Payne
- Field Experts
The Work Group’s charge consists of questions related to three areas:

1). Cotton lure sampling methodology

2). Biological Monitoring, Refugia Collections and Applied Research

3). CSRB Long-term Biological Goals
CSRB Cotton Lure Sampling Methodology

- Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?

- If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?

- If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions?
What changes are recommended for the Biological monitoring sampling program? What are the stated goals behind those changes?

What changes are recommended for Refugia removal efforts? What are the stated goals behind those changes?

Are the current and proposed levels of physical activity in the CSRB habitat protective of the species? If not, what level of activity is appropriate?
CSRB Long-term Biological Goals

- Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?

- What is an appropriate means to monitor the habitat quality goal?

- How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs if needed?
## CSRB WG Timeline

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Background and purpose of CSRB monitoring

- LTBGs for CSRB involve a qualitative habitat component and quantitative population measurement.
- Population measurement goal is to maintain greater than or equal to the median densities observed

<table>
<thead>
<tr>
<th>Density (# of CSRB/Lure)</th>
<th>Spring Run 3</th>
<th>Western Shoreline</th>
<th>Spring Island Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 20</td>
<td>≥ 15</td>
<td>≥ 15</td>
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</tbody>
</table>
Background of the CSRB cotton lure methodology

- A major unknown is the CSRB’s use of subsurface habitat, thus a lure approach has been utilized to collect population data.
- Population measurements are based on long-term trends in specific locations.

| COMAL SPRINGS RIFFLE BEETLE DENSITY (#/LURE) |
|-----------------|-----------------|-----------------|
| Spring Run 3    | Western Shoreline | Spring Island Area |
| Minimum         | 7                | 9                | 7                |
| 25th            | 12               | 13               | 11               |
| Median          | 17               | 14               | 13               |
| 75th            | 21               | 20               | 16               |
| Maximum         | 32               | 26               | 23               |
First discussion question

What are the issues with the current Cotton lure methodology?
Second discussion question

What are the major areas of focus needed to inform fundamental changes to the current monitoring process?
Join Me For Lunch
Biological Monitoring, Refugia Collection and Applied Research

- Biological Monitoring is a comprehensive monitoring program was established by the EAA in 2000.
  - The program accumulates data to refine estimates of “average” conditions as well as producing monitoring data during low-flow periods (and after floods).
- Refugia collection is an essential aspect of building a “standing stock” of covered species at the USFWS SMARC refugia facility.
- Applied Research has been a major area of focus of over the past 5-years.
  - Research on the CSRB has required collection in the past and is expected to continue.
Biological Monitoring, Refugia Collection and Applied Research

- Preliminary data questions from Chad.
First discussion question

What are some information/data needs regarding Biological Monitoring that can help inform the Work Groups decision on how best to redefine CSRB sampling regime?
Second discussion question

What are some information/data needs regarding Refugia collection that can help inform the Work Groups decision on how best to redefine CSRB collection strategy?
Questions are guaranteed in life; Answers aren't.
Schedule of next steps
Comal Springs Riffle Beetle
Work Group
Meeting 2

- Review Work Group goals
- Presentation by Dr. Arsuffi
- Discuss updated dataset and repeated sampling
- Discuss next steps
Work Group Goals

• Cotton lure sampling methodology

• Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?

• If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?

• If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions?
Work Group Goals

• Biological monitoring, Refugia collections, and Applied Research collections
• Long-term biological goals
CSRB lure dataset

• Individual field sheets were reviewed against BioWest’s Access database.

• Riffle beetle counts were almost identical to the previous version.
  • Lures that were lost or disturbed were identified to confirm they were not recorded as zeros.
  • Values in the db for each lure were filled in when they were evidently not filled in, or simply averaged for the whole reach.
  • Slight changes were made to some of indexed values to better reflect the chronological order that the samples were taken.

• USFWS refugia collection events were added to the database.
CSRB lure dataset

- Orifices targeted for repeated sampling were identified in both BW and USFWS data.
Table 1. Biowest CSRB survey results 2004-2018.

<table>
<thead>
<tr>
<th>Location</th>
<th>Surveys</th>
<th>Lures Set</th>
<th>Adults Caught</th>
<th>Larva Caught</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Island</td>
<td>42</td>
<td>425</td>
<td>2704</td>
<td>1407</td>
</tr>
<tr>
<td>Spring Run 3</td>
<td>42</td>
<td>451</td>
<td>4452</td>
<td>573</td>
</tr>
<tr>
<td>Western Shoreline</td>
<td>42</td>
<td>464</td>
<td>4321</td>
<td>1228</td>
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Table 2. USFWS CSRB survey results 2017 - 2/2019.

<table>
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<td>14</td>
<td>51</td>
<td>498</td>
<td>432</td>
</tr>
<tr>
<td>Spring Run 1</td>
<td>14</td>
<td>54</td>
<td>634</td>
<td>50</td>
</tr>
<tr>
<td>Spring Run 2</td>
<td>2</td>
<td>4</td>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>Spring Run 3</td>
<td>21</td>
<td>162</td>
<td>2700</td>
<td>675</td>
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1611 lures set and 19,743 beetles handled since 2004

### Table 1. Biowest CSRB survey results 2004-2018.

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</table>
Distribution of adult and larva bug counts by location for Biowest surveys 2004-2018.
Same as previous figure with adult and larva counts combined.
<table>
<thead>
<tr>
<th>Sampling Reach</th>
<th>Lure Location</th>
<th>Dates/Period</th>
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</thead>
<tbody>
<tr>
<td>Spring Run 3</td>
<td>1</td>
<td>April 2005 – May 2013</td>
</tr>
<tr>
<td></td>
<td>5, 6</td>
<td>Aug 2004 – Dec 2012</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Aug 2004 – May 2013</td>
</tr>
<tr>
<td>Spring Island</td>
<td>1</td>
<td>Dec 2008 – May 2013</td>
</tr>
<tr>
<td></td>
<td>2,3</td>
<td>Nov 2006 – Dec 2012</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>June 2008 – May 2013</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>May 2006 – June 2012, May 2013</td>
</tr>
<tr>
<td></td>
<td>9,10</td>
<td>Nov 2006 – June 2012</td>
</tr>
</tbody>
</table>
Repeated orifice sampling - BioWest
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Repeated orifice sampling - BioWest
Repeated orifice sampling - BioWest
Distribution of adult and larva bug counts by location for Refugia collections 2017-2019.
Same as previous figure with adult and larva counts combined.
Repeated orifice sampling - USFWS
Repeated orifice sampling - USFWS
Repeated orifice sampling - USFWS
Repeated orifice sampling - USFWS
CSRB Research Assessment, Questions, Recommendations Next Steps

- Inductive/Deductive Enhancement
- Context of CSRB and Comal Springs in broader stream ecological empirical understanding and theoretical basis
Ecology and management of the hyporheic zone: stream–groundwater interactions of running waters and their floodplains

Andrew J. Boulton¹,6, Thibault Datry²,7, Tamao Kasahara³,8, Michael Mutz⁴,9, and Jack A. Stanford⁵,10

¹ Ecosystem Management, University of New England, Armidale, New South Wales, Australia, 2351
² Aquatic Ecosystem Biology, CEMAGREF-Lyon 3 bis quai Chauveau, F-69336 Lyon cedex 09, France
³ Department of Watershed Sciences, Utah State University, 5210 Old Main Hill, Logan, Utah 84321 USA
⁴ Department of Freshwater Conservation, Brandenburg University of Technology Cottbus, Seestraße 45, D-15526 Bad Saarow, Germany
⁵ Flathead Lake Biological Station, The University of Montana, 32111 BioStation Lane, Polson, Montana, 59860 USA
4) the use of a species-trait approach to examine both basic and applied aspects of benthic biology, which began in the 1990s, is an expanding research area, and is a valuable application of life-history information.
Conceptual models of patch dynamics can be traced to 2 basic approaches: 1) the landscape ecology perspective and 2) the metacommunity perspective. The former focuses on how spatial patterns are created and affect ecological processes over variable scales of space and time, whereas the latter emphasizes the important influence of periodic disturbances, refugia, and dispersal in maintaining nonequilibrium communities within patch mosaics.
Stream microbial ecology

Stuart Findlay
Cary Institute of Ecosystem Studies, Box AB, Millbrook, New York 12545 USA
Linkages among aquatic ecosystems

- Surface–subsurface linkages (Danielopol 1989)
- Four dimensions of lotic ecosystems (Ward 1989)
- Patch dynamics (Townsend 1989)
- Fluvial ecotones (Naiman et al. 1988)
- Hyporheic linkages (Stanford and Ward 1993)

- Lake–stream linkages (Horvath et al. 1996)
- Surface–subsurface linkages (Valett et al. 1997)
- Benthic–pelagic linkages (Blumenshine et al. 1997)
- Linkages against stream flow (Pringle 1997)
- Upstream–downstream linkages (McTammany et al. 2003)
- Marine–stream linkages (Chaloner and Wipfli 2002)
- Hierarchical scales (Parsons et al. 2004)
- Stream–floodplain linkages (Paetzold and Tockner 2005)

- <1983: Spiralling (Ellwood et al. 1983)
- 1985: River continuum concept (Vannote et al. 1980)
- 1993: Aquatic ecosystem linkages (Gorham 1996)
- 1995: Role of hydrological connectivity (Pringle 2001)
The role of disturbance in stream ecology*

Vincent H. Resh¹, Arthur V. Brown², Alan P. Covich³, Martin E. Gurtz⁴, Hiram W. Li⁵, G. Wayne Minshall⁶, Seth R. Reice⁷, Andrew L. Sheldon⁸, J. Bruce Wallace⁹, and Robert C. Wissmar¹⁰

¹ Department of Entomology, University of California, Berkeley, California 94720 USA
² Department of Zoology, University of Arkansas, Fayetteville, Arkansas 72701 USA
³ Department of Zoology, University of Oklahoma, Norman, Oklahoma 73019 USA
⁴ U.S. Geological Survey, P.O. Box 2857, Raleigh, North Carolina 27602 USA
⁵ U.S. Fish and Wildlife Cooperative Research Unit, Oregon State University, Corvallis, Oregon 97331 USA
⁶ Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209 USA
⁷ Department of Biology, University of North Carolina, Chapel Hill, North Carolina 27514 USA
⁸ Division of Biology, University of Montana, Missoula, Montana 59812 USA
⁹ Department of Entomology, University of Georgia, Athens, Georgia 30602 USA
¹⁰ Center for Streamside Studies, College of Forest Resources and Fisheries Research Institute, University of Washington, Seattle, Washington 98195 USA
The evolving legacy of disturbance in stream ecology: concepts, contributions, and coming challenges

Emily H. Stanley¹, Stephen M. Powers², and Noah R. Lottig³
Center for Limnology, University of Wisconsin, Madison, Wisconsin 53706 USA
Disturbance

Definition: any process or condition external to the natural physiology of living organisms that results in the sudden mortality of biomass in a community on a time scale significantly shorter than the accumulation of the biomass.
5) Resource Availability: immediate mortality is the most dramatic effect, but most important usually are the longer-term consequences for resource availability (e.g., detritus, wood)
Drought

- Direct impacts - loss of water and flow, habitat reduction and reconfiguration
- Indirect impacts - interspecific interactions and the nature of food resources (Lake 2003)
- Reduced flow lower DO levels, harder for the fauna to persist; mortality <10 days (Stanley et al. 1994)
Macroinvertebrate density and diversity may decline following the flood (Scrimgeour and Winterbourne 1989)

Substrate nature - Sandy or stable with algal mats

Dislodgement, scouring and abrasion from high sediment loads and substrate mobilization (Collier and Quinn 2003)
Recolonization

- Organisms establish in new areas or disturbed habitats

- Occurs over broad and variable spatial and time scales (Sheldon 1984)

- Colonize on sediment surface, woody debris in streams (Thorp et al. 1985)
Recolonization continued

Colonization of denuded substratum is a common phenomenon.

Response to sediment-scouring storms but also to other disturbances such as toxic pollutants and drying of the streambed during periods of drought.
Recolonization pathways

- Aerial
- Hyporheic
- Upstream migration
- Downstream drift

(William and Hynes 1976)
What affects resistance and resilience?

Fig. 13.1

Small disturbance or high resistance

- Recovery
- Response
- Resilience

Probability of change

Original state

Large disturbance or low resistance

- Recovery
- Response
- Low resilience
- High resilience

Ecological state

Original state
Comal Springs Riffle Beetle (CSRB), *Heterelmis comalensis*

- Species described from Comal Springs in 1988 (Bosse et al.)
- 1st reported in San Marcos Springs in 1993 (Barr)
Characteristics of *H. comalensis*

- Do not swim or fly
- Adults and larvae found living together
- Adults respire through plastron, larvae have gills
- Require the near-saturated oxygen levels associated with cool, fast-flowing shallow streams (Brown 1987)
- Presumably feed on fungus, algae, and bio-films
- Mostly found in substrate of the direct spring area (<80 cm), in gravel, on woody debris or roots, and under rocks (Gibson et al 2008, Cooke 2012)
- Subterranean habitat use not well-understood
Historical Collections of CSRB

• Various methods employed:
  – Hand-picking
  – Meter Quadrat (Bowles)
  – Hess Sampler (Arsuffi)
  – Drift Nets (Arsuffi, Norris, Gibson)
  – Mop heads
  – Various cloth materials
  – Cotton cloth lures
- CSRB “may have survived …by retreating into the spring-heads, aquifer, or the hyporheos as spring-flows diminished” (Bowles et al. 2003).

- ≈ 4 times more CSRB on lures than from surface sampling (BIO-WEST monitoring 2003-2004)

- CSRBs presumed interstitial habitat associated with spring sources (Cooke et al. 2012)
USGS/ES installed 4 pairs of sampling ports in Spring Run 1 from Sep to Oct 2014

- Stainless steel screen 4” diameter, ca. 2’ deep, 5 mm pore size
Comal Springs Run 1 - Bore Hole Sampling
<table>
<thead>
<tr>
<th>Trap #</th>
<th>Distance (m) from Primary Spring</th>
<th>Trap depth (cm)</th>
<th>Difference of water depth to trap top (cm)</th>
<th>Total depth from stream surface to trap bottom (cm)</th>
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<td>29</td>
<td>71.12</td>
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<td>2</td>
<td>32.5</td>
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<td>-16.51</td>
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<td>Trap # 4</td>
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<td></td>
<td>Upper</td>
<td>Mid</td>
<td>Lower</td>
<td>Upper</td>
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<tr>
<td><strong>Gastropoda</strong></td>
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<td></td>
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<tr>
<td><strong>Thiaridae</strong></td>
<td></td>
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<tr>
<td><em>Tarebia</em> <em>sp.</em></td>
<td>30</td>
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<tr>
<td><strong>Insects</strong></td>
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<td><strong>Coleoptera</strong></td>
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<tr>
<td><strong>Elmidae</strong></td>
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<tr>
<td><em>Microcyclloepus</em> <em>sp. larval</em></td>
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<td><em>Helicopsyche</em> <em>sp.</em></td>
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*Table 3* — Number and identification of fauna removed from traps during 26 Sept - 8 Oct 2014.
### TABLE 3 — Number and identification of fauna removed from traps during phase one.

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<thead>
<tr>
<th>Taxa</th>
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<td><strong>Gastropoda</strong></td>
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<tr>
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<tr>
<td><strong>Insects</strong></td>
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<tr>
<td><strong>Coleoptera</strong></td>
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<tr>
<td><strong>Elmidae</strong></td>
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<tr>
<td><strong>Microcyllopus sp.</strong></td>
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<tr>
<td>adult</td>
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<tr>
<td>larva</td>
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<td><strong>Diptera</strong></td>
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<tr>
<td><strong>Chironomidae</strong></td>
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</table>

![Map of Comal Springs Spring Run 1 Bore Pits (Sampling Sites)](image-url)
- Inserts with lure material and spacers to prevent mixing.

- Sediment influx, removed by electric and hand pumps.

- WQ: Temperature decreased 2 °C at furthest point.

- No CSRB captured. Adults and larvae of *Microcylloepus* captured in upstream pits. Downstream pits anoxic.
Recommendations

- Sample in areas of typical CSRB habitat with spring outflow and low silt.

- Sample Run 3, western shore, Spring Island

- Hand bury slotted pvc pipe or drive sampling points (Bou-Rouche)

- Sample WQ from deeper section of pit while lure inserted
Hyporheic invertebrates: 1) different hydraulic gradients: infiltration, exfiltration, and horizontal advection;  
2) different sediment depths: 20, 50, 100, and 150 cm from the sediment surface;  
3) different environmental gradients: physico-chemical and particle variables; and  
4) different interactive combinations between subsurface hydrology, sediment depth, and environmental gradient.  

Suggest similar study on different types of springs to quantify abiotic vertical conditions wrt to CSRB. Many studies show no recovery following floods from hyporheic, although this is a common hypothesis.
## Experimentation in the hyporheic zone: challenges and prospectus

MARGARET A. PALMER

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Technical/conceptual development</th>
<th>Examples of critical experimental work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conceptualizing the boundaries of the hyporheic zone</strong></td>
<td>Shift research focus from a search for universal hyporheic &quot;models&quot; to reliance on between-system heterogeneity to inspire experiments. Increase replication of experimental units.</td>
<td>Identify key parameters leading to major between-stream differences in the nature and extent of the hyporheic zone. Determine the functional relationship between these key parameters and local biological and physical processes.</td>
</tr>
<tr>
<td><strong>Developing tools for collecting quantitative and unbiased samples</strong></td>
<td>Design sampling devices that can penetrate deep into the streambed. Develop devices for ensuring intact sample retrieval. Prevent sample contamination and sampler avoidance. Calibrate sampling devices and quantify sampling zone of the device.</td>
<td>Assess the relative efficiencies of different sampling devices across substrate types. Evaluate the effect of an experimental manipulation or sampling device on the process under study.</td>
</tr>
<tr>
<td><strong>Evaluating the impact of bed movement on hyporheic processes</strong></td>
<td>Design devices for quantifying near-bed and deep-bed substrate movement. Design experiments that can be extrapolated across hydrological conditions.</td>
<td>Determine the effect of bed movement on nutrient exchange between the hyporheic, groundwater, and surface water zones. Determine the relationship between carbon storage in the hyporheic zone and bed movement. Assess the role of bed movement in constraining biotic processes in the hyporheic zone. Determine if transport events modify hyporheic community dynamics.</td>
</tr>
<tr>
<td><strong>Measuring and manipulating subsurface flows</strong></td>
<td>Develop techniques for measuring subsurface flows over small spatial scales. Design artificial streams and hyporheic incubation chambers that adequately simulate subsurface flows.</td>
<td>Determine how subsurface flows influence: nutrient uptake and storage, primary production, food availability and secondary production, solute exchange, faunal dynamics, retention of organic matter.</td>
</tr>
<tr>
<td><strong>Accounting for exchanges between the water column, the hyporheic zone, and the groundwaters</strong></td>
<td>Develop field techniques for manipulating or controlling these exchanges; at a minimum, incorporate measurement of these exchanges into field protocols.</td>
<td>Determine the relative importance of surface water vs. groundwater inputs on hyporheic processes. Determine the effect of local conditions on the flux of water and material between the surface waters, the hyporheic zone, and the groundwater.</td>
</tr>
</tbody>
</table>
CSRB Life History

- Asynchronous
- Multivoltine
- Detritivore/Herbivore: Shredder/Scraper? (Examine Mandibles, Isotopes, microbial biomass)
- K- Strategist (< growth rates, longevity, reproduction)
Figure S1. Photograph of a dissected single female in captivity that was found to be carrying around 10 relatively large eggs.
CSRB Questions for Evaluation

- Separation of natural variability from perturbation-induced variability for population estimates

- What is appropriate spatial scale for sampling CSRB for biological goals? surface/hyporheic; spring; rock; wood; M2; cotton lure

- “if the appropriate spatial scale for a study cannot be determined a priori, ecological field studies should be conducted across a variety of spatial scales (Ives et al. 1993). Use of plotless designs and related spatial statistics have rarely been pursued by benthic ecologists, although the technical and statistical machinery needed are widely available (e.g. Muotka & Penttinen 1994; Cooper et al. 1998).”
Many studies (flood, drought, pollution) show invertebrate recovery times of a few months to several years.

Recovery a function of life history traits (r-K, temperature, growth rates…).

Recovery a function of disturbance characteristics (intensity, frequency…).

Recovery a function of combination of disturbance events.

Recovery from disturbance of CSRB is likely slow.

Is hyporheic zone a refugia? Need spatial, temporal and vertical characterization. Frequent hypoxia of cotton lures with depth suggest hyporheic is limited away from spring orifices.
Scales of patchiness in the response of lotic macroinvertebrates to disturbance in a regulated river/C. T. Robinson (5,10, None, 3 brick types)
Cotton Lure as Method

- Okay as a refugia collection technique, but
- What does it tell us about CSRB
  - Population (density, abundance)
  - Area sampled
  - Conditioning (microbial colonization)
  - Alternative Assay
  - Distribution Potential w Statistics
A standardized cotton-strip assay for measuring organic-matter decomposition in streams

In field trials, we incubated cotton strips made of artists’ fabric in 49 streams in the Midwest (USA), northern Michigan (USA), and in New Zealand to: (1) test the assay under field conditions, (2) provide an initial population of data to which future studies can be compared, and (3) assess some environmental conditions that might influence cotton-strip decay.
Fig. 4. Positive linear regression between mean cotton-strip tensile-strength loss (±1 SD) and mean cotton-strip respiration (±1 SD) for the cotton strips incubated in Michigan streams.
Cotton Lure Modifications?

- Replace cotton lure material with cotton strip fabric to better mimic leaf/wood
- Determine microbial conditioning curve for cotton strip relative to CSRB
- Pre-condition cotton strip and leave at springs for just 2 days and collect.
Other national USFWS listed aquatic invertebrates

- 41 Species (snails, crawling water bugs, amphipods, damselflies, isopods, crayfish, shrimp).
- Most without life history information and biological goals.
JOURNAL ARTICLE

Modeling Count Data of Rare Species: Some Statistical Issues

Ross B. Cunningham and David B. Lindenmayer

*Ecology*

Vol. 86, No. 5 (May, 2005), pp. 1135-1142
What did we learn from last time regarding cotton lure?

1. *Cotton lure sampling methodology*

Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?

If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?

If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions?
What did we learn from last time regarding cotton lure?

- Potential modifications
  - Examine cotton strip.
  - Determine microbial conditioning curve.
  - Pre-condition, leave at springs for short time.

- Explore hyporheic zone
- Natural variability versus perturbation-induced variability
- Spatial scale
- Disturbance recovery
- Data modeling
Proposed research project – CSRB lure efficiency

• What is the efficiency of the cotton lure method?
  • How does the number of beetles on the lure relate to the number of beetles in the immediate area?
  • How does this change with condition of the lure?

• The general concept is to recreate cotton lure sampling in the laboratory.
Proposed research project – CSRB lure efficiency

• Construct long (~ 1 m) rectangular plexiglass tanks (resembling Cooke et al. 2015).
• Distribute flow as evenly as possible through drilled out pvc buried in substrate.
• Construct multiple standpipes to recirculate water.
• Fill with substrate including rocks, leaves, woody debris, branches.
Proposed research project – CSRB lure efficiency

• Bury preconditioned and unconditioned cotton lure (separate tanks).
• Place 20 adult CSRB in tanks
• Examine lure on days 3, 10, 20, 30.
• Tear down tanks and note mortalities on day 30.
Proposed research project – CSRB lure efficiency

• How many beetles?
• How many replicates?
• How to collect and condition tank material and lures?
• Frequency to check lures?
• Where to place lures?
• Where to place beetles?

• Tank size?
• What can we measure on the lure itself at conclusion of experiment?
Charge #2. Biological monitoring, Refugia collections, and Applied Research collections

• What changes are recommended for the Biological monitoring sampling program? What are the stated goals behind those changes?

• What changes are recommended for Refugia removal efforts? What are the stated goals behind those changes?

• Are the current and proposed levels of physical activity in the CSRB habitat protective of the species? If not, what level of activity is appropriate?
Goals of Biological Monitoring program

• From HCP Section 6.3.1 on Biological Monitoring

  • “...will provide a means of monitoring changes to habitat availability and the population abundance of the Covered Species...”

  • “...will provide information to effectively determine whether the conservation measures are achieving the biological goals and objectives...”
Texas State CSRB population study

• 85 springs repeatedly sampled 4 times with one week in between cotton lure retrieval and re-deployment.

• Use data to conduct occupancy and abundance modeling.
Biological monitoring program

- CSRB surveys are conducted at least 2x annually since 2004. Critical period surveys conducted as well.
- 60/40 cotton/polyester pieces of cloth are placed into spring openings/upwellings and left for 30 days
- Ten lures are placed at 3 locations. Some springs are repeatedly sampled.
- Standardized metadata are recorded at each lure locations (Hall 2016)
- Since 2004, 41 sampling events have occurred (38 at SI)
- Beetles are returned to collection point
Biological monitoring program

• Should we repeat sampling at the same 10 orifices at 3 LTBG reaches?
• Should we randomize orifice selection?
• Do we want to expand outside of our LTBG sampling area?
• How many lures should we set?
• Is twice a year necessary?
• What should we be measuring that we currently are not?
• Should we be quantifying silt accumulation within the sampling areas?
Refugia Program

• USFWS collections for the EAA Refugia began in 2017.
• Collections are conducted to meet contractually obligated standing stock numbers and conduct research.
• In 2017, ~8 cotton lure collection events were conducted among Spring Island and Spring Runs 1, 2, and 3.
• In 2018, ~3 cotton lure collection events Spring Island and Spring Runs 1 and 3.
• In 2019, ~2 cotton lure collection events Spring Run 3.
Refugia Program Research

• 2015: Development of husbandry and captive propagation techniques for invertebrates covered under the Edwards Aquifer Habitat Conservation Plan
• 2018: Life history aspects of the CSRB
• 2019: Two studies examining conditions for optimal pupation and eclosion to adult and a study evaluating captive population nutrition and longevity of the CSRB
Refugia Questions

• How many beetles should we remove from the system each year?
• Does the 25% rule make sense?
• How often should we leave an orifice alone between collections?
• Should we remove from the same orifices that we use for LTBG collections?
• Should USFWS use similar collection measurements and techniques to Biomonitoring methods?
Are the current levels of physical activity in the system appropriate?
Review of Work Group meeting 3 – tank study

Cotton lure efficiency tank study

• 5 circular tanks, water enters tank from bottom, stand pipe in middle
• Tank material consists of wood, leaves, limestone gravel, and cotton lure
• Wood and leaves collected from wild, conditioned appropriately, and kept in wireframe.
• Cotton lure washed thoroughly with DI
• 20 adult beetles placed in tank
• Lure checked at 10, 20, and 30 day intervals
Goals of biomonitoring

• “...will provide a means of **monitoring changes to habitat availability and the population abundance** of the Covered Species...”

• “...will provide information to effectively determine whether the conservation measures are **achieving the biological goals and objectives**...”
Recommendations from meeting 3

• Continue monitoring in the three LTBG reaches and follow established sampling protocols
• Add regular system wide population surveys
Recommendations from meeting 3

• Continue monitoring in the three LTBG reaches and follow established sampling protocols
• Add regular system wide population surveys

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</table>

• Have methodology developed by a third party and approved by CSRB WG or Science Committee prior to procurement
Background on Refugia collections

Refugia collections

• What is USFWS tasked with?
• What did they do in 2017, 2018, 2019
• Location of collections
• Partial take off lure
What is USFWS tasked with?

“Collection, establishment, and maintenance of standing stocks, refugia stocks, and salvage stocks for the Covered Species”

- Standing stock = 500 CSRB
- Salvage stock = 500 CSRB
Background on Refugia collections

Table 1. Biowest CSRB survey results 2004-2018.

<table>
<thead>
<tr>
<th>location</th>
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<td>1228</td>
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</tbody>
</table>

Table 2. USFWS CSRB survey results 2017 - 2/2019.

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<tr>
<td>Spring Run 3</td>
<td>21</td>
<td>162</td>
<td>2700</td>
<td>675</td>
</tr>
</tbody>
</table>
Background on Refugia collections


• 2017
  • 12 unique ‘date.collected’
  • 75 lures set
  • 1896 ‘adult_plus_larva’ encountered

• 2018
  • 7 unique ‘date.collected’
  • 60 lures set
  • 929 ‘adult_plus_larva’ encountered

• 2019
  • 2 unique ‘date.collected’
  • 26 lures set
  • 550 ‘adult_plus_larva’ encountered
Background on Refugia collections


<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>2019</td>
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Spring Run 3 CSRB removals

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<tr>
<th>Year</th>
<th>Cotton Lure</th>
<th>Wood Dowel</th>
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<tbody>
<tr>
<td>2017</td>
<td>347</td>
<td>24</td>
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<tr>
<td>2018</td>
<td>264</td>
<td>44</td>
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<tr>
<td>2019</td>
<td>465</td>
<td>30</td>
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<td></td>
<td>1076</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1174</td>
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</table>
Background on Refugia collections

In 2019 and 2020 the Refugia program is collecting CSRBs to support research purposes rather than standing stock until survivability in captivity is increased and better quantified. USFWS is also using the biomonitoring survey as an opportunity to collect beetles.
22% zero count (n=411)

60% zero count (n=40)

9% zero count (n=161)

CSRB encounters on cotton lures at Spring Run 3 (left to right) BioWest biannual surveys including critical period monitoring 2004-2016, BioWest biannual surveys 2017-2018, USFWS Refugia 2017-Feb 2019.
Questions regarding Refugia collections

How many beetles should we remove from the system each year and where from?
What is an appropriate standing stock number?
How often should we leave an orifice alone between collections?
Should we always sample the same orifices/spring runs?
Should we collect beetles out of the orifices used for biological monitoring?
Should we only take 25% off of a lure returning the other 75%?
Suggested recommendations

Recommendations for standing stock collections during non-drought periods

- No more than 200 beetles removed per year for standing stock purposes
- No more than 50 beetles per year from a single orifice
- Maximum 4 collections per year (2 Bio-West – 2 USFWS)
- Track beetles separately by location and collection event
- Recovered at more than one location in the lake
System Disturbance

Are the Refugia and Biomonitoring sampling programs safe for the beetle?
What data metrics can be regularly examined to make this determination?
Meeting # 5

Review, discussion, and recommendation on Biological Goals.
Overview of Work Group recommendations.
EAHCP CSRB Work Group meeting 5
What do we have left to cover?

- Refugia collections (Number – Location)
- Disturbance
- EAHCP Long-Term Biological Goals
Refugia Operations

- Collection numbers needed to maintain standing stocks
- Collection efforts needed to meet collection numbers
- Salvage rules
Refugia Operations – collections for standing stocks

- How many beetles need to be collected from the wild to continuously maintain a target stock number?
CSRB refugia survivability

Flow through tubes

Containers

Day in Refugia

Days in Refugia

CSRB survivability (%)

SR1, n=31
SR2, n=42
SR3, n=12
SR4, n=14

FT1, n=32
FT2, n=41
FT3, n=13
FT4, n=15

Flow through tubes

Containers
Refugia Operations – collections for standing stocks

- How many beetles need to be collected from the wild to continuously maintain a target stock number?
Refugia Operations – collections for standing stocks

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Refugia Operations – collections for standing stocks

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Refugia Operations – collections for standing stocks

• How many beetles need to be collected from the wild to continuously maintain a target stock number?

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<thead>
<tr>
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<th>142 d</th>
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<tr>
<td>annual removals</td>
<td>260</td>
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</table>

200 – 260 adult CSRBs Removed

100 adult CSRBs in captivity · yr

Assumptions: quarterly collections; linear mortality
Refugia Operations – collections for standing stocks

• How many beetles need to be collected from the wild to continuously maintain a target stock number?

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200 – 260 adult CSRBs Removed
100 adult CSRBs in captivity · yr

Assumptions: quarterly collections; linear mortality
Refugia Operations – collections for standing stocks

• How many beetles need to be collected from the wild to continuously maintain a target stock number?
• What is the collection effort required to meet the number of beetles for the target stock number?
Refugia Operations – collection effort

- How many adult CSRB beetles can we expect to encounter per collection effort?

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<tr>
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Table 2. USFWS CSRB survey results 2017 - 2/2019.
Refugia Operations – collection effort

How many adult CSRB beetles can we expect to encounter per collection effort?

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<tr>
<td>Spring Island</td>
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<td>9</td>
</tr>
<tr>
<td>Spring Run 1</td>
<td>12</td>
<td>-</td>
</tr>
</tbody>
</table>

10 adult CSRBs
1 lure set

Average adults encountered
Refugia Operations – Salvage Refugia

- Standing Stock: 500; permanent
- Refugia Stock: 500 – Standing stock; < 120 cfs
- Salvage Stock: 500; < 30 cfs

- Standing + Refugia + Salvage = 1000
Refugia Operations – How many to collect?

**Known**
- **currently** \( \frac{260 \text{ adult CSRBs Removed}}{100 \text{ adult CSRBs in captivity} \cdot \text{yr}} \)
- \( \frac{10 \text{ adult CSRBs}}{1 \text{ lure set}} \)
- Not in critical drought
- Husbandry skills can be honed at 50-100 beetles
- Standing + Salvage stocks = 1000 (500 at 120cfs; 500 at 30cfs)

**Unknown**
- Surface population size
- Effects of disturbance ecology/reintroduction
- How to reliably breed
- How to reintroduce
- Minimum viable population for reintroduction
- Reliable metrics to assess oversampling
Disturbance

• SR3 – Refugia & BioMon
  • 2017
    • 95 lures set
    • 2021 adult+larva
  • 2018
    • 80 lures set
    • 963 adult+larva
  • 2019
    • 46 lures set
    • > 550 adult+larva
**Disturbance**

Assumptions: quarterly collections; 100% take; linear mortality

<table>
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<tr>
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<tr>
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<tr>
<td>annual adult + larva encounters</td>
<td>350*</td>
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<tr>
<td>2020-2028 removals</td>
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*based off BioWest and Refugia data

^based off BioMon data only

does not include research or system wide surveys

assumes 100% take off lure
**Disturbance**

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### Assumptions:
- Quarterly collections; 100% take; linear mortality

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**260 adult CSRBs Removed**
**100 adult CSRBs in captivity · yr**
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**Assumptions:** quarterly collections; 100% take; linear mortality
Refugia Operations – How many to collect?

**Known**
- **currently** \[rac{260 \text{ adult CSRBs Removed}}{100 \text{ adult CSRBs in captivity \cdot yr}} \]
- 10 adult CSRBs\[\frac{1 \text{ lure set}}{1 \text{ yr}}\]
- Not in critical drought
- Husbandry skills can be honed at 50-100 beetles
- Standing + Salvage stocks = 1000 (500 at 120cfs; 500 at 30cfs)

**Unknown**
- Surface population size
- Effects of disturbance ecology/reintroduction
- How to reliably breed
- How to reintroduce
- Minimum viable population for reintroduction
- Reliable metrics to assess oversampling
Refugia Operations – Where to collect?

- Multiple locations each time
- Separate areas than Biological Monitoring
- Percent take off of lure
- Repeated sampling of orifices
1. Directly out from stage gauge left side of boulder
2. Under right side of boulder
3. 7' down stream from blue pipe under white boulder (no.7 vents)
   tag 156 under big boulder to right hand side
4. tag 180 just to right of bridge
5. tag 201 under tag
6. tag 210 under pecan tree big tree
7. tag 215 under tag: to left of boulder
8. tag 228 under rock pipe near to sycamore
9. tag 255 directly straight out from sycamore, live under horizontal log

(Recorded: 01/08/2018)
Long-Term Biological Goals

• Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?
• What is an appropriate means to monitor the habitat quality goal?
• How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs?
Section 4.1.1.1 of the HCP establishes Long-Term Biological Goals for the Comal Springs riffle beetle.

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

| TABLE 4-7 |
| COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS |
| Spring Run 3 | Western Shoreline | Spring Island Area |
| Habitat | Silt-free gravel and cobble substrate ≥ 90% of each study area | |
| Density (# of CSRB/ | ≥20 | ≥15 | ≥15 |
Section 4.1.1.1 of the HCP establishes Long-Term Biological Goals for the Comal Springs riffle beetle.

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.
For each survey and each location - calculated average number of beetles per lure (n=15 surveys)

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

Rounded median number to nearest ‘5’ increment
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

<table>
<thead>
<tr>
<th>TABLE 4.7</th>
<th>COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
<td>≥20</td>
</tr>
</tbody>
</table>

Average beetles per lure for ea survey n = 39

LTBG ≥ 20

Median value is 12.0
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

---

**Table 4.7**

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Spring Run 3</th>
<th>Western Shoreline</th>
<th>Spring Island Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
<td>≥20</td>
<td>≥15</td>
<td>≥15</td>
</tr>
</tbody>
</table>

**Graph:**

- Spring Run 3 CSRB Biomonitoring 2004-2018
- Individual lures n = 349
- Avg beetles per lure for ea survey n = 39
- LTBG ≥ 20
- 20 CSRBs is at 86 percentile
- Median value is 12.0
LTLBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

<table>
<thead>
<tr>
<th>TABLE 4-7</th>
<th>COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Habitat</td>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
</tr>
<tr>
<td>Density (# of CSRB/ )</td>
<td>≥20</td>
</tr>
</tbody>
</table>

Spring Run 3 CSRB Biomonitoring 2004-2018

Individual lures n = 349
Avg beetles per lure for ea survey n = 39

2016 survey avg

2016 raw (n=16, note points are not jittered)
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

**TABLE 4-7**

<table>
<thead>
<tr>
<th></th>
<th>COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Density (# of CSRB/area)</td>
<td>≥20</td>
</tr>
<tr>
<td></td>
<td>2015 survey avg</td>
</tr>
</tbody>
</table>

Individual lures n = 349
Avg beetles per lure for ea survey n = 39
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Habitat</td>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
</tr>
<tr>
<td>Density (# of CSRB/)</td>
<td>≥20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>date.collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>2015</td>
</tr>
</tbody>
</table>
"The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring."

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Habitat</td>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
</tr>
<tr>
<td>Density (# of CSR)</td>
<td>≥20</td>
</tr>
</tbody>
</table>

15 CSRBS is at 77 percentile
50th percentile is 11.4
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

<table>
<thead>
<tr>
<th>TABLE 4-7</th>
<th>COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring Run 3</td>
</tr>
<tr>
<td>Habitat</td>
<td>Silt-free gravel and cobble substrate ≥ 90% of each study area</td>
</tr>
<tr>
<td>Density (# of CSRB)</td>
<td>≥20</td>
</tr>
</tbody>
</table>

Spring Island CSRB Biomonitoring 2004-2018

Individual lures n = 325
Avg beetles per lure for ea survey n = 38
LTBG ≥ 15

15 CSRBs is at 77 percentile
50th percentile is 11.4

2018 survey avg
2018 raw (n=18, note points are not jittered)
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”

**Western Shoreline CSRB Biomonitoring 2004-2018**

Individual lures n = 366
Avg beetles per lure for ea survey n = 39

LTBG >= 15

**TABLE 4-7**
COMAL SPRINGS RIFFLE BEETLE LONG-TERM BIOLOGICAL GOALS

<table>
<thead>
<tr>
<th>Habitat Description</th>
<th>Spring Run 3</th>
<th>Western Shoreline</th>
<th>Spring Island Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt-free gravel and cobble substrate ≥90% of each study area</td>
<td>≥20</td>
<td>≥15</td>
<td>≥15</td>
</tr>
</tbody>
</table>

15 CSRBs is at 72 percentile
50th percentile is 10.4
LTBGs

“The population measurement goal is to maintain greater than or equal to the median densities observed over the past six years of the EAA Variable Flow Study monitoring.”
Long-Term Biological Goals

• What are the purposes of the Long-Term Biological Goals?
  • HCP goals should address the broad biological needs of the species.
    • Maintaining a specific species life history characteristic
    • Providing conditions necessary for an important life history characteristic
    • Restoring something to more desirable conditions
  • Can focus on species itself or habitat

• EAHCP LTBG purpose
Long-Term Biological Goals

• Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?
• What is an appropriate means to monitor the habitat quality goal?
• How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs?
<table>
<thead>
<tr>
<th>Charge Topic</th>
<th>Topic Question</th>
</tr>
</thead>
</table>
| **Cotton lure sampling methodology** | Is the current cotton lure sampling methodology an appropriate means to monitor abundance at a locale?  
If not, what sampling methodologies exist that would provide a better proxy of abundance at a locale?  
If the previous two questions cannot be adequately answered without additional study, what would be an appropriate study to answer the questions? |
| **Biological monitoring, Refugia collections, and Applied Research collections** | What changes are recommended for the Biological monitoring sampling program?  
What are the stated goals behind those changes?  
What changes are recommended for Refugia removal efforts? What are the stated goals behind those changes?  
Are the current and proposed levels of physical activity in the CSRB habitat protective of the species? If not, what level of activity is appropriate? |
| **Long-term biological goals** | Are the current population and habitat LTBGs for the CSRB appropriate? What are the criteria for more appropriate goals?  
What is an appropriate means to monitor the habitat quality goal?  
How can Biological monitoring, Refugia efforts, and Applied Research studies be used to establish new LTBGs? |
Cotton lure sampling methodology

Recommendations

• Continue using cotton lure for CSRB biological monitoring and refugia removals.
• Conduct cotton lure mesocosm experiment using methodology developed during work group meetings.
• EAHCP goal is to conduct and finalize experiment in 2020.
Recommendations

• Continue historical Biological monitoring program at 3 locations, twice a year, 10 lures per survey, repeated sampling of individual orifices.

• Conduct two Comal system-wide occupancy and population studies prior to 2028.
  • Potential survey years are 2022 and 2025.
  • It is anticipated study design will be contracted out and raw data from the Nowlin 2019 population study will be used to aid design.
Biological monitoring, Refugia and Applied Research collections

Recommendations

• Reduce Refugia standing stock numbers to 150 adults (75 at each station).
• Allow Refugia collections to retain 100% of beetles captured on a lure.
• Alternate spring orifices between Refugia collection events such that the same spring orifice is not sampled on consecutive collection events.
• Do not overlap Refugia collection locations with Biomonitoring locations.
CSRB Long-Term Biological Goals

- Maintain present Long-Term Biological Goals.
- Revisit Long-Term Biological Goals after population studies and in-situ cotton lure studies have been completed.
CSRB future meetings

• Conduct an annual meeting to review progress and discuss current CSRB topics
• December 9th 2020 – location TBD
• Potential topics:
  • 2019 and 2020 Biomonitoring surveys
  • Refugia collections, captive life spans, and standing stock numbers
  • TSU population survey
Edwards Aquifer Habitat Conservation Plan

Report of the 2019 Budget Work Group
To: Edwards Aquifer Habitat Conservation Plan Implementing Committee
From: Edwards Aquifer Habitat Conservation Plan Budget Work Group
Date: September 18, 2019

Overview:

On September 18, 2019, a meeting of the Edwards Aquifer Habitat Conservation Plan (EAHCP) Budget Work Group was held to review and discuss the Edwards Aquifer Authority (EAA) 2020 budget process to monitor the management of EAHCP revenue and expenses. Specifically, the Budget Work Group was charged by the EAHCP Implementing Committee to “collaborate with and inform the EAA Budget Process, as it relates to the EAHCP, EAHCP reserve and EAHCP aquifer management fee and to address fiscal issues.”

Members of this Work Group include:
- Tom Taggart, Implementing Committee (IC) Member (serving as Chair - City of San Marcos)
- Brock Curry, Edwards Aquifer Authority (EAA) designee
- Steve Raabe, EAHCP Stakeholder member
- Myron Hess, EAHCP Stakeholder member
- Mary Bailey, San Antonio Water System (SAWS) designee
- Adam Yablonski, Member-at-Large, Medina County Farm Bureau

Work Group Discussions:

During the meeting, EAA staff presented information on the following items:
- Aquifer Storage Recovery and Voluntary Irrigation Suspension Program Option program updates.
- Updated calculations of the Drought of Record projected expenses, forecasts, and probabilities.
- EAHCP Table 7.1A Analysis and Forecast.
- EAA Aquifer Management Fee and Reserve Forecast.
- EAHCP 2020 Proposed Budget and Reserve Fund.

The discussion concerning these topics is described below. The full set of slides and supporting material (Appendix A), meeting agenda (Appendix B), and meeting minutes (Appendix C) are included as appendices.
Aquifer Storage Recovery (ASR) and Voluntary Irrigation Suspension Program Option (VISPO) programs.

EAA staff provided an update and overview of the ASR and VISPO programs. In 2020, the total costs for the ASR program will be about $6,299,848. This expenditure comprises forbearance agreements, leases, and operations, and maintenance injection costs. Under the VISPO program, as amended in May 2019, 41,795 acre-feet of water is required in forbearance agreements. The target for 2020 is to achieve the new goal of 41,795 acre-feet and to pursue renewals for the expiring 5-year forbearance agreements. The estimated cost for the VISPO program in 2020 is $2,508,070.

Updated calculations of the Drought of Record projected expenses, forecasts and probabilities.

EAA staff presented the updated Drought of Record probabilities to the Work Group. Based on the historical J-17 data and current aquifer levels, there is a 0% chance that VISPO forbearance will trigger in 2020. Between 2021-2027, EAA staff forecasts a 40% chance that VISPO forbearance will trigger in one or more years, a 8.1% chance it will trigger in two or more years, a 1% chance it will trigger in three or more years, and a 0.07% chance of it triggering four or more times.

Based on current modeling scenarios, there is about a 1% probability of the recharge trigger for the ASR forbearance program occurring at least once by 2026, considering a rolling 10-year average. Overall, there is about a 16% probability of the 10-year recharge trigger for the ASR forbearance program occurring at least once by 2029.

EAA 2019 Aquifer Management Fee (AMF) and Reserve Forecast.

EAA staff provided detailed charts to the Work Group that illustrated various projections associated with the EAA General Fund and the EAHCP Fund. These charts delineated the progression of both funds from 2012 until 2024, complete with actuals for 2012-18 and budgeted/forecasted estimates beyond 2019.

The EAHCP Reserve Fund has grown from $14.3 million in 2012 to a projected $28.7 million at the end of 2019. As presently forecasted, the EAHCP Reserve Fund will decrease to $27.9 million in 2020, about $1.5 million above the Reserve Floor of $26.4 million. Based on current projections, without triggering VISPO or ASR forbearance, or implementing the Adaptive Management Process, the EAHCP Reserve will remain consistent with $27.2 million in 2024.

Some Work Group members expressed concerns regarding the reserve minimum and management toward the reserve floor with no plans to build it further. Moreover, the Work Group discussed the mechanism and timing the EAA would employ to rebuild the reserve should a portion of it be used to fund a triggering of ASR or VISPO.

Since 2012, the EAA has absorbed several large expense items while maintaining the combined AMF rate of $84. To ensure adequate reserves for the EAA General Fund while maintaining the $84 combined AMF rate, the EAA has proposed an adjustment to the AMF between the EAA and the EAHCP in 2020. The 2020 Proposed Budget would reduce
the EAHCP Program AMF from the $38 rate in 2019 to $34, and EAA General Fund AMF rate would increase from $46 to $50.

Beginning in 2021, EAA staff projects a potential increase of the combined AMF rate to $88 and a reduction in the EAHCP Program AMF to $31 by 2024. This reduction in the EAHCP Program AMF rate is consistent with the projected reduction in EAHCP expense requirements. Additionally, this change will allow the EAA to build more capacity in the EAA General Fund Reserves by increasing the EAA General Fund AMF to $57 by 2024.

**Considerations for the Implementing Committee.**

The Work Group recommends the following items for the Implementing Committee to consider in their deliberations related to EAHCP funding and possible comment to the EAA Board as they review the budget for FY 2020.

- The current financial projections and cost estimates presented to the Budget Work Group indicate an overall fiscally stable and adequate budget for the EAHCP program.

- The Work Group acknowledges the ASR and VISPO trends and no likelihood of triggering events for either program in 2020.

- The Work Group noted that proposed aquifer management fees (AMF) diverged from previous forecasts in multiple years with continuing declines in the amount of funding devoted to the EAHCP with increasing amounts of the total AMF funding EAA operations.

- Although the EAHCP Reserve is projected to be above the established floor, the Budget Work Group reiterated prior concerns regarding the downward trend of the EAHCP Reserve and the possible fiscal implications should drought conditions trigger ASR or VISPO forbearance. The Work Group recommends the Implementing Committee, EAA Board, and staff continue to monitor the potential Droughts of Record (DOR) and the impact of a DOR on the EAHCP Reserve funds to ensure the continued confidence with the U.S. Fish and Wildlife Service and the EAHCP guarantee of financial security to cover program activities.
APPENDIX A
SLIDE PRESENTATIONS
CHARGE OF THE EAHCP BUDGET WORK GROUP

- Collaborate with and inform the EAA Budget Process, as it relates to the EAHCP, EAHCP reserve and EAHCP aquifer management fee.

- Address fiscal issues as they arise and are referred by the Implementing Committee.
AQUIFER STORAGE AND RECOVERY (ASR) & VOLUNTARY IRRIGATION SUSPENSION PROGRAM OPTION (VISPO)

Requirements
- Deliver 126,000 acre-feet to off-set pumping during the Drought of Record (DOR) and acquire an additional 50,000 acre-feet of withdrawal rights to be left unpumped during DOR.

Objective for 2020
- Continue to implement contract with SAWS and notice 9,957.439 acre-feet for injection bringing total storage to 126,000 acre-feet.
- Secure 34,075.923 acre-feet of ASR Forbearance Water to meet 50,000 acre-feet requirement.

Estimated 2020 Budget
- $2,484,002 Leases (15,924.077 acre-feet)
- $3,407,591 Forbearance Agreements (34,075.923 acre-feet)
- $408,255 Operations and Maintenance (9,957.439 acre-feet)

Total Cost: $6,299,848
## 2020 ASR Leases

<table>
<thead>
<tr>
<th>Lease Terms</th>
<th>Acre-feet</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Year</td>
<td>3,085.950</td>
<td>$432,033</td>
</tr>
<tr>
<td>7 Year</td>
<td>0.500</td>
<td>$60</td>
</tr>
<tr>
<td>10 Year</td>
<td>10,585.422</td>
<td>$1,691,556</td>
</tr>
<tr>
<td>15 Year</td>
<td>2,252.205</td>
<td>$360,353</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td><strong>15,924.077</strong></td>
<td><strong>$2,484,002</strong></td>
</tr>
</tbody>
</table>

## 2020 ASR Program Cost*

<table>
<thead>
<tr>
<th>ASR Program Expense</th>
<th>Acre-feet</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease Agreements</td>
<td>15,924.077</td>
<td>$2,484,002</td>
</tr>
<tr>
<td>Forbearance – 9 Year Agreements</td>
<td>15,509.061</td>
<td>$1,550,904</td>
</tr>
<tr>
<td>Forbearance – 10 Year Agreements</td>
<td>18,566.862</td>
<td>$1,856,687</td>
</tr>
<tr>
<td><strong>ASR Leasing/Forbearance Totals:</strong></td>
<td><strong>50,000.000</strong></td>
<td><strong>$5,891,593</strong></td>
</tr>
<tr>
<td>Operations &amp; Maintenance (injection)</td>
<td></td>
<td>$408,255</td>
</tr>
<tr>
<td><strong>Total ASR Program Costs</strong></td>
<td></td>
<td><strong>$6,299,848</strong></td>
</tr>
</tbody>
</table>

* Includes actual and budgeted forbearance agreements.
## ASR Cumulative Storage

<table>
<thead>
<tr>
<th>Year</th>
<th>ASR Water Noticed To SAWS (acre-feet)</th>
<th>Cumulative Balance (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1,868.325</td>
<td>1,868.325</td>
</tr>
<tr>
<td>2014</td>
<td>4,031.402</td>
<td>5,899.727</td>
</tr>
<tr>
<td>2015</td>
<td>12,075.016</td>
<td>17,974.743</td>
</tr>
<tr>
<td>2016</td>
<td>33,258.630</td>
<td>51,233.373</td>
</tr>
<tr>
<td>2017</td>
<td>31,475.188</td>
<td>82,708.561</td>
</tr>
<tr>
<td>2018</td>
<td>16,667.000</td>
<td>99,375.561</td>
</tr>
<tr>
<td>2019</td>
<td>16,667.000</td>
<td>116,042.561</td>
</tr>
<tr>
<td>2020</td>
<td>9,957.439</td>
<td>126,000.000</td>
</tr>
</tbody>
</table>

Cost of Injection 9,957.439 X $41 = $408,255

## Voluntary Irrigation Suspension Program Option (VISPO)

Requirements:
- Secure 41,795 acre-feet of forbearance agreements.

Target for 2020:
- Enroll 41,795 Acre-feet
- Target new enrollees and expiring 5-year forbearance agreements for renewal (15,812.121 acre-feet).

**Estimated Cost**: $2,508,070
## Rates per Acre-foot:

<table>
<thead>
<tr>
<th>Years</th>
<th>Fee</th>
<th>Beginning Rate</th>
<th>Rate Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year</td>
<td>Standby</td>
<td>$50</td>
<td>1.5%/year</td>
</tr>
<tr>
<td></td>
<td>Forbearance</td>
<td>Plus $150 ($200)</td>
<td>1.5%/year</td>
</tr>
<tr>
<td>10-Year</td>
<td>Standby</td>
<td>$57.50 (years 1-5)</td>
<td>$70.20 (years 6-10)</td>
</tr>
<tr>
<td></td>
<td>Forbearance</td>
<td>Plus $172.50 (years 1-5) ($230)</td>
<td>$210.60 (years 6-10)</td>
</tr>
<tr>
<td>New 5-Year Rate</td>
<td>Standby</td>
<td>$54</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Forbearance</td>
<td>Plus $160 ($214)</td>
<td>None</td>
</tr>
</tbody>
</table>

## 2020 VISPO Agreements Expected to be Under Contract

<table>
<thead>
<tr>
<th>Term</th>
<th>Acre-ft. Enrolled</th>
<th>If Stand-by</th>
<th>If Forbearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year Renewed/New</td>
<td>26,174.931</td>
<td>$1,413,446</td>
<td>$5,601,436</td>
</tr>
<tr>
<td>10-Year</td>
<td>15,620.069</td>
<td>$1,094,624</td>
<td>$4,378,496</td>
</tr>
<tr>
<td>Totals:</td>
<td>41,795.000</td>
<td>$2,508,070</td>
<td>$9,979,932</td>
</tr>
</tbody>
</table>

J-17 Index Well Reading is expected to be above 635 ft. msl on October 1st therefore permit holders will be paid the standby rate.

Total Cost of 2020 VISPO Program will be **$2,508,070**
Based on historical J-17 data and current levels, the probability of VISPO triggering in:

- 2020: 0%
- 2021 – 2027, each year is independent from the previous year:
  - In any individual year = 7%
  - 1 or more VISPO trigger years = 40%
  - 2 or more = 8.1%
  - 3 or more = 1.0%
  - 4 or more = 0.07%

**Note:** These probabilities are for the number of possible occurrences of VISPO years for period 2020-2027. They are not necessarily consecutive years.
ASR Forbearance Triggering Probabilities

- 2020: 0%; 2021: near 0%
- Chances of triggering by 2026 or sooner are only about one percent
- Chance of triggering increases to 8 percent by 2027 when the high recharge year 2016 falls out of the average
- Overall chance of triggering during 2029 or sooner are about 16 percent

EAHCP 7.1 Analysis and Forecast
### EAHCP Table 7.1

#### Big Picture

<table>
<thead>
<tr>
<th>Year</th>
<th>2013-2027</th>
<th>$261,907,955</th>
</tr>
</thead>
</table>

**2013-2027**

- **Aquifer Storage & Recovery:** $104,295,000 (40%)
- **Regional Water Conservation:** $62,580,000 (24%)
- **VISPO:** $19,730,000 (7%)
- **Program Management:** $11,250,000 (4%)
- **San Marcos Springs:** $16,394,000 (6%)
- **Comal Springs:** $16,030,000 (7%)
- **Modeling & Research:** $6,450,000 (2%)
- **Visalia:** $25,178,955 (10%)
- **Refugia:** $10,4,295,000 (40%)

**Table 7.1**

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</tr>
</thead>
<tbody>
<tr>
<td>$20,416,847</td>
<td>$58,110,541</td>
<td>$94,565,735</td>
<td>$130,445,929</td>
<td>$165,121,123</td>
<td>$198,396,567</td>
<td>$230,192,261</td>
<td>$261,907,955</td>
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<td></td>
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7.1 ADJUSTED

“TABLE 7.1A”

Tracks actuals for closed years and forecasted periods through the end of the ITP.

Table 7.1 and Table 7.1A Comparison

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<thead>
<tr>
<th>Year</th>
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<th>Table 7.1A</th>
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<td>$30,437,659</td>
<td>$48,219,546</td>
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<tr>
<td>2014-A</td>
<td>$58,110,541</td>
<td>$86,573,974</td>
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<tr>
<td>2015-A</td>
<td>$76,403,133</td>
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<tr>
<td>2016-A</td>
<td>$94,565,756</td>
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<tr>
<td>2017-A</td>
<td>$112,478,333</td>
<td>$132,068,048</td>
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<tr>
<td>2018-A</td>
<td>$130,445,998</td>
<td>$145,265,596</td>
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<tr>
<td>2019-EST</td>
<td>$147,783,526</td>
<td>$156,334,204</td>
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<tr>
<td>2020-F</td>
<td>$165,121,112</td>
<td>$171,235,516</td>
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<tr>
<td>2021-F</td>
<td>$182,045,474</td>
<td>$184,478,580</td>
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<tr>
<td>2022-F</td>
<td>$198,396,563</td>
<td>$197,695,594</td>
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<tr>
<td>2023-F</td>
<td>$214,254,414</td>
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<tr>
<td>2024-F</td>
<td>$230,192,261</td>
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<tr>
<td>2025-F</td>
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<tr>
<td>2026-F</td>
<td>$261,907,955</td>
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<tr>
<td>2027-F</td>
<td>$280,560,921</td>
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$50.8m

Table 7.1 and Table 7.1A Comparison
## Program Totals | Table 7.1 and Table 7.1A Comparison

<table>
<thead>
<tr>
<th>EAHCP Measure</th>
<th>Table 7.1 Totals</th>
<th>Table 7.1A Projected Totals</th>
<th>△ Between Table 7.1 to 7.1A</th>
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<tbody>
<tr>
<td>Program Administration</td>
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<tr>
<td>ASR - Leasing/Forbearance</td>
<td>$71,385,000</td>
<td>$69,377,063 2,007,937</td>
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<tr>
<td>ASR - O &amp; M</td>
<td>32,910,000</td>
<td>4,835,151 28,074,849</td>
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<tr>
<td>Regional Water Conservation</td>
<td>19,730,000</td>
<td>19,414,103 315,897</td>
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</tr>
<tr>
<td>VISPO</td>
<td>62,580,000</td>
<td>38,051,507 24,528,493</td>
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<tr>
<td>San Marcos Springs</td>
<td>16,394,000</td>
<td>19,313,715 (2,919,715)</td>
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<tr>
<td>Comal Springs</td>
<td>16,030,000</td>
<td>17,681,998 (1,651,998)</td>
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<tr>
<td>Modeling &amp; Research</td>
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<td>6,805,622 (355,622)</td>
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<tr>
<td>Refugia</td>
<td>25,178,955</td>
<td>19,668,592 5,510,363</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$261,907,955</strong></td>
<td><strong>$211,071,126 $50,836,829</strong></td>
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<table>
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<th>Entity</th>
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<th>Table 7.1A Projected Totals</th>
<th>△ Between Table 7.1 to 7.1A</th>
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<td>$187,692,234 ($50,791,721)</td>
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<tr>
<td>City of San Marcos - TSU</td>
<td>11,894,000</td>
<td>12,567,167 (673,167)</td>
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<tr>
<td>City of New Braunfels</td>
<td>11,530,000</td>
<td>10,811,726 718,274</td>
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<tr>
<td><strong>Program Totals</strong></td>
<td><strong>$261,907,955</strong></td>
<td><strong>$211,071,126 $50,836,829</strong></td>
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### Edwards Aquifer Authority 7.1A Budget as Compared to Table 7.1

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<th>Table 7.1A Projected Totals</th>
<th>△ Between Table 7.1 to 7.1A</th>
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</thead>
<tbody>
<tr>
<td>ASR - Leasing/Forbearance</td>
<td>$71,385,000</td>
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<tr>
<td>ASR - O &amp; M</td>
<td>32,910,000</td>
<td>4,835,151 28,074,849</td>
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</tr>
<tr>
<td>Regional Municipal Water Conservation</td>
<td>19,730,000</td>
<td>19,414,103 315,897</td>
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</tr>
<tr>
<td>VISPO</td>
<td>62,580,000</td>
<td>38,051,507 24,528,493</td>
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<tr>
<td>Biological Monitoring</td>
<td>6,000,000</td>
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<tr>
<td>Water Quality Monitoring</td>
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<td>4,662,433 (1,662,433)</td>
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<tr>
<td>Ecological Modeling</td>
<td>1,150,000</td>
<td>1,153,780 (3,780)</td>
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<tr>
<td>Applied Research (Research &amp; Facility)</td>
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<tr>
<td>Refugia</td>
<td>25,178,955</td>
<td>19,668,592 5,510,363</td>
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<tr>
<td>Program Management</td>
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<td><strong>Program Total</strong></td>
<td><strong>$238,483,955</strong></td>
<td><strong>$187,692,234 $50,791,721</strong></td>
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### City of San Marcos/Texas State University 7.1A Budget as Compared to Table 7.1

<table>
<thead>
<tr>
<th>EAHCP Measure</th>
<th>Table 7.1 Totals</th>
<th>Table 7.1A Projected Totals</th>
<th>△ Between Table 7.1 to 7.1A</th>
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</thead>
<tbody>
<tr>
<td>TX Wild Rice Enhancement/Restoration</td>
<td>$1,850,000</td>
<td>1,321,168</td>
<td>$528,832</td>
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<tr>
<td>Sediment Removal</td>
<td>850,000</td>
<td>744,292</td>
<td>105,708</td>
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<td>Non-Native Plant Species Control</td>
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<td>Litter Control/Floating Vegetation</td>
<td>1,200,000</td>
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<tr>
<td>Non-Native Animal Species Control</td>
<td>525,000</td>
<td>415,417</td>
<td>109,583</td>
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<td>Bank Stabilization/Perm Access Points</td>
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<td>1,313,492</td>
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<tr>
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<td>380,000</td>
<td>666,986</td>
<td>(286,986)</td>
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<tr>
<td>Management - Key Public Rec Areas</td>
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<td>Household Hazardous Waste Program</td>
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<tr>
<td>Sessom Creek Sand Bar</td>
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<tr>
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<td>(15,349)</td>
</tr>
<tr>
<td><strong>Program Total</strong></td>
<td><strong>$11,894,000</strong></td>
<td><strong>12,567,167</strong></td>
<td><strong>($673,167)</strong></td>
</tr>
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</table>

### City of New Braunfels 7.1A Budget as Compared to Table 7.1

<table>
<thead>
<tr>
<th>EAHCP Measure</th>
<th>Table 7.1 Totals</th>
<th>Table 7.1A Projected Totals</th>
<th>△ Between Table 7.1 to 7.1A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Channel Restoration</td>
<td>$2,000,000</td>
<td>$1,859,042</td>
<td>$140,958</td>
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<tr>
<td>Flow Split Management</td>
<td>270,000</td>
<td>382,878</td>
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<td>Aquatic Vegetation Restoration</td>
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<td>Non-Native Animal Species Control</td>
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<td>Decaying Vegetation Removal</td>
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<td>435,518</td>
<td>524,482</td>
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<td>Riparian Impr - Riffle Beetle</td>
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<td>Gill Parasite Control</td>
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<td>999,840</td>
<td>325,160</td>
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<tr>
<td>LID/BMP Management</td>
<td>1,900,000</td>
<td>1,402,380</td>
<td>497,620</td>
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<tr>
<td>Household Hazardous Waste Program</td>
<td>450,000</td>
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<td>Litter Control/Floating Vegetation</td>
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<td>Prohibition - Hazardous Materials Route</td>
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<tr>
<td>Education</td>
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<td>(3,349)</td>
</tr>
<tr>
<td><strong>Program Total</strong></td>
<td><strong>$11,530,000</strong></td>
<td><strong>$10,811,726</strong></td>
<td><strong>$718,274</strong></td>
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EAHCP EXPENSE PROJECTIONS

Note: Percentages indicate year-to-year percentage change in forecast.
AQUIFER MANAGEMENT FEES AND EAHCP RESERVE FUND

AMF RATES

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Forecasts</th>
<th>2012-P</th>
<th>2021-P</th>
<th>2022-P</th>
<th>2023-P</th>
<th>2024-P</th>
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<tbody>
<tr>
<td></td>
<td>Aquifer Management Fee</td>
<td>Program Aquifer Management Fee</td>
<td>AMF - 2019 Forecast</td>
<td>Program AMF 2019 Forecast</td>
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<tr>
<td>2012</td>
<td>$37</td>
<td>$34</td>
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<td>$32</td>
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<td>$30</td>
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<tr>
<td>2013</td>
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<td>2014</td>
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<td>$41</td>
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<td>$38</td>
<td>$37</td>
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<td>2015</td>
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<td>$38</td>
<td>$37</td>
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<td>2017</td>
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<td>2018</td>
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<td>$40</td>
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<td>$38</td>
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<td>2022-P</td>
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<td>$45</td>
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<td>$38</td>
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<td>2023-P</td>
<td>$33</td>
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<td>$41</td>
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<td>2024-P</td>
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<td>$41</td>
<td>$40</td>
<td>$39</td>
<td>$38</td>
</tr>
</tbody>
</table>
**EAA Budget Process**

- **Goal Setting**
- **Formulation of 5-Year Forecast**
- **Formulation of department budgets**
- **Review of proposed budget by General Manager**
- **Board review of proposed budget**
- **Public notice and public hearings**
- **Final Board review and adoption**
- **Monthly budget review and Amendments (as necessary)**

*May / June*  
*July - September*  
*October*  
*November*

---

**2020 Proposed Budget Schedule**

- **Board of Directors** 9/10/19
- **Board of Directors** 10/8/19
- **Finance Committee** 10/22/19
- **Finance Committee** 9/24/19
- **Public Meetings** 10/9 - 10/15/19  
  Written Comments Due 10/16/19
- **Board of Directors** 11/12/19

**2020 Budget Adoption**
QUESTIONS?
EAHCP EXPENSE PROJECTIONS (2018)
AMF Rates

Historical Rates

Illustrative Rates
AMF Rates (2018)

<table>
<thead>
<tr>
<th>Year</th>
<th>AMF</th>
<th>Program AMF</th>
<th>AMF - 2018 Forecast</th>
<th>Program AMF 2018 Forecast</th>
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<td>$47</td>
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<tr>
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<td>2022</td>
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<td>$31</td>
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</table>
EAHCP Reserve Projections (2018)

<table>
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<tr>
<th>Year</th>
<th>EAHCP Actual</th>
<th>EAHCP 2017 Budget WG Projections</th>
<th>EAHCP Estimate/Forecast</th>
<th>Reserve Cap/Floor</th>
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<tbody>
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<td>$30,474</td>
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<td>2013-A</td>
<td>$24,161</td>
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<td>2014-A</td>
<td>$35,041</td>
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<td>2015-A</td>
<td>$35,513</td>
<td>$37,430</td>
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<tr>
<td>2016-A</td>
<td>$35,513</td>
<td>$37,430</td>
<td>$37,722</td>
<td>$37,722</td>
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<tr>
<td>2017-A</td>
<td>$31,317</td>
<td>$27,147</td>
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<td>2018-EST</td>
<td>$31,834</td>
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<td>$38,011</td>
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EAHCP General AMF:
- 2012-A: $47
- 2013-A: $47
- 2014-A: $47
- 2015-A: $47
- 2016-A: $44
- 2017-A: $44
- 2018-B: $42
- 2019-F: $46
- 2020-F: $48
- 2021-F: $52
- 2022-F: $52
- 2023-F: $53

HCP Program AMF:
- 2012-A: $37
- 2013-A: $37
- 2014-A: $47
- 2015-A: $47
- 2016-A: $44
- 2017-A: $40
- 2018-B: $42
- 2019-F: $38
- 2020-F: $36
- 2021-F: $32
- 2022-F: $32
- 2023-F: $31

HCP Program AMF - 2017 Budget WG:
- 2018-EST: $42
- 2019-F: $44
- 2020-F: $44
- 2021-F: $44
- 2022-F: $44
- 2023-F: $44
NOTICE OF OPEN MEETING
Available at eaahcp.org

2019 EAHCP Budget Work Group
Wednesday, September 18, 2019 at 10:00am – 12:00pm
Edwards Aquifer Authority, 900 E. Quincy St. San Antonio, TX 78215

The EAHCP Budget Work Group reviews the EAHCP budget process and makes recommendations to the Implementing Committee regarding any substantive changes to ensure good stewardship of public dollars.

Members of this workgroup include Tom Taggart (Chair - City of San Marcos), Adam Yablonski (Medina County Farm Bureau), Myron Hess (Texas Living Waters Project), Steven Raabe (SARA), Brock Curry (EAA), and Mary Bailey (SAWS).

At this meeting, the following business may be considered and recommended for Budget Work Group action:

1. Call to order - Establish that all members are present or represented

2. Public Comment

3. Presentation of the Aquifer Storage Recovery (ASR) and Voluntary Irrigation Suspension Program Option (VISPO) programs
   **Purpose:** To provide an update on the ASR and VISPO programs
   **Action:** No action required

4. Presentation and discussion of the updated Drought of Record probabilities
   **Purpose:** To provide an overview of the updated Drought of Record projected expenses
   **Action:** No action required

5. Presentation and discussion of the EAHCP Table 7.1A Analysis and Forecast
   **Purpose:** To provide forecasted analysis of the EAHCP 7.1A Budget
   **Action:** No action required

6. Presentation and discussion of the 2020 EAHCP Budget
   **Purpose:** To provide an overview of the EAHCP 2020 Budget and Reserve Fund
   **Action:** Consideration to make recommendations to the Implementing Committee

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

8. Questions and comments from the public

9. Adjourn
APPENDIX C
MEETING MINUTES
EAHCP Budget Work Group  
Meeting Minutes  
September 18, 2019

Members of this Work Group include Tom Taggart (Chair - City of San Marcos), Adam Yablonski (Medina County Farm Bureau), Myron Hess (Texas Living Waters Project), Steven Raabe (SARA), Brock Curry (EAA), and Mary Bailey (SAWS).

1. **Call to order – 10:00 a.m.**  
   Tom Taggart called roll for the Work Group. Myron Hess was absent from the meeting. All other members were present.

2. **Public Comment**  
   No comment.

3. **Presentation of the Aquifer Storage Recovery (ASR) and Voluntary Irrigation Suspension Program Option (VISPO) programs.**

   Javier Hernandez, Edwards Aquifer Authority staff, provided an update and overview of the ASR and VISPO programs. The total cost for the ASR Program is estimated at $6,299,848. This expenditure comprises forbearance agreements, leases, and operations and maintenance injection costs. By 2020, the cumulative balance of ASR storage is expected to be 126,000 acre-feet. The estimated cost for the VISPO in 2020 is $2,508,070 with a targeted enrollment of 41,795 acre-feet in forbearance agreements.

4. **Presentation and discussion of the updated Drought of Record probabilities.**

   Shelly Hendrix, Edwards Aquifer Authority staff, presented the updated Drought of Record probabilities. Based on historical data from J-17 and current aquifer levels, there is a 0% chance that VISPO and ASR will trigger in 2020. Based on modeling scenarios, there is an overall 16% chance of ASR triggering during the timeframe from 2029 to present.

5. **Presentation and discussion of the EAHCP Table 7.1A Analysis and Forecast.**

   Ms. Hendrix presented an overview of EAHCP Table 7.1. Overall, Table 7.1 is budgeted at $261,907,955 for EAHCP activities from 2013-2028. Ms. Hendrix also presented Table 7.1A. Table 7.1A represents the actual amounts spent per conservation measure per year through 2018 and forecasts expenses through the end of the Incidental Take Permit (2028). A comparison between Table 7.1 and Table 7.1A indicates a $50,836,829 difference in savings. Mr. Taggart clarified that these projections assume no adaptive management changes to the program would
6. **Presentation and discussion of the 2020 EAHCP Budget.**

Ms. Hendrix presented the 2020 proposed budget for the EAHCP program. For 2020, the estimated budget to implement EAHCP activities is $14,385,592, which is less than the projected 2020 expense in Table 7.1. Tom Taggart asked how many job positions are paid by EAHCP funding. Ms. Hendrix answered that, of the nine EAHCP staff, seven are funded by the EAHCP and two are funded by the EAA.

Ms. Hendrix presented the Aquifer Management Fees (AMF) progression since 2012 through projected rates in 2024. Darren Thompson (SAWS) asked what volume of municipal and industrial permits were assumed in the AMF rates. Ms. Hendrix answered that the volume is based on about 365,000 acre-feet. Ms. Hendrix then presented the EAHCP reserve projections from 2012-2024 based on AMF rates. EAHCP budget estimates are projected to remain above the reserve floor.

Mr. Taggart discussed the difference of AMF rates from previous years and the differences in AMF projections. Mary Bailey commented, from a SAWS perspective, increases in AMF rates are not favorable; however, the program was intended to be flexible. Ms. Bailey also noted that the reserve should be at, or around, the floor. Mr. Taggart commented that the reserve floor, though not originally planned, was intended to provide a financial buffer from increasing AMF rates during a trigger event. Brock Curry, noted that if a trigger event was to occur and the reserve was depleted, a strategic plan would be to restore the reserve. Mr. Taggart added that, from a program standpoint, the contract with the U.S. Fish and Wildlife Service (USFWS) guaranteed financial security to cover program activities. Nathan Pence (GBRA) reminded the Work Group that the $26.4 million floor was presented as financial security to cover years during a drought of record. This would allow the EAA time to review and present strategies to the EAA Board in order to reestablish the $26.4 million floor.

At the conclusion of the Budget Work Group meeting, Mr. Taggart summarized key areas of consensus to provide to the Implementing Committee for discussion at their next meeting.

7. **Consider future meetings, dates, locations, and agendas.**

No comments.

8. **Questions and comments from the public.**

No comments.

9. **Adjourn: 11:11 a.m.**
APPENDIX F5
ADAPTIVE MANAGEMENT STAKEHOLDER COMMITTEE

January 24, 2019  Meeting Agenda
Meeting Minutes

May 23, 2019  Meeting Agenda
Meeting Minutes

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

October 3, 2019  Meeting Agenda
Meeting Minutes

December 19, 2019  Meeting Agenda
Meeting Minutes
Myron Hess - Chairman
The EAHCP Stakeholder Committee consists of 28 individuals representing diverse interests throughout the region.
Scott Storment - EAHCP Program Manager

Thursday, January 24, 2019
9:00 AM
EAA Board Room

1. Call to Order

Present: Chuck Ahrens, Buck Benson, Ryan Kelso, Jim Bower, Doris Cooksey, Adam Yablonski, Kerim Jacaman, Annie Kellough, Cindy Hooper, Melani Howard, Cindy Loeffler, Glenn Lord, Greg Malatek, Kimberly Meitzen, Gary Middleton, Con Mims, Carol Patterson, Ray Joy Pfannstiel, Steve Raabe, Patrick Shriver, Nathan Pence and Dianne Wassenich.

Chairman Cooksey called the meeting to order at 9:00 AM.

2. Public Comment

There were no citizens who requested to address the Stakeholder Committee.

3. EAHCP Program Manager Announcements

3.1
- Introduction to EAA Board Room
- Spring Systems and Index Well Update
- J-17 Forecast
- Budget Reports
- Annual Report Draft 1
- Update on the EAHCP Phase I to Phase II Transition Process

4. Approval of Minutes

4.1 Approval of previous committee meeting minutes
- October 18, 2018

A motion was made by Gary Middleton, seconded by Jim Bower, to approve the October 18, 2018 meeting minutes, as revised.

The motion was approved.

[Attached and made a part of these minutes.]

5. Reports
5.1 Receive report from Dr. Chad Furl, EAHCP Chief Science Officer, on the 2018 Biological Monitoring activities and Net Disturbance and Incidental Take in the San Marcos and Comal Spring systems.

5.2 Receive report from Dr. Chad Furl, EAHCP Chief Science Officer, on 2018 Water Quality Monitoring activities conducted in the San Marcos and Comal Spring systems.

7. Future Meetings

Cindy Loeffler made a motion to begin EAHCP Committee Meetings no earlier than 10:00 AM. The Committee approved the motion by consensus.

8. Questions from the Public

9. Adjourn

There being no further business to discuss, the meeting adjourned at 10:15 AM.

__________________________
Patrick Shriver
Secretary, Stakeholder Committee
NOTICE OF OPEN MEETING

EAHCP Stakeholder Committee

Myron Hess - Chairman
The EAHCP Stakeholder Committee consists of 28 individuals representing diverse interests throughout the region.
Scott Storment - EAHCP Program Manager

Thursday, January 24, 2019 9:00 AM EAA Board Room

At this meeting, the following business may be considered:

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements
   3.1 Introduction to EAA Board Room
   3.1 Spring Systems and Index Well Update
   3.1 J-17 Forecast
   3.1 Budget Reports
   3.1 Annual Report Draft 1
   3.1 Update on the EAHCP Phase I to Phase II Transition Process

4. Approval of Minutes
   4.1 Approval of previous committee meeting minutes
      - October 18, 2018

5. Reports
   5.1 Receive report from Dr. Chad Furl, EAHCP Chief Science Officer, on the 2018 Biological Monitoring activities and Net Disturbance and Incidental Take in the San Marcos and Comal Spring systems.
   5.2 Receive report from Dr. Chad Furl, EAHCP Chief Science Officer, on 2018 Water Quality Monitoring activities conducted in the San Marcos and Comal Spring systems.

6. Individual Consideration

7. Future Meetings

8. Questions from the Public
9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

EAHCP Stakeholder Committee

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

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

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

AGENDA

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements

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

4. Approval of Minutes

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

5. Reports

6. Individual Consideration

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

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

8. Questions from the Public

9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

Meeting Minutes

EAHCP Stakeholder Committee

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

Thursday, May 23, 2019 10:00 AM
City of New Braunfels Live stream:
https://newbraunfels.legistar.com/Calendar.aspx

1. Call to Order

Chairman Hess called the meeting to order at 10:08 AM.

Present: Carl Adkins, Chuck Ahrens, Bruce Alexander, Jim Bower, John Byrum, Doris Cooksey, James Dodson, Adam Yablonski, Kerim Jacaman, Myron Hess, Cindy Hooper, Melani Howard, David Villarreal, Cindy Loeffler, Glenn Lord, Mark Enders, Kimberly Meitzen, Gary Middleton, Carol Patterson, Ray Joy Pfannstiel, Steve Raabe, Humberto Ramos, Patrick Shriver, Nathan Pence, and Dianne Wassenich.

2. Public Comment

There were no citizens who requested to address the Stakeholder Committee.

3. EAHCP Program Manager Announcements

3.1
- Recognition of Con Mims, EAHCP Stakeholder Committee Member
- Hydrologic Update
- SAWS ASR
- Budget Reports
- EAHCP Program Management
- Spring Communities Update

4. Approval of Minutes

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

A motion was made by Doris Cooksey, seconded by Glenn Lord, to approve the meeting minutes from January 24, 2019. The motion was approved.

5. Reports

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

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

A motion was made by Nathan Pence, seconded by Gary Middleton, to approve the EAHCP Nonroutine Adaptive Management Process Proposal. The motion was approved.

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

A motion was made by Myron Hess, seconded by Jim Bower, to approve the Nonroutine Adaptive Management Process Stakeholder Report and its submission to the Implementing Committee. The motion was approved.

7. Future Meetings

8. Questions from the Public

9. Adjourn

There being no further business to discuss, the meeting adjourned at 1:30 PM.
Olivia Ybarra
Habitat Conservation Plan Coordinator

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

[Signature]
Patrick Shriver
Secretary, Stakeholder Committee
PREAMBLE
This Adaptive Management Stakeholder Committee Report¹ is issued in response to the Nonroutine Adaptive Management (AMP) proposal ("Proposal") submitted by the Program Manager of the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan ("EAHCP; EARIP, 2012), dated March 14, 2019. Having considered the attached Scientific Evaluation Report issued by the Adaptive Management Science Committee ("Science Committee") regarding the Proposal, this report presents the final recommendation of the Adaptive Management Stakeholder Committee ("Stakeholder Committee") concerning the proposed Nonroutine AMP action.

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

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

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

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

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

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

**Minimum Flows**

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

**80cfs Pulse**

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

**Facilitation of discussion**

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

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

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

**Final motions by the Committee**

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

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

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

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

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

**REFERENCES**


**ATTACHMENTS**
- Attachment 1: Nonroutine Adaptive Management Proposal
- Attachment 3: Meeting minutes to be approved at the October 3, 2019 Stakeholder Committee Meeting. A draft will be included in this report TBD.
Attachment 4: May 22, 2019 Possible Components of Stakeholder Committee Recommendation from Myron Hess.
A meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan will be held on the date, time, and location stated above.

AGENDA

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements

   3.1 Hydrologic Update
   SAWS ASR
   Budget Reports
   EAHCP Program Management
   Spring Communities Update

4. Approval of Minutes

   4.1 Approval of previous committee meeting minutes
      - May 23, 2019

5. Reports

   5.1 Receive report from Tanya Sommer, U.S. Fish and Wildlife Service Branch Chief, about the proposed amendments to the Recovery Plan.

   5.2 Receive report from Scott Storment, EAHCP Program Manager, on the EAHCP response to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan.

   5.3 Receive report from Scott Storment, EAHCP Program Manager, on general activities occurring within the EAHCP program.

   5.4 Receive report from Chad Furl, EAHCP Chief Science Officer, and Scott Storment, EAHCP Program Manager, on EAHCP Work Groups.
6. Future Meetings

7. Questions from the Public

8. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

This meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan complies with Section 7.8.4 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA).
Receive report from Tanya Sommer, U.S. Fish and Wildlife Service Branch Chief, about the proposed amendments to the Recovery Plan.

RECOMMENDED MOTION:

None. This item is for informational purposes only.

SUMMARY:

The purpose of this item is for the Stakeholder Committee to receive a report from Tanya Sommer, U.S. Fish and Wildlife Service (USFWS) Branch Chief, on a recent proposal by USFWS for amendments to the Recovery Plan for Texas wild-rice (Zizania texana), fountain darter (Etheostoma fonticola) and Texas blind salamander (Typhlomolge rathbuni). Recovery Plans are guidelines for how a federally listed species can recover from being classified as threatened or endangered. The proposed amendments have no effect on current EAHCP activities.
Receive report from Scott Storment, EAHCP Program Manager, on the EAHCP response to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan.

RECOMMENDED MOTION:

None. This item is for informational purposes only.

SUMMARY:

The purpose of this item is for the Stakeholder Committee to receive a report from Scott Storment, EAHCP Program Manager, on the EAHCP program’s response to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan for Texas wild-rice (Zizania texana), fountain darter (Etheostoma fonticola), and Texas blind salamander (Typhlomolge rathbuni). The proposed amendments have no effect on current EAHCP activities.
Receive report from Scott Storment, EAHCP Program Manager, on general activities occurring within the EAHCP program.

RECOMMENDED MOTION:

None. This item is for informational purposes only.

SUMMARY:

The purpose of this item is for the Stakeholder Committee to receive a report from Scott Storment, EAHCP Program Manager, on program activities the EAHCP administration has completed and will continue to pursue. Program activities include reporting activities, geographic information system (GIS) and communication strategies, research updates, and other administrative duties.
Receive report from Chad Furl, EAHCP Chief Science Officer, and Scott Storment, EAHCP Program Manager, on EAHCP Work Groups.

RECOMMENDED MOTION:

None. This item is for informational purposes only.

SUMMARY:

The purpose of this item is for the Stakeholder Committee to receive a report from Chad Furl, EAHCP Chief Science Officer, on the EAHCP Research and Comal Springs riffle beetle Work Groups. Additionally, the Committee will receive a report from Scott Storment, EAHCP Program Manager, on the proposed Work Group resulting from the May 23 joint Stakeholder and Implementing Committee meeting.
A meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan was held on the date, time, and location stated above.

AGENDA

1. **Call to Order**

   Chairman Hess called the meeting to order at 10:08 AM.

   Present: Javier Hernandez, Buck Benson, Jim Bower, John Byrum, Doris Cooksey, Adam Yablonski, Kerim Jacaman, Myron Hess, Cindy Hooper, Melani Howard, David Villarreal, Colette Barron, Glenn Lord, Mark Enders, Kimberly Meitzen, Gary Middleton, Carol Patterson, Ray Joy Pfannstiel, Brian Mast, Humberto Ramos, Brandon Payne, Nathan Pence, and Rachel Sanborn.

2. **Public Comment**

   There were no citizens who requested to address the Stakeholder Committee.

3. **EAHCP Program Manager Announcements**

   3.1
   
   - Hydrologic Update
   - SAWS ASR
   - Budget Reports
   - EAHCP Program Management
   - Spring Communities Update

4. **Approval of Minutes**

   4.1

   Approval of previous committee meeting minutes
   - May 23, 2019

   A motion was made by Doris Cooksey, seconded by Glenn Lord, to approve the meeting minutes from May 23, 2019. The motion was approved.

5. **Reports**
5.1 Receive report from Tanya Sommer, U.S. Fish and Wildlife Service Branch Chief (USFWS), about the proposed amendments to the Recovery Plan.

Tanya Sommer, U.S Fish and Wildlife Service Branch Chief, provided an overview of the August 2019 proposed amendments to the Recovery Plan. Ms. Sommer clarified that the Recovery Plan was not the same as delisting criteria.

5.2 Receive report from Scott Storment, EAHCP Program Manager, on the EAHCP response to the U.S. Fish and Wildlife Service’s proposed amendments to the Recovery Plan.

Scott Storment, EAHCP Program Manager, provided an overview of the EAHCP’s response to the USFWS proposed amendments to the Recovery Plan. Nathan Pence requested that Committee members be notified when EAHCP staff receive announcements from the USFWS.

5.3 Receive report from Scott Storment, EAHCP Program Manager, on general activities occurring within the EAHCP program.

Scott Storment, EAHCP Program Manager, provided the Committee a summary of general activities occurring within the EAHCP program. Activities included contract updates, GIS tracking, improvements to the EAHCP administrative record, EAHCP Steward Newsletters, and the fall EAHCP internship.

5.4 Receive report from Chad Furl, EAHCP Chief Science Officer, and Scott Storment, EAHCP Program Manager, on EAHCP Work Groups.

Chad Furl, EAHCP Chief Science Officer, updated the Committee on the Research and Comal Springs Riffle Beetle work groups. Scott Storment, EAHCP Program Manager, updated the Committee on the Budget and Springflow Habitat Protection work groups.

6. Future Meetings

7. Questions from the Public

None.

8. Adjourn

There being no further business to discuss, the meeting adjourned at 11:44 AM.
Olivia Ybarra  
Habitat Conservation Plan Coordinator  

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

Patrick L. Shriver  
12-19-2019
A meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan will be held on the date, time, and location stated above.

AGENDA

1. Call to Order

2. Public Comment

3. EAHCP Program Manager Announcements
   3.1 Hydrologic Update
   3.2 SAWS ASR
   3.3 Budget Reports
   3.4 EAHCP Program Management
   3.5 Spring Communities Update

4. Approval of Minutes
   4.1 Approval of previous committee meeting minutes
      - October 3, 2019

5. Reports
   5.1 Receive report from Tanya Sommer, U.S. Fish and Wildlife Service Branch Chief, on the Species Status Assessment of the Texas blind salamander and the fountain darter.
   5.2 Receive report from Jamie Childers, EAHCP Manager, on the EAHCP Addendum and Strategic Adaptive Management Process Report.
   5.3 Receive report from Chad Furl, EAHCP Chief Science Officer, on the Comal Springs riffle beetle work group and other research activities.

6. Individual Consideration
6.1 Consider staff recommendation to appoint officers for the 2020 Stakeholder Committee.

7. Future Meetings

7.1 EAHCP 2020 Committee Meetings

8. Questions from the Public

9. Adjourn

Olivia Ybarra
Habitat Conservation Plan Coordinator

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

AGENDA

1. Call to Order

Chairman Hess called the meeting to order at 10:00 AM.


2. Public Comment

There were no citizens who requested to address the Stakeholder Committee.

3. EAHCP Program Manager Announcements

Scott Storment, EAHCP Program Manager, provided the Committee with an administrative overview of the various on-going projects happening within the program.

3.1

- Hydrologic Update
- SAWS ASR
- Budget Reports
- EAHCP Program Management

4. Approval of Minutes

4.1 Approval of previous committee meeting minutes

- October 3, 2019

A motion was made by Adam Yablonski, seconded by Glenn Lord, to approve the meeting minutes from October 3, 2019.
5. Reports

5.1 Receive report from Tanya Sommer, U.S. Fish and Wildlife Service Branch Chief, on the Species Status Assessment of the Texas blind salamander and the fountain darter.

5.2 Receive report from Jamie Childers, EAHCP Manager, on the EAHCP Addendum and Strategic Adaptive Management Process Report.

5.3 Receive report from Chad Furl, EAHCP Chief Science Officer, on the Comal Springs riffle beetle work group and other research activities.

6. Individual Consideration

6.1 Consider staff recommendation to appoint officers for the 2020 Stakeholder Committee.

Cindy Loeffler nominated Myron Hess, Doris Cooksey, and Patrick Shriver as Chair, Vice-Chair, and Secretary of the Stakeholder Committee, respectfully.

A motion was made by Jim Bower, seconded by Nathan Pence, to approve the Stakeholder Committee Officer nominations. Motion was approved. There were no objections.

7. Future Meetings

7.1 EAHCP 2020 Committee Meetings

8. Questions from the Public

9. Adjourn

There being no further business to discuss, the meeting adjourned at 11:52 AM.

Olivia Ybarra
Habitat Conservation Plan Coordinator

This meeting of the Stakeholder Committee of the Edwards Aquifer Habitat Conservation Plan complies with Section 7.8.4 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA).
APPENDIX F6
ADAPTIVE MANAGEMENT SCIENCE COMMITTEE

March 27, 2019
Meeting Agenda
Meeting Minutes

June 27, 2019
Meeting Agenda
Meeting Minutes
NOTICE OF OPEN MEETING
Available at eahcp.org

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

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

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

1. Call to order.
2. Public comment.
3. Approval of the minutes from the November 11th Science Committee meeting (Attachment 1).
4. Receive report from the Program Manager.
   - Hydrologic update
   - June 27 meeting location update
   - Comal Springs riffle beetle Work Group update
   - Phase II update
5. Discussion and possible action to elect the nomination for the Science Committee Vice-Chair for 2019.
   
   **Purpose:** To elect the nomination for the Science Committee Vice-Chair for 2019.
   
   **Action:** To possibly elect the Science Committee Vice-Chair for 2019.
6. Presentation, discussion, and possible recommendation of the Nonroutine Adaptive Management proposal related to the VISPO Flow Protection Measure (Attachment 2).

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

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

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

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

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


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

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


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

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


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

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

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

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

    Action: No action required.

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

    • Thursday, June 27, 2019 at 9 a.m. at the USFWS San Marcos Aquatic Resources Center (500 E McCarty Ln, San Marcos)
Members of this committee include: Tom Arsuffi, Janis Bush, Jacquelyn Duke, Charles Kreitler, Conrad Lamon, Glenn Longley, Doyle Mosier, Chad Norris, Jackie Poole, Floyd Weckerly and Jack Sharp.

1. Call to order.
Janis Bush, Jackie Poole, and Glenn Longley were unable to attend.

2. Public comment.
Myron Hess, Chair of the EAHCP Stakeholder Committee, requested that language regarding Phase II be added to the title of the Scientific Evaluation Report (SER) for the VISPO nonroutine adaptive management proposal (AMP).

3. Approval of the minutes from the November 11th Science Committee meeting
Mr. Mosier motioned to approve the meeting minutes and Dr. Weckerly seconded; no opposition.

4. Receive report from the Program Manager.
- Hydrologic update
- June 27 meeting location update
  *The next meeting will be at the USFWS San Marcos Aquatic Resource Center*
- Comal Springs Riffle Beetle Work Group update
- Phase II update
  *Scott Storment, EAHCP Program Manager, presented an overview of the Phase 2 Work Plan process. The Phase 2 Work Plan will be presented for approval at the Implementing Committee meeting on May 23rd.*

5. Discussion and possible action to elect the nomination for the Science Committee Vice-Chair for 2019.
Dr. Kreitler motioned to approve Jacquelyn Duke as the Vice-Chair, Dr. Weckerly seconded; no opposition.

6. Presentation, discussion, and possible recommendation of the Nonroutine Adaptive Management proposal related to the VISPO Flow Protection Measure.
Minimum Flow Objectives
Dr. Furl presented an overview of the nonroutine adaptive management proposal (AMP) related to the VISPO Flow Protection Measure. The VISPO AMP seeks to increase the VISPO forbearance from 40,000 ac·ft yr⁻¹ to 41,795 ac·ft yr⁻¹ to the minimum flow objective of 30.0 cfs at Comal Springs during a repeat of the drought of record. Slide 23 of the VISPO AMP presentation summarizes the MODFLOW modeled outputs over time.

Based on the current enrollment amount of 40,921 ac·ft yr⁻¹, this amendment would require enrollment and new leases for the difference of 874 ac·ft yr⁻¹. Stakeholders inquired about the distribution and duration of the existing and the proposed AMP VISPO leases. EAA’s VISPO and Modeling staff experts replied that most of the permits are in Uvalde and Medina counties and are on 5-year leases with the likelihood of renewal, new leases may be in Uvalde and Medina county.

Dr. Lamon, inquired about the status of the USGS sensitivity analysis. Dr Furl and Mr. Winterle replied that the results will be available later this year. However, the model’s calibration and validation are reviewed and published and the National Academies of Sciences’ Report 3 states that the MODFLOW model’s Flow Protection package simulations were conservative and “effective” at achieving the minimum flow requirements for Comal and San Marcos spring complexes. Dr. Lamon suggested one cannot make an effective decision on forebearance without understanding model uncertainty.

EAHCP Program Manager, Scott Storment, also discussed how modifications to the VISPO Flow Protection Measure are a part of the Strategic Adaptive Management Process for Phase 2. The Funding and Management Agreement (FMA) lists deadlines for approving such changes for Phase 2, therefore, the VISPO AMP should proceed in order to meet the FMA requirements.

Long-term Flow Objectives
Next, the committee reviewed long-term average flow model simulations. Previous long-term springflow modeling suggests that average Comal discharge would be 196 cfs, a deficit of 29 cfs from the long-term average of 225 cfs. Dr. Furl offered that the goals could not be met with the pumping assumptions required regardless of what model is being used. He suggested that the empirical springflow record experienced over the last 4 decades indicate little chance of violating the 50 year average flow goals. Some expressed concern that future recharge rates may decrease with a warmer climate and pumping may increase with population growth. Mr. Winterle explained that the flow protection measures help regulate the amount of pumping and the recharge rates represent drought of record conditions.

80 cfs pulse requirements
Next, the committee discussed the 80 cfs pulse requirements that are related to the minimum flow requirements. The EAHCP states that, during drought of record conditions, the minimum flow cannot exceed six months of duration and would be followed by 80 cfs flows for 3 months. Dr. Furl commented that the current flow proposal would not trigger the 80 cfs requirement. Mr. Norris expressed that the logic behind the 80 cfs flow criteria was to ensure that the Comal Spring Runs would not be dry for more than 6 months.
Dr. Arsuffi motioned to approve the VISPO AMP and Dr. Sharp seconded the motion, Dr. Lamon and Mr. Mosier abstained; the motion passed.

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

Committee members approved the submission of the Scientific Evaluation Report (SER) through the Science Committee chairs to the Stakeholder Committee per the inclusion of the requested ASR Forbearance schedule assumptions used to generate the recent model results.

Dr. Weckerly motioned to approve the Chairs submission of the SER for the Stakeholder Committee and Dr. Sharp seconded the motion; the motion passed.


Kristy Kollaus, EAHCP Environmental Scientist, presented an overview of water quality trends and characteristics measured by the EAA Real-Time water quality data. Ms. Kollaus explained that the Comal Landa Lake station would be relocated to the Upper Spring Run to account for inflows from Spring Run 4 and the Blieders Creek tributary. Mr. Norris proposed that the monitoring station would be better suited near Spring Island, instead of the Upper Spring Run. Dianne Wassenich of the San Marcos River Foundation requested the water quality data for the lowest San Marcos monitoring location, the TPWD Fish Hatchery.


Mark Enders presented an overview of the proposed work listed in the 2020 City of New Braunfels Work Plan. The Committee discussed littoral vegetation removal efforts for the invasive, elephant ear and other plants; removal efforts can increase erosion if the areas are not replanted. Mr. Enders replied that they will work with the landowners to select replacement plants. Moving on to the invasive species removal, Dr. Arsuffi inquired if the removal efforts have been effective. Dr. Weckerly proposed documenting and evaluating the number of individuals caught per catch event as a good starting point.


Melani Howard presented an overview of the proposed work listed in the 2020 City of San Marcos Work Plan. Texas wild-rice (TWR) seed production will continue but will no longer be managed by USFWS staff at SMARC and will instead be overseen by Meadows Center staff that have prior experience propagating the TWR from seed. Mrs. Howard also presented an overview of the newly revised phasing of WQ/LID implementation in the Sessom Creek watershed as part of the Impervious Cover and Water Quality Protection Conservation Measure.

11. Presentation on the aquatic plant boom assessment in Spring Lake.
Ms. Kollaus, presented an overview of the proposed methodology for Spring Lake aquatic vegetation plant boom assessment. Overall, members agreed that such a catchment system is needed to prevent the spread and deposition of floating vegetation mats on vulnerable stands of TWR and native aquatic plants located downstream.

12. Consider future meetings, dates, locations, and agendas.
   • Thursday, June 27, 2019 at 9:30 a.m. at the USFWS San Marcos Aquatic Resources Center (500 E McCarty Ln, San Marcos)
NOTICE OF OPEN MEETING
Available at eahcp.org

As required by Section 7.9.3 of the Funding and Management Agreement (FMA), an interlocal agreement made pursuant to Texas Government Code Chapter 791 by and among the Edwards Aquifer Authority (EAA), the City of New Braunfels (New Braunfels), the City of San Marcos (San Marcos), the City of San Antonio acting by and through its San Antonio Water System (SAWS), Texas State University, and the Guadalupe-Blanco River Authority (GBRA), a meeting of the Science Committee for the Edwards Aquifer Habitat Conservation Plan is scheduled for Thursday, June 27, 2019 at 9:30 a.m. at the San Marcos Aquatic Resources Center, 500 E. McCarty Ln., San Marcos, TX 78666. Lunch will be provided. All attendees are encouraged to please RSVP to ktolman@edwardsaquifer.org by Monday, June 24th.

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

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

1. Call to order.

2. Public comment.

3. Approval of the minutes from the March 27th Science Committee meeting (Attachment 1).

4. Receive report on EAHCP updates.
   - Hydrologic update
   - Spring Lake dam construction
   - Comal Springs riffle beetle Work Group
   - Fountain darter parasite
   - Phase II Adaptive Management Process

5. Presentation of the aquatic plant boom assessment in Spring Lake.
   *Purpose*: To inform the Science Committee of the aquatic plant boom progress in Spring Lake.
   *Action*: No action required.

   *Purpose:* To inform the Science Committee of the catch per unit effort of non-native suckermouth catfish removal efforts in the San Marcos River.

   *Action:* No action required.

7. Consider future meetings, dates, locations, and agendas.
   - Wednesday, September 11, 2019 at 9 a.m. at the San Marcos Rec Hall, 170 Charles Austin Drive, San Marcos, Tx. 78666 (near Lions Club).

8. Tour the San Marcos Aquatic Resources Center Refugia facility.
Members of this committee include: Tom Arsuffi, Janis Bush, Jacquelyn Duke, Charles Kreitler, Conrad Lamon, Glenn Longley, Doyle Mosier, Chad Norris, Jackie Poole, Floyd Weckerly and Jack Sharp.

1. Call to order.
Charlie Kreitler was unable to attend.

2. Public comment.
No public comment.

3. Approval of the minutes from the March 27th Science Committee meeting.
Dr. Sharp motioned to approve the meeting minutes and Dr. Weckerly seconded.

4. Receive report on EAHCP updates.
   - Hydrologic update
   - Spring Lake dam construction: USFWS refugia staff will continue to monitor and collect endangered species impacted by TxState’s repair of the Spring Lake Dam.
   - Comal Springs riffle beetle Work Group: will meet next week on Tuesday, July 2.
   - Fountain darter parasite: The haplorchis pumilio virus that impacts fountain darters was recently in the news. The virus has been in the system for years and is not considered a major threat to the fountain darter, but it will be monitored and reevaluated if the threat increases.
   - Phase II Adaptive Management Process

5. Presentation of the aquatic plant boom assessment in Spring Lake.
Kristy Kollaus, EAA Environmental Scientist, presented an overview of the Spring Lake Veg Boom applied research in Spring Lake. The reason for the applied research is to assess different methods for capturing the floating vegetation in Spring Lake, prior to it going downstream and depositing on native aquatic vegetation. Members asked if the amount of floating vegetation going downstream could be quantified; Ms. Kollaus replied it’s too early to say. Additional information can be found in the presentation posted on the EAHCP Science Committee website.

Ms. Kollaus presented an overview of her research on data from the non-native suckermouth catfish removal efforts in the San Marcos River, data were collected as part of the Polespear Tournament that is hosted by the EAHCP contractor, Atlas Environmental. Additional information can be found in the presentation posted on the EAHCP Science Committee website.

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

- Wednesday, September 11, 2019 at 9 a.m. at the San Marcos Rec Hall, 170 Charles Austin Drive, San Marcos, Tx. 78666 (near Lions Club).

  Edit: the September 11th meeting was cancelled and the next meeting was held on December 19th at the EAA.

8. Tour the San Marcos Aquatic Resources Center Refugia facility

Dr. Chad Furl and Dr. Lindsay Campbell gave a tour of the facility to members of the Science Committee.
APPENDIX F7
RESEARCH WORK GROUP

December 11, 2019

Meeting Agenda

Meeting Minutes
As jointly determined by the Implementing Committee and the EAHCP Program Manager (FMA § 7.9.3.b), the Research Work Group has been formed to suggest refinements to the proposed methodology of the Refugia research projects occurring in 2020. The Research Work Group is comprised of members selected from the EAHCP Adaptive Management Science Committee and other experts. A meeting of the Research Work Group for the Edwards Aquifer Habitat Conservation Plan is scheduled for Wednesday, December 11th, 2019, at 10:00am at the Meadows Center for Water and the Environment, SLH 107 Conference Room, 201 San Marcos Springs Dr., San Marcos, Texas, 78666. Lunch items will be provided. Members are encouraged to please RSVP to kkollaus@edwardsaquifer.org by Monday, December 9th.

Members of this Work Group include: Tom Arsuffi, Conrad Lamon, Chad Norris, Floyd Weckerly, and Nathan Bendik

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

1. Call to order – Establish that all members are present or represented.

2. Public comment.

3. Presentation and discussion of methodology proposed for the Refugia research project:
   Continuation of 2019 study: Factors affecting pupation in the endangered Comal Springs Riffle Beetle, presented by Weston Nowlin, Texas State University.
   Purpose: To provide the Research Work Group with the opportunity to discuss 2019 results and provide comment on the methodology proposed to continue evaluating factors affecting Comal Springs Riffle Beetle pupation rates.
   Action: To obtain input from the Research Work Group regarding the proposed methodology to continue studying pupation rates of the Comal Springs Riffle Beetle.

4. Presentation and discussion of methodology proposed for the Refugia research project:
   Continuation of 2019 study: Identify conditions affecting pupation rates in the endangered Comal Springs Riffle Beetle, presented by BIO-WEST Staff.
Purpose: To provide the Research Work Group with the opportunity to discuss 2019 results and provide comment on the methodology proposed to continue identifying conditions that allow for optimal Comal Springs Riffle Beetle pupation rates.

Action: To obtain input from the Research Work Group regarding the proposed methodology to continue studying pupation rates for the Comal Springs Riffle Beetle.

5. Presentation and discussion of methodology proposed for the Refugia research project: 
   *Continuation of 2019 study: Captive population nutrition and longevity of the Comal Springs Riffle Beetle*, presented by Camila Carlos-Shanley, Texas State University, and Amelia Hunter and Lindsay Campbell, U.S. Fish and Wildlife Service.
   
   Purpose: To provide the Research Work Group with the opportunity to discuss 2019 results and comment on the methodology to continue analyzing gut content of captive Comal Springs Riffle Beetle individuals and compare to wild Comal Springs Riffle Beetle individuals.
   
   Action: To obtain input from the Research Work Group regarding the methodology proposed to continue assessing the nutrition of captive Comal Springs Riffle Beetle.

6. Presentation and discussion of methodology proposed for the Refugia research project: 
   *Continuation of research on reproductive dysfunction of San Marcos salamanders*, presented by Lindsay Campbell and Kelsey Anderson, U.S. Fish and Wildlife.
   
   Purpose: To provide the Research Work Group with the opportunity to comment on the continued efforts to identify factors causing reproductive dysfunction of San Marcos salamanders in refugia.
   
   Action: To obtain input from the Research Work Group regarding the methodology proposed for the San Marcos salamander reproduction dysfunction research project.

7. Consider possible future meetings, dates, locations and agendas.

8. Questions and comments from the public.

Members of this committee included: Conrad Lamon, Chad Norris, Tom Arsuffi, Butch Weckerly, and Nathan Bendik

1. **Call to order:** 9:40 am – All members of the work group were present.

2. **Public Comment:**
   There were no comments from the public.

3. **Presentation and discussion of methodology proposed for Refugia research project:**
   *Continuation of 2019 study: Factors affecting pupation in the endangered Comal Springs Riffle Beetle*

   Dr. Weston Nowlin was unable to attend the Research Work Group meeting but is scheduled to present on January 6, 2020 to EAA and USFWS staff at the Edwards Aquifer Authority building in San Antonio. This item was removed from the agenda.

4. **Presentation and discussion of methodology for the Refugia research project:**
   *Continuation of 2019 study: Identify conditions affecting pupation rates in the endangered Comal Springs Riffle Beetle.*

   Dr. Ely Kosnicki, from BIO-WEST, presented findings from his 2019 CSRB pupation study. During his research, he was able to determine an optimal current velocity in the flow through tubes for housing of CSRBs. Different housing techniques to prompt CSRB larvae to pupate and result in eclosion to adult were discussed. In 2020, Dr. Kosnicki will build off what he learned in 2019 and will increase the number of replicates in treatments he observed success in 2019. Housing treatments will include providing access to terrestrial and aquatic environments in the same housing system. He plans on further investigating the utility of starvation to initiate CSRB pupation. Fecundity will be tracked for F1 female adults. No major suggestions were added by the Research Work group.

5. **Presentation and discussion of methodology proposed for the Refugia research project:** *Continuation of 2019: Captive population nutrition and longevity of the Comal Springs Riffle Beetle.*
Dr. Camila Carlos-Shanley presented over the work she performed in 2019 in characterizing the microbiome of captive versus wild CSRBs. Her research from 2019 revealed the microbiome for wild and captive beetles were distinct albeit with some overlap. Captive beetles were found to have more bacterial genera in their microbiome than wild and they shared only eight of the same bacterial genera. One genera, *Chromobacterium*, was found in captive beetles and various species of this genera are known to have insecticide or larvicide effects. Sequencing of the rRNA gene will occur in 2020 to further identify the species of bacteria to determine if the captive beetles are missing beneficial microbes or have deleterious microbes. Once identified, the next step will be to develop management strategies to improve the microbiome for captive CSRB that could result in increased survivability and reproduction rates.

Dr. Lindsay Campbell presented over a proposed 2020 research project to assess the effects of *Chromobacterium* on wild caught CSRB larvae. She proposed a study with two bacteria concentration levels (i.e., high and medium) and a control. The suggestion was made by Tom Arsuffi to add a low bacteria concentration level to the study. Conrad Lamon had questions on how the bacteria concentrations would be monitored during the study. Lindsay’s response was that it is difficult to know the exact bacterial concentration once its added, but they can monitor whether the bacteria are still alive once added.

Amelia Hunter presented next over the nutrition study proposed for 2020. The proposed 2020 research will assess the use of formulated feed to increase survivability rates and longevity for captive CSRB. Wild caught CSRB will be given the opportunity to feed on four formulated pellets (i.e., animal, plant, single cell and log-life) and stable isotope analysis will be used to determine which food pellet the beetles are eating. Adult survival and larval production will also be assessed for each individual pellet type in a performance study. Finally, Amelia discussed using 3D printing to create food structures using the best pellet formulation type. Using the 3D printer could provide a more efficient way to present food to the CSRB. Dr. Chad Furl suggested adding traditional food items (i.e., cotton lure, leaves, wood) to the four pellet consumption experiment. Dr. Arsuffi had questions on the dissolve rates of the pellets and Amelia responded that she will be testing this once she receives the pellets before starting the experiments.

6. **Presentation and discussion of methodology proposed for the Refugia research project: Continuation of research on reproduction dysfunction of San Marcos salamanders**

Dr. Lindsay Campbell presented on aspects from the 2019 research study on San Marcos salamander reproduction. During the study, they were relatively unsuccessful at increasing reproduction rates for the San Marcos salamanders, despite attempting many different strategies to stimulate reproductive behavior. Findings from the trace minerals results suggest captive salamanders have much higher barium levels compared to wild individuals. Dr. Campbell mentioned another study showed reduced spermatogenesis in rats exposed to high levels of barium gas, so barium in co-occurrence with microsporidia, could be responsible for lower reproductive success in captive San Marcos salamanders. Refugia staff plan on removing food items with higher barium levels in 2020 and monitor if
reproduction rates improve. Dr. Ruth Marcec-Greaves, the Director for the National Amphibian Conservation Center will be visiting the San Marcos Aquatic Resource Center to evaluate the current set up and breeding practices. The refugia staff will also test the exposure to Luteinizing Hormone Releasing Hormone (LHRH) to induce reproduction.

Dr. Nate Bendik from the City of Austin, who works with the Barton Springs salamander and other salamander species, had several suggestions for the Refugia staff. His suggestions included, moving the individuals into different tanks, not feeding them as much (i.e., over-nutrition could be a concern), and placing the salamander in dark conditions and leaving them alone. Dr. Campbell is going to incorporate these suggestions and try a low-light treatment in 2020.

7. **Consider possible meetings:**
   The next Research work group meeting will occur on December 9, 2020 following the meeting by the Comal Springs Riffle Beetle Work Group.

8. **Questions from the public.**
   None.

9. **Adjourn.**
   1:00 pm